WEP Warwick Evans Publishing

International Journal of Public Health and Medical Research

ISSN: 3006-7707 (Print), ISSN: 3006-3752 (Online) | Volume 5, Number 1, Year 2025
DOI: https://doi.org/10.62051/ijphmr.v5n1.09
Journal homepage: https://wepub.org/index.php/IJPHMR/index

# Public Health Implications of Violent Video Game Exposure: Effects on Adolescent Aggressive Behavior and Mental Well-being

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## ABSTRACT

With the rapid proliferation of the Internet and digital entertainment in China, violent video games have become increasingly accessible to adolescents. This trend raises growing public health concerns regarding the psychological and behavioral development of young individuals. Adolescents with limited self-regulation may experience excessive exposure to violent gaming content, which has been associated with heightened risks of aggressive behavior, impaired moral judgment, reduced academic performance, and potential antisocial tendencies. These behaviors not only affect individual well-being but may also contribute to broader social and mental health issues. This study aims to examine the relationship between violent video game exposure and adolescent aggressive behavior from a public health standpoint. Key variables include game market penetration, usage patterns, the intensity of violent content, and adolescents' normative beliefs about aggression. Data were collected using the Video Game Questionnaire (VGQ), the Buss-Perry Aggression Questionnaire (PBAQ), and the Normative Beliefs About Aggression Scale (NOBAGS). The findings are intended to inform early behavioral interventions and preventive strategies that promote adolescent mental health and reduce the public health risks associated with digital violence exposure.

## KEYWORDS

Public Health; Mental Health Risk; Adolescent Aggression; Violent Video Games; Behavioral Intervention

## 1. INTRODUCTION

With the rapid advancement of the economy and technology, video games have become a major form of leisure activity. However, the widespread popularity of violent video games among adolescents has raised increasing concern within the field of public health. Violent video games are typically defined as games in which players deliberately cause harm to others while assuming roles of their choosing (Anderson & Bushman, 2001) [1]. Alarmingly, more than 89% of video games today contain violent content, with nearly 50% featuring extreme violence (Mellado, 2023). Titles such as Honor of Kings and PUBG have become especially popular among young people in China.

A relevant survey suggests that, juveniles, typically defined as those between the ages of 10 to 19 (UNICEF& UNFPA, 2023) [2]. As we all know, they have the power to advance society and shape culture. And there is a growing emphasis on the protection and education of adolescents and minors. However, in 2021, the national violent and severe crime rate of minors between the ages of 12 and 17 was 5 per 1,000, and the total number of cases of serious violent crime involving minors were about 123,000 cases (Bureau of Justice Statistics, 2021). Many suspected it has something to do with

gaming. Many also worried that violent game is causing irreversible damage to young people's sense of right and wrong, their health, and their academic lives. And pertinent survey evidence indicates that teens are more susceptible to the detrimental effects of media violence and may even unintentionally choose a criminal career due to their hazy moral convictions and lack of self-control (Chen, 2010) [3].

In light of the aforementioned context, adolescents who struggle with self-control become addicted to violent video games, which has a negative impact on both their academic standing and general health.

So, this study aims to analyze whether violent gameplay directly encourage aggressive behavior in adolescents. And discuss the relationship between violent games and adolescent aggressive behavior. Finally, we will put forward constructive suggestions about this impact, which has realistic significance for the growth of teenagers and the harmony and stability of society.

## 2. THEORETICAL FRAMEWORK

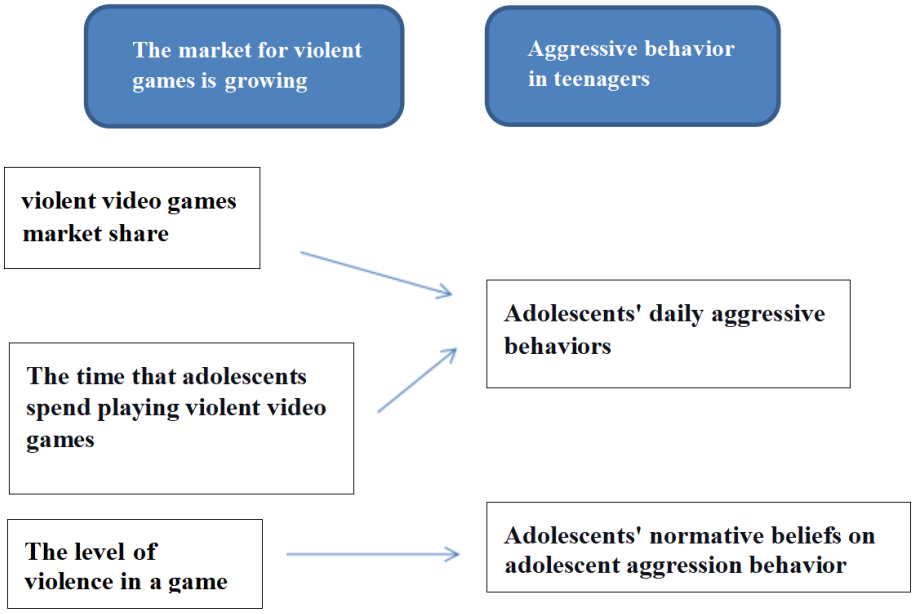


**Figure 1.** Theoretical framework

## 3. LITERATURE REVIEW

Opinions about the effects of violent gaming on adolescents vary depending on demographics and individual gaming experiences. Some researchers have concluded that violent games have social and behavioral and cognitive benefits, while others have argued that the medium of gaming contributes to mass shootings and, more broadly, has a sustained and strong effect on aggressive behavior (Jay, 2013) [4]. Recently, a series of open letters published by scholars have warned the public and policymakers that the positive and negative effects, addictive potential, cognitive benefits, and aggressive impacts of spending time playing games maybe overstated. Like individuals, professional organizations have expressed different positions on the effects of video games. Professor Andrew Przybylski, Director of Research and Principal Investigator at the Oxford Internet Institute, stated, "The idea that violent videogames trigger aggression in the real world is popular, but it has not been well tested overtime." "Despite the interest of parents and policymakers in this topic, research has not shown cause for concern (Przybylski & Weinstein, 2019) [5]."

A growing body of research establishes a connection between violent video games to aggressive cognition, attitudes, and behaviors. Anderson and Bushman (2001) figured that playing violent games not only increase aggressive behaviors but also increase aggressive cognition, and decrease prosocial behaviors. The frustration-aggression theories developed by Berkowitz's (1989) suggest that losing in competitive games can lead to frustration, which may in turn increase aggressive behavior [6].

However, some of research supposed that there is no relationship between violent games and adolescences aggressive behavior. Przybylski & Weinstein (2019) argue that there is no observable association between violent video games engagement and adolescent aggressive behavior [7].

It can be seen that the literature mentioned above advocate that violent video games is related to teenagers' aggression have some limitation. There is controversy that researches on the relationship between violent game contact and aggressive behavior has reached inconsistent conclusions.

### 3.1. Violent Video Games

Psychological researchers in different countries have different interpretations on the definition of violent video games, there remains controversy of violent video game. There is an acceptable definition stated that an individual participating in a game involving opponents other than himself, where the player inflicts harm and enables the individual to fulfill their optimal role (Anderson & Bushman, 2001).

### 3.2. Aggressive Behavior

Aggressive behavior is any act directed at another person with the intent to cause harm at close range (immediately) (Ireland, 2024) [8]. Aggression may involve violence, and this violence maybe adaptive under some circumstances of natural selection (Lio, 2024). While this is usually done with the intention of causing harm, for some it can be transformed into a creative and practical outlet. Additionally, the perpetrator must believe that the act will harm the target and that the target is motivated to avoid the act Unintentional harm is not aggressive because it is not intentional. Injuries that are incidental byproducts of beneficial actions are also not aggressive because the injurer believes that the target has no motivations to avoid the action (e.g., pain experienced during a dental procedure). Aggressive behaviors are observable manifestations of aggression and are often associated with developmental shifts across the lifespan as well as a range of behaviors (Liu & Lewis, 2012) [9]. Similarly, pain inflicted in sexual masochism is not aggressive because the victim has no motivations to avoid it-in fact, pain is actively solicited to serve a higher purpose (Anderson & Bushman, 2002) [10].

### 3.3. Violent Video Market Shares

Market share is the proportion of a product's sales volume in relation to the sales volume of similar products in the industry, generally expressed as a percentage (Buzzell & Gale, 1975) [11]. Market share reflects the competitive position and profitability of the product under study and is one of the important indicators of the popularity of the product. Market share has two characteristics, quantitative and qualitative. It is a common method of assessing the market position and performance of that product. The same is true for the market share of violent games. Violent games market share can be defined as the market share of violent games in the overall game industry.

### 3.4. The Violent Video Games Market Share and Adolescence Aggressive Behavior

The research conducted by Joost Impink, Patrick Kielty & Han Stice shows that the popularity of violent video games increases crime rates, especially among people under 17. However, according to a study by Ferguson (2008) [12], the crime rate of adolescents decreases because of the use of games. Additionally, according to the US Department of Justice statistics in 2013, the number of hours of

teenagers playing video games per week and the violent crime rate during the same period of data, from 13 years to now, the frequency has continued to increase but the violent crime rate has shown a trend of decline. There is controversy in the study of violent video games and crime rates. Taken together, the hypotheses are follows:

H1: The violent video games market share is positively associated with adolescence aggressive behavior.

### 3.5. Playing Violent Games Time

The amount of time (in hours) spent in playing video games that show players hurting each other or trying to do harm to other individuals (Luo, 2016) [13].

### 3.6. The Time That Adolescents Spend Playing Violent Video Games and Adolescents' Daily Aggressive Behavior

Tian (2020) has conducted sampling studies and analyzed the GAM, concluding that there is a positive relationship between the time spent playing violent video games and adolescents' aggressive behavior. Shao and Wang (2019) supported the GAM by theorizing that moral disengagement, anger, and hostility maybe the factors that increase the level of aggression. Furthermore, Yao has used the moral disengagement scale (MDS), Buss–Perry aggression questionnaire (BPAQ), and sensation-seeking scale (SSS-V) to support the GAM model [14].

In the existing research reports on the relationship between time spent playing violent games and aggressive behavior in adolescents, although GAM can capture nonlinear patterns by combining the smoothing functions of multiple predictors, it still ignores some external factors that might also affect the result. For instance, aggressive individuals may gravitate towards violent games than other individuals. In such a scenario, violent games are not the only reason for their violent behavior. So, in further study, factors that contain bias, such as gender, family situation, school interpersonal relations, and class differences, should be excluded in advance. Taken together, the hypotheses are follows:

H2: The time that adolescents spend playing violent video games is positively associated with adolescents' daily aggressive behaviors.

### 3.7. The Level of Violence in Violent Video Games

The level of violence in violent video games is often defined in terms of the type, frequency, and intensity of their violent content. The content of violent in the game, including but not limited to fighting, bloodshed, killing and other scenes. Violent elements in violent video games often appear in the form of images, the performance of plot and sound effects to create an immersive virtual violence experience for players (Ministry of Culture Tourism of the People's Republic of China, 2013). The violence level of violent video games is measured according to the violence value tendency of the theme content of online games.

### 3.8. Normative Cognition of Aggressive Behavior

Normative cognition of aggressive behavior is defined as individuals'normative beliefs towards various aggressive behaviors that appeared in different scenarios, which measures the cognitive standards about the acceptability of aggressive behavior (Swit & Harty, 2023) [15].

### 3.9. The Level of Violence in Violent Video Games That Adolescents Play and Normative Cognition of Aggressive Behavior

Despite the growing interest and research on violent gaming and juvenile delinquency rates, there are still significant gaps in the research. Few studies have explored the role of normative beliefs in cyberattacks (Wright & Li, 2013). Several studies have found that normative beliefs can act as mediators of delinquent behavior. Normative beliefs moderate behavior regardless of internal or external endorsement, although beliefs supported by internal endorsement are more stable. Huesmann and Guerra (1997) argued that aggressive individuals will have normative beliefs that are more approving of aggressive behavior, and conversely, those individuals who are more approving of aggressive behavior will also be more aggressive [16].

However, no study has explored normative beliefs as a mediator of online gaming aggression. According to the study, to assess the moderating mediating role of normative beliefs about aggression on violent video game exposure and adolescents' aggression, Shao (2019) examined whether they normalize aggression in games and whether these normative beliefs explain their aggression in games based on the Social Cognitive Information Processing Model and Normative Belief Theory. To summarize, relevant studies in China and abroad have mainly explored the effects of violent games and the main violent components in them on aggressive tendencies, and few studies have separated the violence levels of various violent games through experimental designs to examine their effects on aggressive tendencies separately (Greitemeyer, 2019) [17]. The present study also examined the effects of separate levels of game violence and their relationship to adolescent engagement on implicit perceptions of aggression and aggressive behavior, which is the main novelty of this study. We will analyze adolescent players' perceptions of aggression in terms of the level of violence in the game.

H3: The level of violence in violent video games that adolescents play has a negative correlation with their' normative cognition of aggressive behavior.

## 4. VARIABLE SPECIFICATION

**Table 1.** Variable Specification

| No. | Name | Type | Measurement | Scale | Source |
|---|---|---|---|---|---|
| V1a | Violent video games market share rate in Canada | Independent Variable | Proportion of sales | Ratio | https://arcabc.ca/islandora/object/mru%3A819/datastream/PDF/view |
| V1b | Violent Video Game Market Share Rate in United State | Independent Variable | Proportion of sales | Ratio | https://arcabc.ca/islandora/object/mru%3A819/datastream/PDF/view |
| V2 | Playing time of violent video games | Independent Variable | Video Game Questionnaire (VGQ) | Interval | Questionnaire survey based on Anderson and Bushman model |
| V3 | The level of violence in violent video games that samplers play | Independent Variable | Violence level score | Ordinal | Ministry of Culture and Tourism of the People's Republic of China |
| V4a | Number of Serious Violent Crimes Committed by Youth in U.S. | Dependent Variable | Number of juvenile delinquency cases statistics total | Ratio | https://www.statista.com/ |
| V4b | Youth Crime Severity Index in Canada | Dependent Variable | Youth CSI | Ordinal | https://www.statista.com/ |
| V5 | Aggressive behavior of adolescent | Dependent Variable | Buss-Perry Aggression Scale (BPAQ) | Ordinal | Questionnaire survey based on Buss and Perry model |
| V6 | The normative cognition of aggressive behavior of samplers | Dependent Variable | The quantitative value of the cognitive coefficient | Ordinal | Questionnaire survey based on Huesmann and Guerra model |

# 5. METHODOLOGY

## 5.1. Hypothesis 1

### 5.1.1. Sample

(1) The independent variable

Sample selecting: Using the share of total video games in the Canadian and U.S. video game markets between 2010 and 2020.

Appropriateness: Because in 2010, the U.S. Supreme Court rejected a law banning the sale of violent video games to minors after the video game industry sued (Sutter, 2010). Restrictions on the sale of violent video games in California were lifted, and the industry in United State began to largely expand.

Definition for sample (market share of violent video game in Canada and U.S): In the United States and Canada, violent video games are classified using the same hierarchical system, based on the level of violence, bloody scenes, sexual content and other factors included in the game. Divide games into different age-appropriate levels: 1. EC (Early Childhood). suitable for children aged 3 years and above. 2. E (Everyone). For players of all ages. 3. E10+ (Everyone 10 and older). Suitable for players aged 10 and older. 4. T (Teen).

Suitable for players aged 13 and over. 5. M (Mature). Suitable for players 17 and older. 6. AO (Adults Only). Suitable for adults only and usually includes adult content. Generally, games with graphic violence and bloody content are classified as T or above. In T games, there is a certain level of violence, but usually not too bloody or cruel, and as the level increases, the level of violence in the games in these categories will become higher and higher.

Thus, it is possible to calculate the proportion of the number of T-rated and above games in the number of all rated games, which is considered as the market share of the violent video games, and compare the year-to-year growth rate of the market shares to reflect the size fluctuations of the violent video game industry.

(2) The dependent variables:

Sample selecting: Using the Canadian juvenile delinquency Severity Index and the number of juvenile violent crimes in the United States.

Appropriateness: Because research has shown that the factor that strongly anticipates illegal and antisocial behavior among minors is aggression in the form of physical aggression, and that there is a significant association between levels of juvenile delinquency and aggression (Barbary, 2017).

Definition for Juvenile Crime in Canada and U.S.: Teens with aggressive behavior often get into juvenile delinquency as well as legal problems as a result of their actions.

Juvenile delinquency is the act of a minor or a person under the age of legal majority who participates in a violation of the law. In the United States, a juvenile delinquent is a person who commits a crime and is under a specific age. Most states designate a juvenile offender or young offender as an individual under the age of 18, while a few states set a slightly different maximum age. In Canadian law, the age of juvenile delinquency is usually between the ages of 12 and 17. Under U.S. and Canadian law, juvenile delinquency includes, but is not limited to, theft, drug-related crimes, violent crimes, arson, sexual assault, and weapons offenses. Laws against juvenile delinquency usually have special procedures and systems to deal with the cases of minors (Hartjen & Shana's, 2013). It should be noted that different from The United States, which directly calculates the number of cases, the Canadian government uses The Youth Crime Severity Index to reflect the characteristics of juvenile delinquency in Canada. The Youth Crime Severity Index (Youth CSI) takes-into account both the volume and the seriousness of youth crime. In the calculation of the Youth CSI, each youth offense is assigned a weight, derived from average sentences handed down by criminal courts. The more

serious the average sentence, the higher the weight for that offense. As a result, more serious offenses have a greater impact on changes in the index. All police- reported youth Criminal Code offenses are included in the Youth CSI.

The number of juvenile crimes in a country can reflect the fluctuation of the number of juvenile aggressive behaviors and the severity of their aggressive psychology to a certain extent. Violent crimes are often committed by attacking individuals to achieve the purpose of crime. Research has shown that the factor that strongly anticipates illegal and antisocial behavior among minors is aggression in the form of physical aggression, and that there is a significant association between levels of juvenile delinquency and aggression (Barbary, 2017). Therefore, juvenile delinquency can reflect their ability to realize aggressive psychology, and the formation mechanism of their aggression can be found from specific criminal behaviors.

#### 5.1.2. Appropriateness of Data Analysis

Correlation Analysis:

The linear regression equation can be used to find the correlation coefficients between

$$y_i = \alpha + \beta x_i + \varepsilon_i .$$

IV and DV, and then the correlation coefficients can be used to determine whether there is an asymmetric causal relationship of the Stimulus-Response type between the two.

The correlation in linear regression equation can directly reflect the functional relationship and correlation relationship between variables. Through the form of one-to-one correspondence, the correlation coefficient between each observation point is found.

Furthermore, various statistical tests are carried out on the reliability of these relations and the significance of the regression coefficient, and the values of one or several variables are used to predict or control the value of another specific variable, and the accuracy of such prediction or control is given.

### 5.2. Hypothesis 2

#### 5.2.1. Sample

(1) The independent variable

Sample selecting: Violent video gameplay time for teenagers.

Appropriateness and definition: The usage time of video games can be measured in the form of survey questionnaire using existing Video Game Questionnaire (Anderson & Dill, 2000). And combining with the Ministry of Culture Tourism of the People's Republic of China, the questionnaire content was newly compiled according to the formula of violent game tendency in China to measure the violent theme content of online games. The game is rated according to the violence of the content, and the higher the score, the more violent. The participants were asked to answer questions about how much time they spent on games with different levels of violence, reflecting their exposure to games.

(2) The dependent variable

Sample selecting: Adolescent feedback on aggressive behavior.

Appropriateness and definition: The aggressive behavior of adolescent can be measured by BPAQ model. In the Buss-Perry Aggression Scale (Buss and Perry, 1992) [18], atotal of 29 questions in the questionnaire cover four dimensions of physical aggression, verbal aggression, anger and hostility.

“One” is completely inconsistent and “five” is completely consistent, with higher scores indicating more aggression.

#### 5.2.2. Data collection

In the data collection session, exposure time to violent games and aggressive behavior toward adolescents are divided into two sections on the same questionnaire. In the first part of the questionnaire, the Video Game Questionnaire (Anderson & Dill, 2000), there have eight questions to be answered, corresponding to eight game categories. Respondents are asked to choose one from a list of six usage intervals for each game categories. According to the order of the six time interval options given, the measurement is scored in the rank order of 0-5 points. Based on the calculation method given by the Ministry of Culture and Tourism, PRC, five different levels of violence of the above eight games categories were obtained. The questionnaire of Anderson & Dill was adapted to make the results more reliable and valid in China. Finally, through the formula: the score of the violent content in the game usage * frequency /5. In the end, the total score was added, and the higher the score, the stronger the exposure to violent games.

In the second part of the questionnaire, respondents were asked to answer 29 questions related to the Buss-Perry Aggression Scale (Buss and Perry, 1992) [18]. The 29 questions of BPAQ were classified and arranged according to the four dimensions of physical aggression, verbal aggression, anger and hostility. Each question is measured on a scale of 1-5 according to the order of the choices, resulting in a score in each of the four dimensions and the total score of the 29 questions. The higher the total score, the more aggressive the behavior. The questionnaire was created on the Credamo platform and then released through WeChat, and 276 valid samples of teenagers aged 10-19 were collected. In the questionnaire, we excluded the questionnaires that contained short responding time which reduced the bias and ensured the authenticity and effectiveness of the questionnaires. In addition, we also set regional gender and other options to narrow the sample and enhance the accuracy.

#### 5.2.3. Appropriateness of Data Analysis

Firstly, using SPSS to conduct Cronbach's alpha, factor loading and model of AVE (Average Variance Extracted) and CR (Composite Reliability) for testing the reliability of the sample data, comparing the contribution degree between the four dimensions and variables, and measuring the internal consistency, which in order to judge the reliability of the questionnaire. Then, descriptive statistics and correlation analysis will be performed to measure the strength of the association between the duration of game use and aggressive behavior.

### 5.3. Hypothesis 3

#### 5.3.1. Sample

(1) The independent variable

Sample selecting: The level of violence in violent video games that samplers play. Appropriateness and definition: The Internet has brought unlimited freedom mainly through the video game industry, which has led to an increase in violent behavior by adolescents (Ružić, 2011) [19]. To distinguish this, violent games are divided into several levels of violence. Violence in games is measured in the same way as in hypothesis 2. According to the measurement of Hypothesis 2, different types of games are assigned to different violence scores to judge their level of violence.

(2) The dependent variable

Sample selecting: The normative cognition of aggressive behavior of samplers.

Appropriateness: The normative cognition of aggressive behavior is measured by the 20-item Normative Beliefs About Aggression Scale (NOBAGS). The correlation between these two variables can be seen from the samplers' scores on the NOBAGS and the level of violence with violent

games they usually play.

Definition for the normative cognition of aggressive behavior: Aggressive behavior is an act of injury, and violence is a physical attack with social significance. It has the function of survival protection and extension of social system value (Novaco, 2017). Normative cognition refers to an individual's beliefs about the extent to which others believe they should or should not behave in a particular way (Normative Beliefs, nd). The relationship between normative cognition and aggressive behavior is measured by the Normative Belief About Aggression Scale (NOBAGS), which uses a 4-point Likert scale survey (1 means "absolutely wrong" and 4 means "absolutely right") and includes 20 items within the survey questions. A higher score indicates a stronger normative belief about aggressive behavior.

#### 5.3.2. Data collection

In the same questionnaire, levels of violence in popular violent games and normative perceptions of aggressive behavior were divided into two sections. In the first part of the questionnaire, 10 mobile games in terms of popularity were selected and assigned a score for violence level, samplers were asked to choose one of the 10 games they frequently played. In the second part of the questionnaire, samplers were asked to answer 20 questions related to the Normative Belief About Aggression Scale, each of which was measured on a scale of 1-4 points. Finally, the scores of each of the 20 questions were added together, the higher the score, the more normative the cognition of aggressive behavior. The questionnaire was created on the Credamo platform and then released through WeChat, and 271 valid samples of teenagers aged 10-19 were collected.

The questionnaire was excluded in the same way as hypothesis 2.

#### 5.3.3. Appropriateness of Data Analysis

Pearson correlation coefficient: The Pearson correlation coefficient is a descriptive statistic, meaning that it summarizes the characteristics of the data set. Specifically, it describes the strength and direction of the linear relationship between two quantitative variables.

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

The Pearson correlation coefficient reflects the degree of linear correlation between two variables.

It quantifies the linear relationship between two variables by calculating their covariance and standard deviation. The value is between -1 and 1, where 1 means completely positive correlation, -1 means completely negative correlation, and 0 means no linear relationship.

# 6. ANALYSIS PROCEDURES AND FINDINGS

## 6.1. Hypothesis 1

### 6.1.1. Hypothesis 1-a

There is a positive correlation between violent video game market share and Youth Crime Severity Index in Canada.

**Table 2.** Linear regression model

| Year | Y | X |
|---|---|---|
| 2010 | 15.63 | 90.01 |
| 2011 | 17.22 | 81.72 |
| 2012 | 19.27 | 77.42 |
| 2013 | 21.45 | 66.16 |
| 2014 | 22.65 | 60.62 |
| 2015 | 26.54 | 60.42 |
| 2016 | 27.55 | 59.89 |
| 2017 | 27.96 | 62.68 |
| 2018 | 28.14 | 56.58 |
| 2019 | 29.74 | 55.10 |
| 2020 | 29.85 | 43.02 |

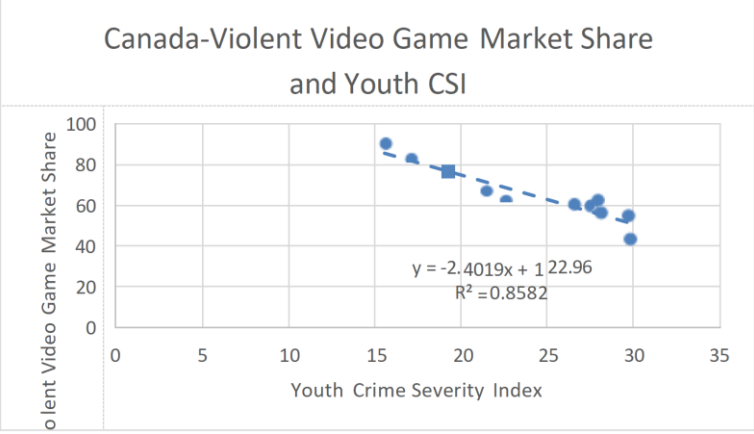


**Figure 2.** Canada-Violent Video Game Market Share and Youth CSI

This is a two-variable statistic. Independent Variable is Violent Video Game Market

Share in Canada, dependent variable is Youth Crime Severity Index in Canada, from 2010 to 2020.

**Table 3.** Residuals Statistics

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 51.2604 | 85.4148 | 64.8745 | 12.37376 | 11 |
| Residual | -8.24039 | 6.88011 | .00000 | 5.03061 | 11 |
| Std. Predicted Value | -1.100 | 1.660 | .000 | 1.000 | 11 |
| Std. Residual | -1.554 | 1.297 | .000 | .949 | 11 |

a. Dependent Variable: The Youth Crime Severity Index in Canada between 2010 and 2020.

Causal Relationship Analysis: According to the correlation coefficient r, there is a strong negative correlation between the increasing market share of violent video games in Canada and the value of Youth Crime Severity Index in Canada. The Youth Crime Severity Index in Canada between 2010 and 2020. r = 122.956 - 2.402 * Violent video games' share of total Canadian gaming market share.

Based on the results of the above regression analysis, the relationship between Canadian the Youth Crime Severity Index in Canada between 2010 and 2020.and Violent Video Games' share of the total Canadian gaming market is presented below:

Controlling for other variables held constant, the mean value of the Youth Crime Severity Index in Canada between 2010 and 2020.r is expected to be 122.956. the coefficient of violent video games'

share of the total Canadian gaming market is -2.402, p<0.001, indicating that this coefficient is statistically significant. This means that violent video games' share of the Canadian gaming market negatively and significantly predicts the Youth Crime Severity Index in Canada between 2010 and 2020. i.e., an increase in the market share of violent video games in Canada significantly predicts a decrease in Canadian Youth CSI. The range of the residuals is from -3.138 to -1.666, which indicates that the range of variation of the residuals is small, the model fits well, and the effect of violent video game market share on the Youth Crime Severity Index in Canada between 2010 and 2020. is more stable.

In conclusion, there is a negative relationship between the share of violent video games in the Canadian gaming market and the Youth Crime Severity Index in Canada between 2010 and 2020.

### 6.1.2. Hypothesis 1-b

There is a positive correlation between violent video game market share and number of serious violent crimes committed by youth in U.S..

**Table 4.** Linear regression model

| Year | Y | X |
|---|---|---|
| 2010 | 15.63 | 90.01 |
| 2011 | 17.22 | 81.72 |
| 2012 | 19.27 | 77.42 |
| 2013 | 21.45 | 66.16 |
| 2014 | 22.65 | 60.62 |
| 2015 | 26.54 | 60.42 |
| 2016 | 27.55 | 59.89 |
| 2017 | 27.96 | 62.68 |
| 2018 | 28.14 | 56.58 |
| 2019 | 29.74 | 55.10 |
| 2020 | 29.85 | 43.02 |

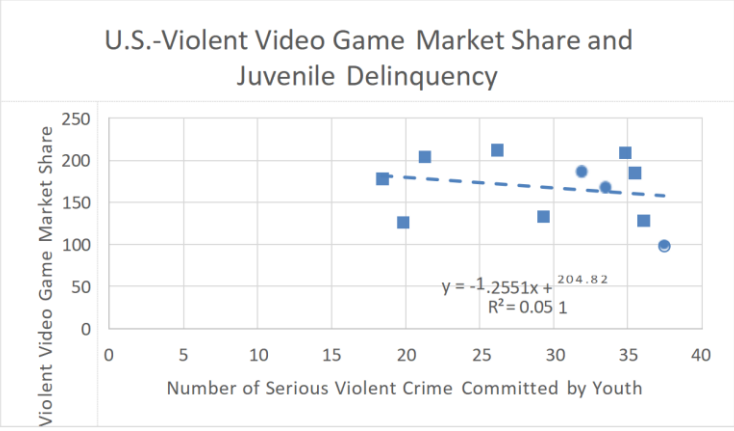


**Figure 3.** U.S.-Violent Video Game Market Share and Juvenile Delinquency

**Table 5.** Residuals Statistics

| | Minimum | Maximum | Mean | Std. Deviation | N |
|---|---|---|---|---|---|
| Predicted Value | 157.7763 | 181.6483 | 167.8000 | 8.75177 | 11 |
| Residual | -57.77632 | 49.89767 | .00000 | 37.76992 | 11 |
| Std. Predicted Value | -1.145 | 1.582 | .000 | 1.000 | 11 |
| Std. Residual | -1.451 | 1.253 | .000 | .949 | 11 |

a. Dependent Variable: The number of serious violent crimes committed by youth in United State between 2010 and 2020.

This is a two-variable statistic. Independent Variable is Violent Video Game Market Share in U.S., dependent variable is Number of Serious Violent Crime Committed by Youth in U.S., from 2010 to 2020.

Causal Relationship Analysis: According to the correlation coefficient r, there is a slightly negative correlation between the increase in the market share of violent video games in the United States and the number of serious violent crimes committed by youth in the United States.

The number of serious violent crimes committed by youth in United State between 2010 and 2020. = 204.817 - 1.255 * Violent video games' share of total U.S. gaming market share Controlling for other variables held constant, the mean value of American number of serious crimes committed by youth is expected to be 204.817. The coefficient on violent video games' share of the total American gaming market is -1.255, p=0.505 > 0.05, indicating that this coefficient is not statistically significant. This implies that violent video games' market share of the U.S. gaming market does not significantly predict the number of serious violent crimes committed by youth in United State between 2010 and 2020. However, the residuals range from -57.77632 to 49.89767, suggesting that the residuals have a large range of variation and that there maybe other unconsidered factors that have an impact on American number of serious crimes committed by youth.

Based on the results of the current regression analysis, the relationship between violent video games' share of the U.S. gaming market and the number of serious violent crimes committed by youth in United State between 2010 and 2020 is not statistically significant. However, more research is needed to delve into other factors that may influence the number of serious violent crimes committed by youth in United State between 2010 and 2020.

## 6.2. Hypothesis 2

There is a significant positive correlation between violent game usage and Anger, Physical aggression, Hostility and Verbal aggression.

**Table 6.** Cronbach's α Coefficient Table

| | Numbers of questions | Cronbach's α Coefficient |
|---|---|---|
| Anger | 7 | 0.727 |
| Physical aggression | 9 | 0.812 |
| Hostility | 8 | 0.848 |
| Verbal aggression | 5 | 0.741 |
| Violent game usage | 8 | 0.608 |

According to the Cronbach's α coefficient, the Cronbach's α coefficient of each variable is greater than 0.6, indicating that the questionnaire has good reliability and certain reliability.

According to the factor loading, the factors of anger, physical aggression, hostility, verbal aggression and violent game usage can be effectively extracted.

**Table 7.** AVE and CR

| Factor | Average variance extraction AVE value | Combined reliability CR value |
|---|---|---|
| Anger | 0.322 | 0.745 |
| Physical aggression | 0.335 | 0.816 |
| Hostility | 0.419 | 0.85 |
| Verbal aggression | 0.366 | 0.742 |
| Violent game usage | 0.195 | 0.605 |

The AVE and CR test results of the model show that: The AVE value of anger is 0.322, less than 0.5, and the CR value of the combination reliability is 0.745, greater than 0.7, indicating that the extraction degree of measurement indicators within the factor is good.

The AVE value of physical aggression is 0.335, which is less than 0.5, and the CR value of combination reliability is 0.816, which is greater than 0.7, indicating that the extraction degree of measurement indicators within the factors is good.

The AVE value of hostility is 0.419, which is less than 0.5, and the CR value of combination reliability is 0.85, which is greater than 0.7, indicating that the extraction degree of measurement indicators within the factors is good.

The AVE value of verbal aggression is 0.366, which is less than 0.5, and the CR value of combination reliability is 0.742, which is greater than 0.7, indicating that the extraction degree of measurement indicators within the factors is better.

The AVE value of game usage is 0.195, which is less than 0.5, and the CR value of combination reliability is 0.605, which is less than 0.7, indicating that the extraction degree of measurement indicators within the factors is general.

In conclusion, the reliability and validity ofthe questionnaire are good, and further data analysis can be conducted.

**Table 8.** Descriptive Analysis

| Variables | Maximum | Minimum | Mean | Standard Deviation | Median | Variance |
|---|---|---|---|---|---|---|
| Violent game usage | 31.8 | 0 | 15.354 | 6.095 | 14.4 | 37.148 |
| Anger | 31 | 7 | 20.333 | 4.45 | 20 | 19.801 |
| Physical Aggression | 41 | 9 | 25.435 | 6.254 | 26 | 39.112 |
| Hostility | 40 | 8 | 23.022 | 6.008 | 24 | 36.094 |
| Verbal Aggression | 25 | 5 | 14.913 | 3.48 | 15 | 12.109 |

From descriptive analysis, we can see that the mean of violent game usage is 15.354, the maximum is 31.8, and the minimum is 0. The mean of Physical aggression is the largest and Verbal aggression is the smallest.

**Table 9.** Correlation Analysis

| | Violent game usage | Anger | Physical Aggression | Hostility | Verbal Aggression |
|---|---|---|---|---|---|
| Violent game usage | 1(0.000***) | 0.271(0.000***) | 0.331(0.000***) | 0.293(0.000***) | 0.257(0.000***) |
| Anger | 0.271(0.000***) | 1(0.000***) | 0.667(0.000***) | 0.619(0.000***) | 0.575(0.000***) |
| Physical aggression | 0.331(0.000***) | 0.667(0.000***) | 1(0.000***) | 0.732(0.000***) | 0.584(0.000***) |
| Hostility | 0.293(0.000***) | 0.619(0.000***) | 0.732(0.000***) | 1(0.000***) | 0.687(0.000***) |
| Verbal aggression | 0.257(0.000***) | 0.575(0.000***) | 0.584(0.000***) | 0.687(0.000***) | 1(0.000***) |

Note: ***, ** and * represent significance levels of 1%, 5% and 10% respectively

The correlation analysis illustrates that the correlation coefficients between violent game usage and Anger, Physical aggression, Hostility and Verbal aggression are 0.271, 0.331, 0.293 and 0.257, respectively, and the significant P-value is less than 0.05. Therefore, there is a significant positive correlation between violent game usage and Anger, Physical aggression, Hostility and Verbal aggression.

### 6.3. Hypothesis 3

The level of violence in violent video games that adolescents play is negatively associated with adolescents'normative cognition of aggressive behavior.

Pearson Correlation Coefficient Method: X Values refer to the scores of each participant from the Normative Beliefs About Aggression Scale (NOBAGS) survey. Y Values are defined as the level of violence of violent video games played by each participant.

Causal Relationship Analysis: According to the correlation coefficient r, which is -0.225, there is a weak negative correlation between the level of violence in violent video games that adolescents play and their' normative cognition of aggressive behavior. Based on the results of the above Pearson Correlation Coefficient analysis, the relationship between the level of violence in violent video games that adolescents play and their' normative cognition of aggressive behavior.is presented below:

Controlling for other variables held constant, the mean value of the scores of each participant from the Normative Beliefs About Aggression Scale (NOBAGS) survey and the level of violence of violent video games played by each participant is -2178.483. The coefficient r is -0.225, $p = 0.000188$, indicating the statistical significance of the observed difference is large. This means that the level of violence in violent video games that adolescents play has a weak negative correlation with their'normative cognition of aggressive behavior, which shows a higher standard of normative cognition of aggressive behavior related to playing less violent video games.

In conclusion,there is a weak negative relationship between the level of violence in violent video games that adolescents play and their'normative cognition of aggressive behavior. However, the weak correlation cannot be the direct evidence proving that there is a causal relationship between the level of violence in violent video games that adolescents play and their' normative cognition of aggressive behavior. The limitations and the bias of this study will be further discussed in the discussion.

## 7. DISCUSSION AND RECOMMENDATIONS

### 7.1. Theoretical Distribution

This study contributes to bringing the gap in understanding the relationship between violent video games and teenager behavior. In our study, it can be seen that hypothesis one (But Violent Video Game Market Share in U.S., and Number of Serious Violent Crime Committed by Youth in U.S. There is a weak negative correlation) and three both indicate that there is a negative correlation between violent video games and teenager aggressive behavior. In contrast, hypothesis two figure out that increasing time of playing violent video games will foster juvenile crime rate.

Building on this, the hypothesis one and three shares similarities with the theory of Przybylski & Weinstein (2019), particularly regarding hypothetical of the same association between the popularity of violent video games and levels of juvenile aggression. However, the results of hypothesis two in keeping with the viewpoint of Ferguson (2008),providing a new and more objective perspective and questioning established beliefs. From the discussion, one may conclude that violent video games may not affect teenager aggressive behavior, which conflicts the hypothesis.

### 7.2. Limitations

One concern about the finding is that, three hypotheses sample consists of teenagers in China, Canada and America, which may introduce a significant bias in the study of teenager aggressive behavior by assuming that these three countries extends to the entire adolescence population. Therefore, the representative of juvenile crime rate is insignificant. besides, in hypothesis one, the time spans only 10 years (2010-2020), which may not capture a long-term fluctuation in this relationship. Additionally,

teenager crime rate is affected not only for violent video games, but also multiple factors, while the study is not excluded the external factors.

About the measurement instrument, in hypothesis one, the measurement in America and Canada are different, the method of Crime Severity Index and Number of Serious Violent Crime Committed. Moreover, the method of issuing the survey contains several biases, which involve social desirability bias and acquiescence bias, especially on the sensitive topic of violence. Social desirability bias refers to the respondents answering the questions with answers that they think might be viewed favorably by others. The word "Violence" often symbolizes a negative meaning towards society, so the respondents maybe more likely to give answers that attempt to demonstrate a higher level of cognition of aggression, which leads to some social desirability biases

### 7.3. Recommendations and Future Research

The correlation represents that violent video games popularity results in higher juvenile crime rate. Future study should enhance the representativeness and generalizability of findings. The sample of two countries youth should be expanded to more than three countries teenagers, fostering the data applicability and universalized. The potential variables (family, educations etc.) should be controlled to avoid the external influence. In our further study, for our design of questionnaire, we can improve our survey by asking neutral questions, avoiding leading questions, emphasizing anonymity, and including red herrings.

## 8. CONCLUSION

The main findings obtained from this research are as follows.

1) The share of violent video games in the Canadian gaming market is a negative and significant predictor of the Youth Crime Severity Index in Canada from 2010 to 2020. The relationship between the share of violent games in the U.S. gaming market and the number of serious violent offenses committed by U.S. youth from 2010-2020 has a weak negative correlation.

2) There is a significant positive correlation between violent game usage and Anger, Physical aggression, Hostility and Verbal aggression.

3) There is a weak negative relationship between the level of violence in violent video games played by adolescents and their normative perceptions of aggressive behavior.

To answer the objective research question, combining the results of the data and the influence of various complex mediators, we can infer that the growth of violent video games market is not the only direct cause of aggression in juvenile, although there maybe a stimulus-response relationship between them in a certain extent.

The literature on the relationship between video games and violence and behavior in virtual reality is in its infancy. Caution should be exercised when attempting to draw definitive conclusions from this particular literature due to its very small frame ofreference and many methodological problems and inconsistencies.

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