

# **How Does Gaming Influence Depression During COVID-19?**

by

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## **Abstract**

Much research has been done regarding the negative impact video games can have on mental health and emotional development. Existing research has also found gender differences in this relationship – females tend to exhibit stronger depressive symptoms than males while playing the same amount of video games. However, over the last two decades, research on video games' benefits has begun to surface. Largely, this research has focused on how video games can contribute to mental and emotional development. This paper expands on that existing research, but moves away from video games' effect on development, and instead focuses on how they can help adults cope with difficult, COVID-19 circumstances – namely quarantines, social distancing, and lockdowns.

The data referred to in this paper were gathered via a survey, which measured each participant's gaming habits and genders alongside their levels of depression. The analysis was conducted via linear regressions, running mental health against amount of time spent playing video games during COVID-19. Overall, there appears to be little predictive power between general gaming and depression levels during COVID-19. However, time spent playing video games does have a statistically significant, positive correlation with depression levels during COVID-19 for males. Unfortunately, likely due to the relatively small number of female participants, there appears to be no correlation between the two for females. Regardless, this research concludes that playing more video games during COVID-19 correlates with higher levels of depression.

## **1. Introduction**

Over the course of the last year, COVID-19 has made socializing unsafe, forcibly halting virtually all in-person social interaction. Naturally, the inability to see one's friends and family can have a negative impact on one's mental health. To that end, rather than going out to dinner or going to see a movie, many are choosing to play video games instead. During this quarantine, video game sales and participation have risen astronomically. Whether these games are primarily social or solo, more people are playing them than ever before. Through this research, I hope to discover the extent to which video games can serve as a substitute for social interaction. I hypothesize that a moderate amount of gaming can help mitigate the negative mental effects of social distancing and quarantine. but that an excessive amount of gaming will correlate with stronger depressive symptoms.

### **1.1 Mental Health and Social Relationships**

Mental health issues are widely associated with a lack of, or negative, social relationships. In a study conducted regarding the effect of social relationships' dynamics on mental health, the ESRC found that large, supportive groups of friends and family members has a positive correlation with mental health<sup>1</sup>. The reverse holds true as well, in that a lack of supportive friends and family members generally correlates with a negative trend in mental health. Thus, in an era when seeing and interacting with friends is difficult, naturally many will suffer a decline in their social relationships, which likely will have a negative effect on their mental health. In fact, with regard to SARS, Hawryluck and Gold studied the effect of quarantine on mental health, finding a strong positive correlation between levels of quarantine and

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<sup>1</sup> Cable N, Bartley M, Chandola T, et al. "Friends are equally important to men and women, but family matters more for men's well-being." J Epidemiol Community Health 2013;67:166-171.

frequency and severity of depression symptoms among the general population of Toronto, Canada<sup>2</sup>. Thus, existing research establishes that enforced social distancing and quarantine rules have had, and will continue to have, a negative effect on mental health, at the very least through the lens of depression symptoms.

### 1.2 Video Games during COVID-19

Video game participation during COVID-19 has risen to new levels. The United States video game industry’s market size has increased steadily since 2012, and has reached a new high in 2020, as demonstrated in figure 1 below.<sup>3</sup>

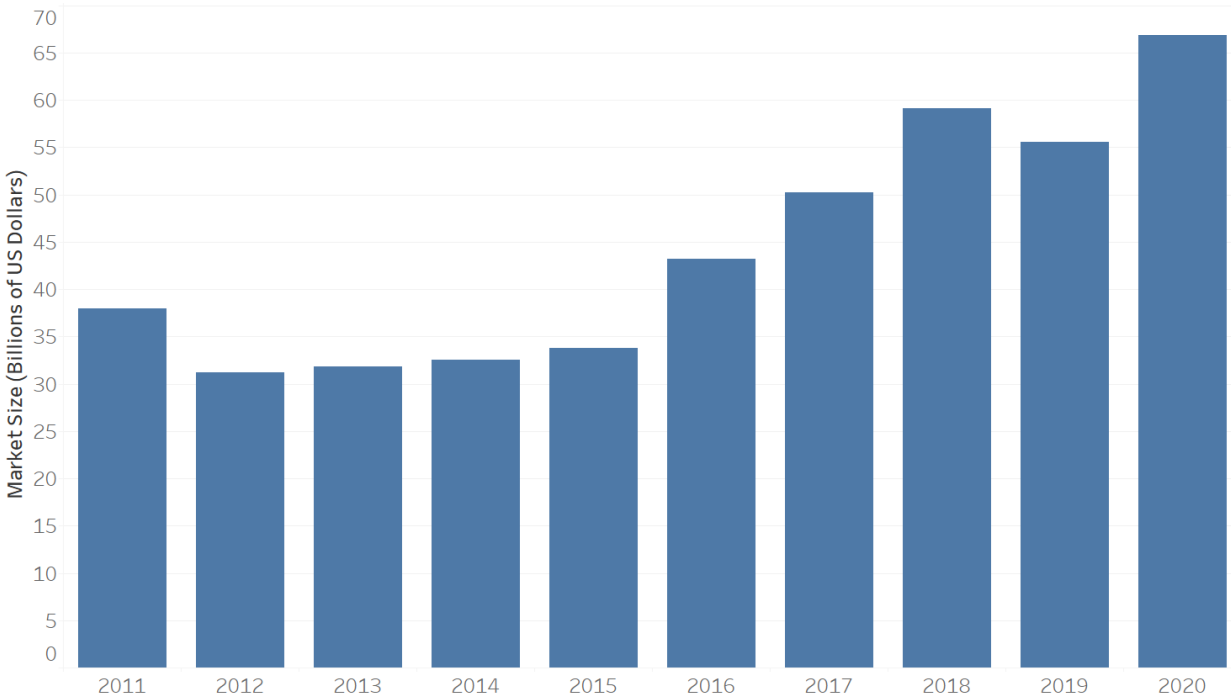


Figure 1. US Video Game Industry Market Size, 2011-2020

<sup>2</sup> Hawryluck, Laura et al. “SARS control and psychological effects of quarantine, Toronto, Canada.” Emerging infectious diseases vol. 10,7 (2004): 1206-12. doi:10.3201/eid1007.030703

<sup>3</sup> “IBISWorld - Industry Market Research, Reports, and Statistics.” Accessed May 10, 2021. <https://www.ibisworld.com/default.aspx>.

While this new high may be attributed to the growth of the gaming industry over the years, other entertainment media industries that can be enjoyed during lockdown have also improved sales, whereas industries like movies have taken a huge hit during COVID-19.<sup>4</sup> Thus, it appears that COVID-19 is propping up video game sales.

## 2. Literature Review

Over the last several decades, research conducted on video games and their effect on mental health varies. From the beginning, most research was focused on gaming's mental health repercussions. In 2007, a research study published in BMC Psychiatry found that online gamers with more hours spent gaming every week tended to showcase more severe depressive, social phobic, and internet addiction symptoms.<sup>5</sup> This study also demonstrated that this correlation was stronger for females than males. Female participants had fewer weekly online gaming hours than male participants, but more severe somatic, pain, and social phobic symptoms. This demonstrates potential gender differences in the relationship between mental health and gaming. At this time, research largely painted a negative picture of gaming, demonstrating its ability to worsen depressive symptoms and social phobic behavior.

However, more recently, video game research has begun to demonstrate that video games can bolster emotional and mental stability and childhood development. In an analysis of video games' effect on mental health, Jones, Scholes, and Johnson discovered that playing video games can correlate with better mental health<sup>6</sup>. While a large percentage of existing literature on

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<sup>4</sup> Adgate, Brad. "The Impact COVID-19 Had on The Entertainment Industry In 2020." Forbes. Accessed May 10, 2021. <https://www.forbes.com/sites/bradadgate/2021/04/13/the-impact-covid-19-had-on-the-entertainment-industry-in-2020/>.

<sup>5</sup> Wei, Han-Ting, Mu-Hong Chen, Po-Cheng Huang, and Ya-Mei Bai. "The association between online gaming, social phobia, and depression: an internet survey." BMC psychiatry 12, no. 1 (2012): 1-7.

<sup>6</sup> Christian Jones, et al., "Gaming well: links between videogames and flourishing mental health." Frontiers in Psychology vol. 5 (2014). doi:10.3389/fpsyg.2014.00260

gaming has focused on its negative effects, primarily aggression and lower psychosocial well-being, throughout the 2000s, much work has been done studying the link between gaming and overall positive well-being. For example, in 2011, Kevin Hull concluded that moderate video game play can help reduce emotional disturbances in children, contributing to emotional stability and maturity.<sup>7</sup> So, while gaming too much can certainly have negative effects, a moderate amount can actually be beneficial to one's development.

Also worth noting, several recent research papers focused on problematic amounts of gaming during COVID-19. In an analysis of increased risks of gaming disorder during COVID-19, Daniel King finds that individuals that are susceptible to excessive gaming are at increased risk during COVID-19, citing known risks associated with large amounts of gaming.<sup>8</sup> His findings are backed by existing literature and is certainly a point worth considering. Most likely, excessive gaming will showcase higher levels of depression, and demonstrably is not healthy. This paper builds off the existing research—examining gaming's role in mitigating the negative mental effects of lockdown; it also notes the correlation between gaming level and mental health, which is likely not linear, but rather U-shaped or quadratic.

## **2.2. Hypotheses**

Based on this literature, I formulated two hypotheses. First, as discussed above, research shows that gaming can be both beneficial and also destructive for one's mental health. Thus, I hypothesized that moderate levels of gaming correlates with less depression during COVID-19, but excessive gaming will correlate with more depression.

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<sup>7</sup> Hull, K. (2009). *Computer/Video Games as a Play Therapy Tool in Reducing Emotional Disturbances in Children*. Doctoral dissertation, UMI Number: 3380362, Liberty University, Lynchburg, VA.

<sup>8</sup> King, Daniel L., et al. "Problematic online gaming and the COVID-19 pandemic." *Journal of Behavioral Addictions* 9.2 (2020): 184-186.



Second, I wanted to explore the gender differences in this relationship more deeply. As aforementioned, previous literature has found that females are more negatively affected by gaming than males. Thus, I hypothesized that excessive gaming will more strongly harm females' mental health than it does males'.

### **3. Data & Methodology**

#### **3.1 Data Collection & Description**

Data for this project consists of survey data gathered via online channels. In particular, the survey was distributed via Reddit and a number of student Facebook groups. To specify, the survey was distributed via gaming-focused subreddits. A subreddit is a subsection of Reddit dedicated to one topic or thing in particular. For example, there is a subreddit dedicated to gaming in general, as well as many subreddits devoted to individual video games or genres of video games. Many of the larger subreddits do not allow surveys, and so the survey could not be distributed in those subreddits. However, the survey was posted to any large subreddit dedicated to some form of gaming, and most of the final data was gathered via Reddit. Aside from this, a respectable amount of data was gathered via NYU student groups, and the remaining data points were gathered via word of mouth.

The survey itself consists of three parts. First, the survey asked participants questions from the Zung Self-Rating Depression Scale (ZSDS) in order to approximate the participant's current levels of depression. Second, the survey asked participants questions regarding their gaming habits, specifically how often they gamed, what kinds of games they played, and whether they primarily gamed with friends or alone. Lastly, the survey asked for demographic and lifestyle information. This order of sections was decided on in order to influence participant

responses as little as possible. The demographics, lifestyle, and gaming questions were essentially rooted in fact, and so did not necessitate any particular placement. The ZSDS was placed at the very front, directly after the consent form, in order to try and gauge the participant's depression levels as close to as is. A complete list of all survey questions can be found in Appendix A.

The first section was originally designed to ask participants to rate their own levels of anxiety, depression, and stress. However, that was deemed unrealistic and unreliable. Thus, the first section comprised the ZSDS, a twenty item questionnaire, each of which is rated on a four-point scale. These answers are then converted to an integer value and summed. Thus, the depression score ranges from twenty to eighty. Within this range, twenty to forty-nine marks a normal score, while fifty or above implies increasingly higher levels of depression.<sup>9</sup> The questions themselves are designed to provide a brief quantification of a participant's current depressive state. For example, it asked participants to rate how clear-minded they have felt, their irritability, and their hopefulness, among other categories. In this manner, the scale has achieved reasonable acclaim, and has been verified to function to at least at a similar level to the Hamilton Rating Scale, the most commonly used clinician-assessed depression scale.<sup>10</sup> The validity has been further investigated by the British Journal of Clinical Psychology, which found that the ZSDS was consistent with other clinician-administered scales.<sup>11</sup> Thus, the ZSDS is a reliable measure of a participant's current depressive state.

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<sup>9</sup> Zung WW. (1965). A self-rating depression scale. *Archives of General Psychiatry* 12: 63-70.

<sup>10</sup> Biggs, J., Wylie, L., & Ziegler, V. (1978). Validity of the Zung Self-rating Depression Scale. *British Journal of Psychiatry*, 132(4), 381-385. doi:10.1192/bjp.132.4.381

<sup>11</sup> Knight, R.G., Waal-Manning, H.J. and Spears, G.F. (1983), Some norms and reliability data for the State-Trait Anxiety Inventory and the Zung Self-Rating Depression scale. *British Journal of Clinical Psychology*, 22: 245-249. <https://doi-org.proxy.library.nyu.edu/10.1111/j.2044-8260.1983.tb00610.x>

Second, the survey asked questions about the amount of and types of video games played during the COVID-19 era. In particular, it asked for a participant's average amount of time spent gaming each week, separated into two categories: multiplayer and single-player video games. It also asked participants what video game genres they primarily play, which video game titles they spent the most time on, and what platform they used to play video games. Collected data regarding what video game genres and titles a participant plays was naturally gathered in an open text format, and therefore was manually preprocessed and separated into appropriate subcategories. The rest of the data was gathered via a numerical scale, and was therefore ready to be worked with right away. It is also worth specifying that this part of the survey asked what platform the participant games on: PC, console, mobile, or other, in order to combat potential confounders arising from a variety of gaming platforms. Lastly, this section of the survey asked whether the participant plays these games primarily alone or with friends, as I believed that this would be important in discerning whether playing video games is a social or a solitary activity for the participant, which in turn plays a pivotal role in determining the cause of changes in depression.

In the third and final section, the survey asked participants to answer several questions about themselves. In particular, it asked for or about each participant's age, gender, educational level, employment status, sleep schedule, social interaction, and social media usage. These variables can all have a significant impact on one's mental health, and also may contribute to one's ability and desire to purchase and play video games. Therefore, these demographics were gathered in order to allow regression to hopefully mitigate their potential confounding effects. Of course, this will not completely mitigate all confounders, but it will help draw more realistically significant, as well as interesting, conclusions.

At the conclusion of the data collection phase, the survey received approximately 550 responses. Of those 550, approximately 400 were mostly complete. After dropping responses which did not finish the ZSDS, 332 responses remained. Out of these 332 responses, 27% of participants were female, and 73% were male. The average participant was 26.8 years old, had a depression score of 44.5, and gamed for 33.8 hours a week. On the Zung Self-Rating Depression Scale, a score of 50 is considered mildly depressed, so the average participant is not depressed, despite approaching that cutoff. Further, while 332 usable responses is far from useless, it does not provide enough data to run specific categorical analyses between genres and titles of video games.

### **3.2 Data Issues**

The largest problem with the data came from the first part of the survey. While the merits of the ZSDS have been discussed in the previous section, any self-administered online depression assessment will never be perfect. Data regarding depression thus varied widely, and it was difficult to discern which data points should not be used. Further, some participants noted that they wished there were a “never” option regarding the ZSDS questions, which can be found in Appendix A. As it is currently, the possible answers for each of the twenty questions were: a little of the time, some of the time, good part of the time, and most of the time. However, participants found that some of the questions did not apply to them whatsoever, and thus felt uneasy completing the survey. This likely resulted in somewhat inaccurate results, and also caused some participants to stop taking the survey. In the future, this could perhaps be resolved by changing to an alternative self-rating depression scale, although the public availability of reliable depression scales is extremely limited.

Data collection also certainly suffered from some amount of bias due to data being primarily collected via Reddit and Facebook. Despite the fact that Reddit has over 400 million monthly users, a large percentage of these users are young, white, liberal, American males. Because the survey did not ask for race, that demographic cannot be verified, but the demographics section reflected the rest, as approximately two-thirds of the data points came from young males. The data collected via Facebook suffered a similar problem, as, again, primarily young males responded on Facebook groups and group messages. Further, the Facebook groups consisted of primarily NYU students. This implies that many of these students were far better off financially than the average citizen, and likely was not accurately representative of national demographics as a whole.

It also proved difficult to incentivize non-gamers to participate in the survey. While gamers may be interested, simply because they possess a shared defining trait, non-gamers may simply take no interest in this research. Luckily, their participation is not as important as it would be in other projects, as this data will consider the amount of time spent gaming as the independent variable, meaning that a lack of people who do not game at all (spend zero hours weekly gaming) may not actually impact the regression meaningfully. However, in either case, and to incentivize even more to participate, the survey did include an entry into a raffle for a \$50 Amazon gift card, conditional on survey completion. Given that time spent to complete the survey is far too low, that data point was thrown out, and the participant was removed from the raffle.

Furthermore, as mentioned above, 73% of the total responses were male, leaving only approximately 90 female responses. This number is rather low, and reduces the significance of analysis conducted for female responses. It also explains why, as I will discuss below, the

overall correlations correlated very strongly with the male participants' correlations, but did not correlate very strongly with female participants' correlations. Lastly, a survey is always somewhat flawed, as there exist cases of reporting bias, or of participants who entered just for the chance to win the \$50 Amazon gift card. It is very likely that some of these responses are not truly indicative of the participant's life, depression, or gaming habits.

### **3.3 Methodology**

I conducted analysis using several Python libraries. In particular, I used Pandas to store my data, to create a correlation matrix, and later to compute interaction terms. I used matplotlib, as well as Tableau, a data visualization software, to visualize my scatterplots and best fit lines. Lastly, I used Statsmodels to conduct regression analyses and extract summary statistics.

To begin, I first noted that the data was too noisy to conduct useful quadratic regression, and decided to stick to linear regressions. Next, I ran linear regressions for depression against time spent playing single player games, and against time spent playing multiplayer games, in order to see which had a stronger correlation with depression. However, I discovered that total hours spent playing video games had a stronger correlation with depression than either alone, so I decided to use total hours spent gaming as my independent variable. Despite this, the correlation remained weak, so I looked into other factors that might have an influence on depression. To do so, I first used Pandas to build a correlation matrix between all variables I considered likely to have an effect on depression, displayed in Figure 2 below.

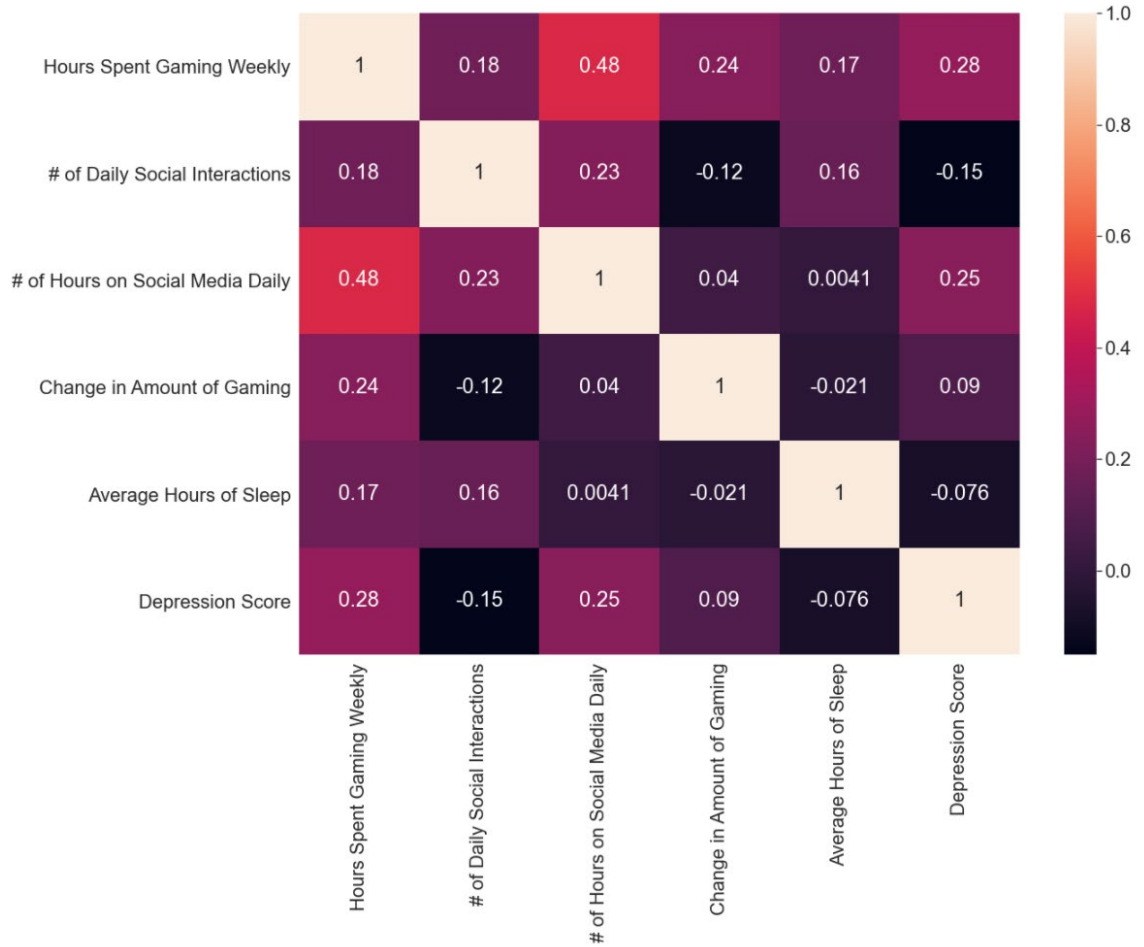


Figure 2. Correlation Matrix

Each square in this correlation matrix represents the correlation between the two variables on the same x and y axes as the square. For example, the correlation between a participant’s number of daily social interactions and his or her hours spent gaming weekly is 0.18. The closer this correlation is to 1 or -1, the stronger the correlation between the two; inversely, the closer the correlation is to 0, the weaker it is. A negative value signifies that the relationship between the two is negative; as one increases, the other decreases.

This correlation matrix reveals that, aside from total hours spent gaming weekly, number of daily social interactions and number of hours spent on social media daily have some correlation with depression score. Thus, I ran linear regressions for both of these variables

against depression score individually. However, I was more interested in the interaction between those variables and total hours spent gaming weekly, and how that interaction affected one's depression. In order to analyze that, I first centered each variable around its mean. Hours spent gaming was measured weekly, while the other two variables were measured daily, so centering helped account for the difference in units of measurement. Furthermore, as seen in the correlation matrix above, number of hours spent on social media has a reasonably strong correlation with hours spent gaming weekly. Therefore, mean centering the data further helped account for potential multicollinearity issues.

Next, I computed interaction terms between gaming and social media usage, as well as between gaming and daily social interactions. Then, using the interactions, alongside each variable, I conducted a multivariate linear regression to analyze the predictive power and correlation each had with depression.

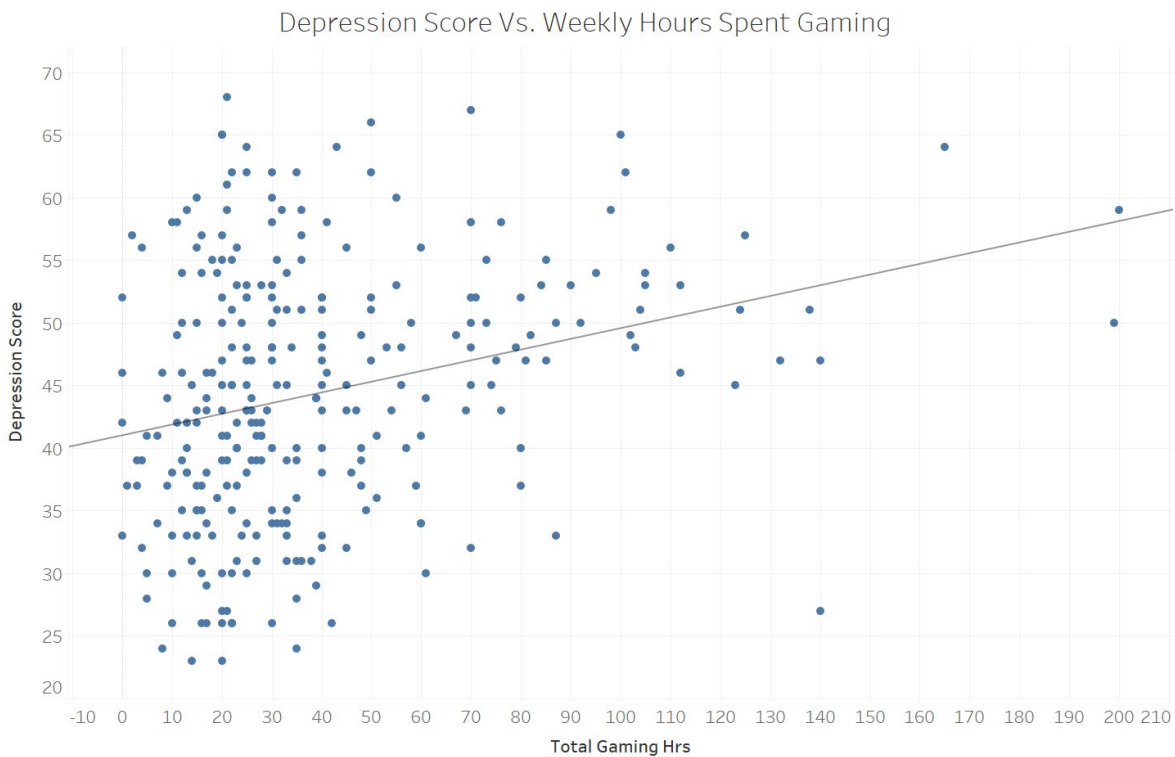
Lastly, I started back at the single-variable regressions for each of my three variables, total hours spent gaming weekly, number of daily social interactions, and hours spent on social media daily. From here, I separated my data into two datasets, one holding all male participant responses, and the other holding all female participant responses. Then, I conducted each of my single-variable regressions again for each gender. Last, I re-centered my data in each dataset, re-calculated interaction terms, and re-ran the multivariate regressions for each gender.



## 4 Results

### 4.1 Single-Variable Regressions

As discussed above, I conducted linear regressions for each potential predictor of depression, namely total hours spent gaming weekly, number of daily social interactions, and hours spent on social media daily. These linear regressions were conducted thrice, once for the total dataset, once for male responses, and once for female responses. The first three regressions, for depression score against total hours spent gaming, are visualized in figures 3 and 4 below.



*Figure 3. Depression Score vs. Total Gaming Hours, all responses*

As shown in figure 3 above, the overall data is extremely noisy. This is likely due to the multitude of potential confounding variables. Depression is inherently a complicated issue, and many social factors contribute to one's level of depression.<sup>12</sup> However, despite the scattered

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<sup>12</sup> McFarlane, Allan H., Anthony Bellissimo, Geoffrey R. Norman, and Phil Lange. "Adolescent depression in a school-based community sample: Preliminary findings on contributing social factors." *Journal of Youth and Adolescence* 23, no. 6 (1994): 601-620.

datapoints, there is still a clear positive trend between depression score and total hours spent gaming weekly. The regression analysis, showcased in Appendix B, backs this. With a low r-squared value of 0.077, total hours spent gaming explains very little of the variation in depression scores. However, the regression analysis returned a p-value of nearly 0, with a standard error even lower than that. This implies that there is almost certainly some positive relationship between depression score and total hours spent gaming weekly, contrary to my original hypothesis. Further, it appears that this correlation is linear or logistic, rather than quadratic or U-shaped.

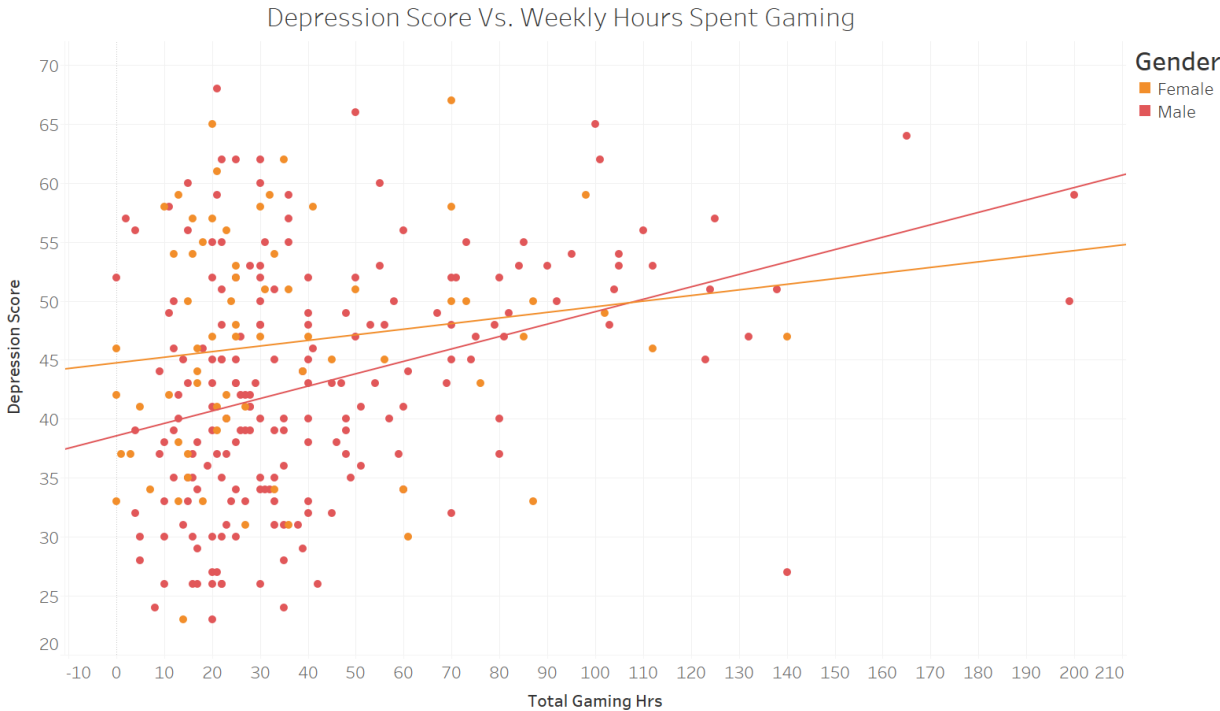


Figure 4. Depression Score vs. Total Gaming Hours, Female responses vs. Male responses

Interestingly, it appears that this relationship is stronger for males than for females. Contrary to the hypothesis, it would appear that gaming affects males’ mental health more negatively than females’. However, for those who play under a hundred hours of video games a

week, it does appear that males actually do have a lower depression score than females who play the same amount. Very few people play more than one hundred hours of video games every week, as evidenced by the scatterplot above, so previous literature's conclusion that females are more strongly affected may still hold sway. I further found that this model's p-value for total hours spent gaming weekly, for female participants, at 0.228941, is not significant. This provides more evidence against my hypothesis, as not only is the correlation between depression and hours gaming weaker for females, but it may actually simply not exist.

The next regressions, for depression score against number of daily social interactions, are shown below in figures 5 and 6.

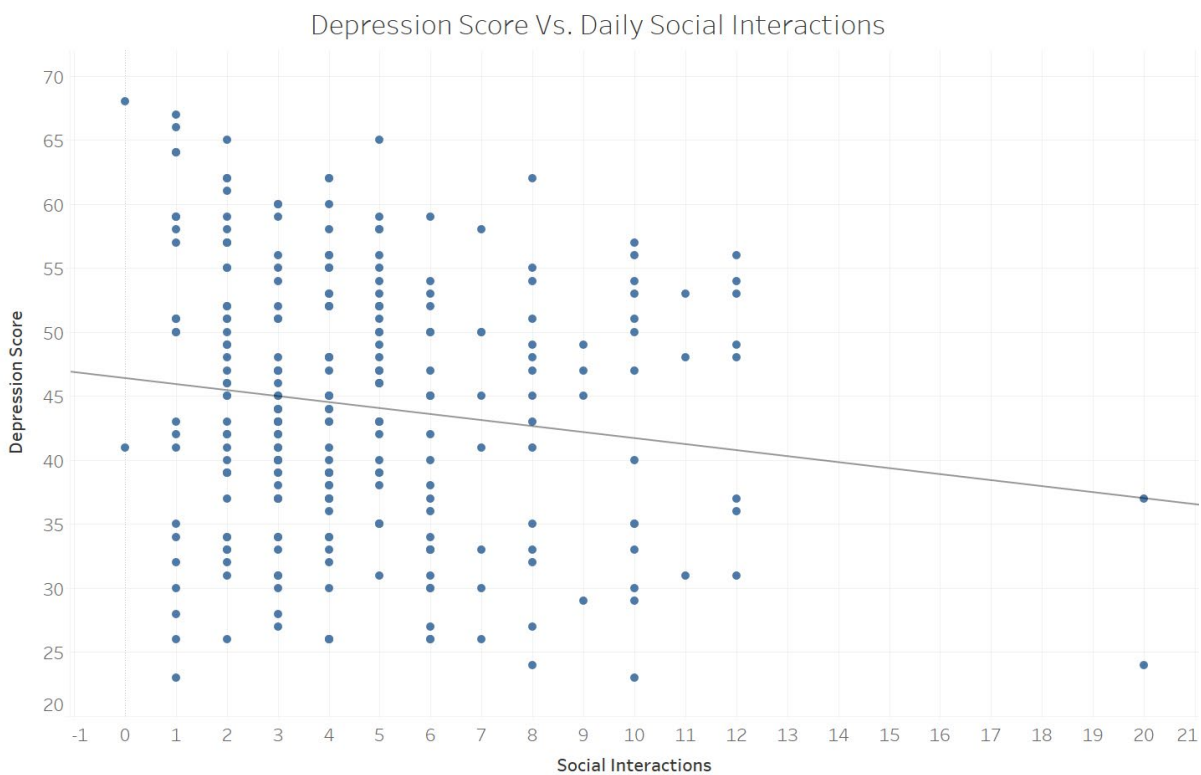


Figure 5. Depression Score vs. Number of Daily Social Interactions, all responses

Demonstrably, the correlation between depression and number of daily social interactions is even noisier than the correlation between depression and hours spent gaming weekly. I did, however, still find a statistically significant negative correlation, with a p-value of 0.0202558.

So, similarly to gaming, while this single-variable model has no predictive power, it is all but certain that there does exist some negative relationship between social interactions and depression.

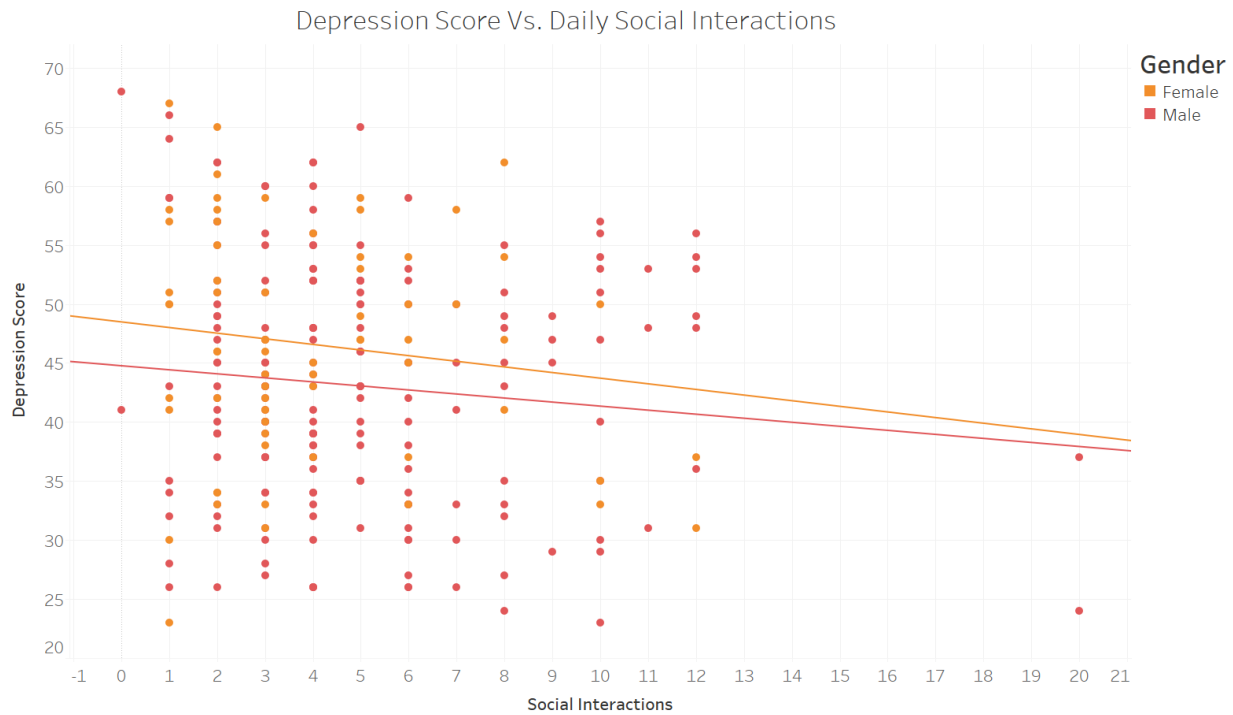
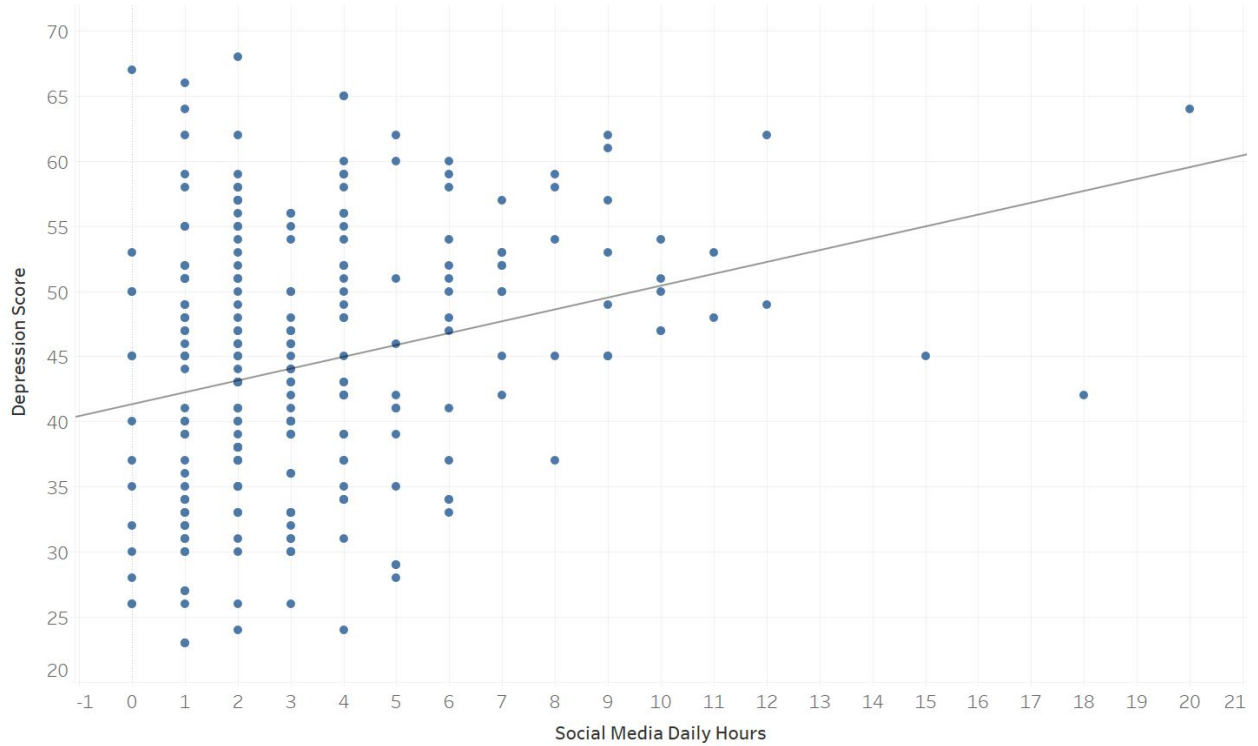


Figure 6. Depression Score vs. Number of Daily Social Interactions, Female responses vs. Male responses

However, when separating out for female and male responses, I discovered that neither p-value was significant. For males, the p-value was 0.139599, and for females, 0.265524. This led me to believe to that the original, significant p-value for total responses was likely a result of a lot of data points, and thus potentially not indicative of an actual correlation. Thus, I concluded that daily social interactions does not have a significant effect on depression.

The last single-variable regressions, for depression score against hours spent on social media daily, are shown below in figures 7 and 8.

Depression Score Vs. Daily Hours on Social Media



This chart looks very similar to the first, which makes sense, as the correlation matrix revealed that daily hours spent on social media had a reasonably strong correlation with total hours spent gaming weekly. The analysis also reveals a very similar result to depression score versus total hours spent gaming weekly. That is, while this single-variable model certainly has minimal predictive power, daily hours on social media has a near-zero p-value, implying that there is almost certainly some positive relationship between it and depression.

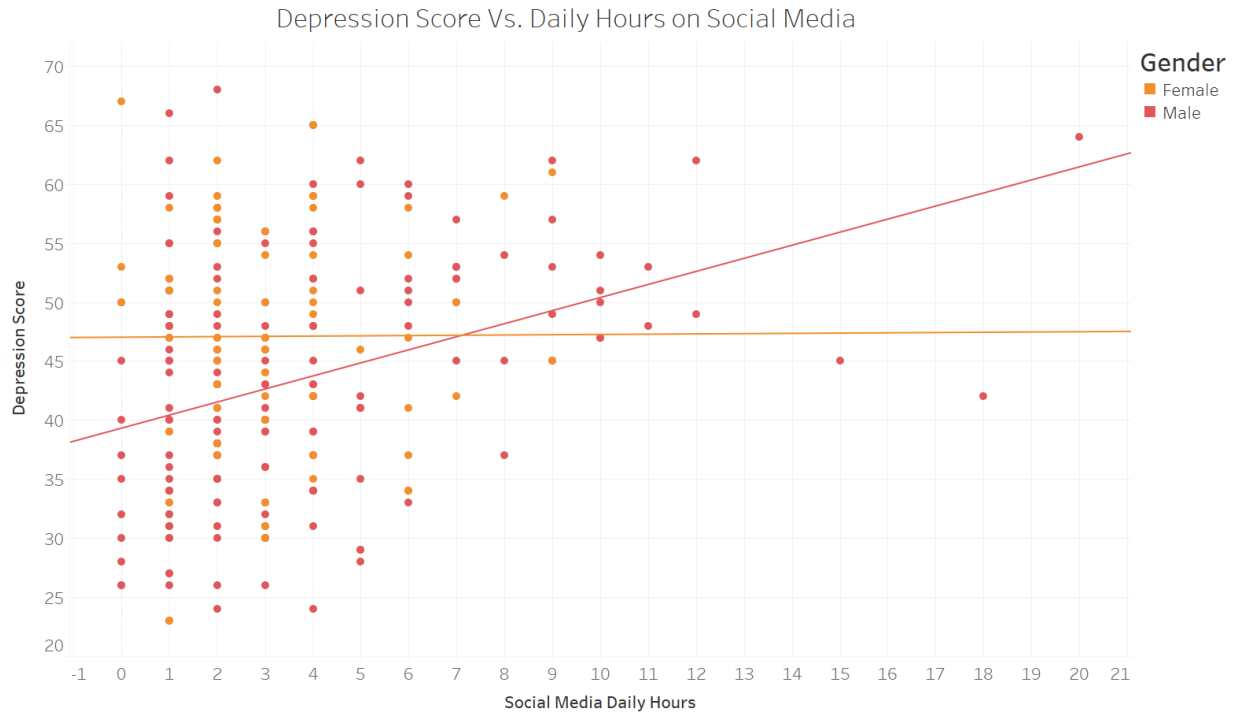


Figure 8. Depression Score vs. Daily Hours on Social Media, Female responses vs. Male responses

Then, investigating the gender differences with regards to social media usage and how it affects depression, it seems that females are minimally affected by social media usage, while the relationship is clearly positive for males. For male data points, social media usage's p-value remains near zero, meaning that positive relationship is significant. However, for females, that p-value reaches 0.968069, meaning that there almost certainly is zero relationship whatsoever between depression score and social media usage for females. However, I believe this is likely due to a limited number of data points, as I discussed above in the Data Issues section. All single-variable regression statistics can be found in Appendix B.

## 4.2 Multivariate Regression

Specific coefficients, p-values, and other regression statistics for the multivariate regression can be found in Appendix C. This multivariate regression was run with each of the three variables discussed above, as well as the interaction between daily hours on social media and gaming, and the interaction between number of daily social interactions and gaming. I found that, for total responses and for just male responses, each of the three variables are individually significant. However, I also found that neither interaction is significant. Thus, changes in your hours spent gaming does not affect how your social media usage or social interactions influence your depression, and vice versa. For females, no variable, nor the interactions, were significant. This, again, is likely due to a small data sample for female responses, and warrants further investigation in the future.

## 5 Future Work

This study establishes that gaming does have a significant positive correlation with depression. However, it does not provide a model with any predictive power. In order to do so, future research would have to conduct a controlled experiment. As evidenced by existing research, a large variety of factors contribute to depression.<sup>13</sup> A future experiment would have to control as many of these factors as possible, ranging from ones covered in this survey such as social media usage and social interactions, to factors like time spent outside and healthiness of a participant's diet. This would provide more insight into the direct effect gaming has on one's levels of depression.

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<sup>13</sup> McFarlane, Allan H., Anthony Bellissimo, Geoffrey R. Norman, and Phil Lange. "Adolescent depression in a school-based community sample: Preliminary findings on contributing social factors." *Journal of Youth and Adolescence* 23, no. 6 (1994): 601-620.

Alternatively, increasing the size of the dataset here could serve as a first step towards future research. Given the small sample size of female participants, it is likely that the lack of correlation in results for female responses is at least partially due to the small sample size. Therefore, by receiving a higher quantity of female responses, the same analysis may find significance, as it did for male responses.

## 6 Conclusion

This research establishes a significant positive correlation between hours spent gaming and depression. The more time one spends gaming, the more likely they are to be depressed. However, I must note that this may not be a causal relationship. It is entirely possible that the more depressed one is, the more time they spend gaming. Regardless, this contradicts my original hypothesis, that a moderate amount of gaming will correlate with lower levels of depression. It also contradicts recent research, which generally finds that time spent gaming is negatively correlated with depression.<sup>14</sup> One possible reason for this is that this survey was conducted during COVID-19, a very unique time. Research has demonstrated that quarantine has a significant negative effect on depression.<sup>15</sup> Gaming may improve depressive symptoms in participants, but that improvement may be outweighed by the heavy presence of the pandemic.

This research also fails to draw any statistically significant conclusions regarding the relationship between gaming and depression for female participants. This contradicts existing literature, which finds that gaming more negatively affects than males.<sup>16</sup>

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<sup>14</sup> Brunborg, Geir Scott, Rune Aune Mentzoni, and Lars Roar Frøyland. "Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems?." *Journal of behavioral addictions* 3, no. 1 (2014): 27-32.

<sup>15</sup> Hawryluck, Laura et al. "SARS control and psychological effects of quarantine, Toronto, Canada." *Emerging infectious diseases* vol. 10,7 (2004): 1206-12. doi:10.3201/eid1007.030703

<sup>16</sup> Wei, Han-Ting, Mu-Hong Chen, Po-Cheng Huang, and Ya-Mei Bai. "The association between online gaming, social phobia, and depression: an internet survey." *BMC psychiatry* 12, no. 1 (2012): 1-7.



Regardless, the gaming industry continues to increase in market size and revenue every year. As more people begin gaming, or increasing the amount they game, it becomes more and more important to study the effects of gaming on mental health. This paper concludes that gaming negatively impacts mental health. However, other research concludes the opposite, and so controlled experiments ought to be done in the future to find the true relationship between the two, accounting for potential confounders. Only in this manner can we really understand what gaming does to our mental health, and make educated decisions about how much time we spend playing video games.

## 7 Appendices

### *Appendix A: Survey Questions*

#### Section 1: Mental Health - Zung Self-Rating Depression Scale

Answer one of the following for each of the 20 questions:

A Little of The Time,  
Some of The Time,  
Good Part of The Time,  
Most of The Time

Questions:

For each item below, please select the answer which best describes how often you felt or behaved this way during the past several days.

1. I feel downhearted and blue.
2. Morning is when I feel the best.
3. I have crying spells or feel like it.
4. I have trouble sleeping at night.
5. I eat as much as I used to.
6. I still enjoy sex.
7. I notice that I am losing weight.
8. I have trouble with constipation.
9. My heart beats faster than usual.
10. I get tired for no reason.
11. My mind is as clear as it used to be.
12. I find it easy to do the things I used to.
13. I am restless and can't keep still.
14. I feel hopeful about the future.
15. I am more irritable than usual.
16. I find it easy to make decisions.
17. I feel that I am useful and needed.
18. My life is pretty full.
19. I feel that others would be better off if I were dead.
20. I still enjoy the things I used to do.

## Section 2: Video Games

1. Have you played more, less, or the same amount of video games during COVID-19, as compared to before?
2. How many hours a week on average do you spend playing multiplayer video games?
3. How many hours a week on average do you spend playing single-player video games?
4. What genres of video games do you primarily play? (Maximum 3)
5. What video game(s) do you play the most? (Maximum 3) (Multiple answer selection)
6. What platform do you primarily game on? (PC, Console, Mobile)
7. Do you primarily play video games with friends or by yourself?

## Section 3: Demographics

1. Please enter your age in years.
2. Please select your gender.
3. What is the highest level of education you have completed or are currently completing?  
(None, High School, College, Masters, PhD)
4. What is your household size? (1-10+)
5. Are you currently employed? (Yes, no, student)
6. Should you wish to be entered into the raffle for a \$50 Amazon Gift Card, please enter your Email Address and/or Reddit Username below.

*Appendix B: Single-Variable Regression Statistics*

**Depression Score Vs. Total Hours Spent Gaming Weekly**

**All Responses**

$$\text{Depression Score} = 0.0855168 * \text{Total Gaming Hrs.} + 41.0103$$

Coefficients

Term	Value	StdErr	t-value	p-value
Total Gaming Hrs.	0.0855168	0.0177193	4.82621	< 0.0001

R-squared: 0.0765

**Male Responses**

$$\text{Depression Score} = 0.105214 * \text{Total Gaming Hrs.} + 38.5566$$

Coefficients

Term	Value	StdErr	t-value	p-value
Total Gaming Hrs.	0.105214	0.0197044	5.33964	< 0.0001

R-squared: 0.129

**Female Responses**

$$\text{Depression Score} = 0.0475757 * \text{Total Gaming Hrs.} + 44.7406$$

Coefficients

Term	Value	StdErr	t-value	p-value
Total Gaming Hrs.	0.0475757	0.0391834	1.21418	0.228941

R-squared: 0.0229

## Depression Score Vs. Number of Daily Social Interactions

### All Responses

$$\text{Depression Score} = -0.468875 * \text{Social Interactions} + 46.3986$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Interactions	-0.468875	0.200738	-2.33576	0.0202558

R-squared: 0.0203

### Male Responses

$$\text{Depression Score} = -0.34209 * \text{Social Interactions} + 44.7663$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Interactions	-0.34209	0.230592	-1.48353	0.139599

R-squared: 0.0115

### Female Responses

$$\text{Depression Score} = -0.476858 * \text{Social Interactions} + 48.481$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Interactions	-0.476858	0.424589	-1.1231	0.265524

R-squared: 0.0190

## Depression Score Vs. Daily Hours Spent on Social Media

### All Responses

$$\text{Depression Score} = 0.909619 * \text{Social Media Daily Hours} + 41.3225$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Media Daily Hours	0.909619	0.207685	4.37979	< 0.0001

R-squared: 0.0737

### Male Responses

$$\text{Depression Score} = 1.10684 * \text{Social Media Daily Hours} + 39.3058$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Media Daily Hours	1.10684	0.219304	5.04707	< 0.0001

R-squared: 0.130

### Female Responses

$$\text{Depression Score} = 0.023128 * \text{Social Media Daily Hours} + 47.0179$$

#### Coefficients

Term	Value	StdErr	t-value	p-value
Social Media Daily Hours	0.023128	0.575432	0.0401924	0.968069

R-squared: 0.0000261

*Appendix C: Multi-Variate Regression Statistics (with Interactions)*

**All Responses**

Term	coefficient	std err	t-value	p-value
Hours Spent Gaming Weekly	0.0868	0.021	4.043	0.000
# of Daily Social Interactions	-0.7884	0.192	-4.097	0.000
# of Hours on Social Media Daily	0.7194	0.249	2.885	0.004
Gaming * Daily Interactions	0.0081	0.005	1.570	0.118
Gaming * Daily Social Media	-0.0039	0.004	-0.975	0.330

R-squared: 0.192

**Male Responses**

Term	coefficient	std err	t-value	p-value
Hours Spent Gaming Weekly	0.0998	0.025	4.005	0.000
# of Daily Social Interactions	-0.7358	0.212	-3.478	0.001
# of Hours on Social Media Daily	0.9329	0.276	3.374	0.001
Gaming * Daily Interactions	0.0067	0.005	1.215	0.226
Gaming * Daily Social Media	-0.0074	0.004	-1.733	0.085

R-squared: 0.256

**Female Responses**

Term	coefficient	std err	t-value	p-value
Hours Spent Gaming Weekly	0.0571	0.044	1.288	0.203
# of Daily Social Interactions	-0.7235	0.475	-1.523	0.133
# of Hours on Social Media Daily	-0.0586	0.628	-0.093	0.926
Gaming * Daily Interactions	-0.0005	0.016	-0.032	0.975
Gaming * Daily Social Media	0.0011	0.021	0.054	0.957

R-squared: 0.063

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