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Abstract

Throughout the past decade, numerous states have passed legislation to prohibit the sale of violent video games to children, usually in conjunction with an argument that exposure to violent media increases violent behavior. However, the link between video games and violence is not yet fully understood. This study uses propensity score matching as a method to more adequately address the underlying issue of causality. Using a sample of 6,567 8th grade students, these analyses test whether there is a causal link between playing violent video games and violence, non-violent deviance and substance use. Results indicate a substantial decrease in the relationship between video games and these outcomes when a matched sample is used. This suggests that the strength of evidence supporting a relationship has likely been overestimated using other methodologies.

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Causal or spurious: Using propensity score matching to detangle the relationship between violent video games and violent behavior

1.1 Introduction

Two parallel lines bounce a small white ball back and forth, a yellow circle eats little pellets while being chased by ghosts, an ethnic carpenter evades barrels thrown by a giant ape in an attempt to save a woman in distress. Early video games such as Pong, Pac-Man and Donkey Kong elicited sparse concern that video games were corrupting youth and causing anti-social behavior except, perhaps, being a waste of children's time. However, advances in video game design have led to ever increasing realism in today's video games. The narrowing gap between video games and reality, in terms of graphics at least, has resulted in increased concerns that playing violent games may increase destructive behavior in youth and gamers in general. A number of theoretical reasons exist for why video games may increase violence more than other forms of media, such as television. Dill and Dill [1] list a number of these potential reasons, including that video games: offer immediate rewards and punishments for committing delinquent acts in the game such as continuing to the next level for killing an opponent, are a form of symbolic aggression that conditions players to commit aggressive acts, increasingly show more lifelike characters, and allow the player to identify with the aggressor as they are controlling the character committing the violent acts such as in first person shooter games where the player sees through the eyes of the character they control.

Between 2002 and 2010, thirteen states introduced legislation prohibiting the sale of violent video games to children. The exact details of the laws vary from state to state, both in terms of what is restricted (e.g., games with a certain rating, games with specific violent acts, etc.) and how the law is enforced. The one thing all of these states have in common is that each law was later overturned by a district or appeals court as being unconstitutional as a violation of the first amendment, with video games cited as protected speech [2]. Ultimately, the Supreme Court of the United States ruled that video games were protected free speech and that scientific evidence of a danger from them was overstated. In writing for the majority, Justice Scalia wrote, "These studies... do not prove that violent video games cause minors to act aggressively... [instead] they show at best some correlation between exposure to violent entertainment and minuscule real-world effects..." [3, p. 12-13]. The problem with these correlations is that they do not necessarily establish causality and require further testing to determine whether the video games actually *cause* violence. This study seeks to detangle correlation from causality and, through empirical tests, determine the true substantive effect of violent video games on real-life violence and other deviant acts.

2.1 The Empirical Link between Video Games and Deviance

The academic literature on the topic the media influence of violence is somewhat fractured between those who contend that exposure to violent media increases antisocial behavior and those that claim exposure to violent media has no deleterious effects. Anderson and Bushman [4], in a meta-analysis of the existing literature on video games and violence, found that exposure to video game violence is associated with higher levels of aggression. Their results were supported by another meta-analysis [5] on the literature from 1975-2000 that also reported a relationship between violent video game play and aggression. The study did note, however,

that the effect size of video games was smaller than that of other media influences and was generally weak.

A number of laboratory experiments have also been conducted to examine the relationship between video games and aggression. One such study [6] explored how exposure to video game violence affected aggression by having two groups of males play either a first-person shooter game or a non-violent puzzle game. After playing these games, participants then compete with another opponent in a test to measure reaction time, with the loser being administered a blast of noise, the intensity and duration of which is decided by the winner. The authors found that those who played the violent video game administered longer and louder noise blasts than those who played the non-violent video game. Another laboratory study [7] found that playing violent video games has a physiological desensitizing effect, with those who had played a violent video game being less physiologically aroused when shown a video tape of real violence. Though generally supportive of a link with violence, these studies only account for aggression and desensitization that occurs shortly after playing video games and cannot test for lingering effects that remain after playing a violent video game.

A handful of longitudinal studies looking at video games and violence have been conducted in recent years. These studies have generally shown that playing violent video games at time 1 is correlated with aggression or violence at time 2 of the study. In a study consisting of three independent samples of youth in Japan and the United States, Anderson et al. [8] found that after the initial survey, youths who habitually played violent video games had higher levels of aggression 3 to 6 months later during the second wave of the study. The relationship between exposure to violent video games was further explored by Moller and Krahe [9] who found that violent video game play at time 1 was related to physical aggression, but not indirect/relational aggression, six months later at time 2. While these studies begin to address the issue of time-order between violent videogame play and aggression, the non-experimental nature of these studies leaves the causality of the relationship in question. Additionally, though technically longitudinal because they measure over multiple timepoints, these studies have generally not been long-term in that the effects of video games, if real, would take years to manifest rather than months.

In addition to the above studies, other research has also been published indicating an absence of correlations between video games and violence in both laboratory and survey designs [for examples, see 10,11,12,13,14). There have also been disconfirming longitudinal studies [15,16]. Another study reported that results varied by gender, with boys no more or less likely to bully others based on exposure to violent games [17]. Overall, research has provided evidence both supporting a correlation and failing to support a correlation.

2.2 Video Games and the Non-Violent Evils

Though there appears to be some relationship, causal or otherwise, strong or weak, between exposure to violent media and committing violent acts, there is less research on the possible link between violent video games and non-violent delinquent acts, such as cheating, skipping school, stealing, vandalism, and breaking and entering among youth. One study of 10-14 year olds found that violent video game exposure was not related to non-violent delinquent behavior [13]. There is, however, some evidence to suggest that playing violent video games may be correlated with non-violent delinquency in older individuals. In a survey and laboratory experiment conducted on undergraduates in a Midwestern University, Anderson and Dill [18]

discovered that those who reported more exposure to violent video games also reported higher levels on nonaggressive delinquency at a statistically significant level.

Another form of problem behavior that may be related to violent video games is substance abuse. One study [19] found that problematic game use was associated with increased odds of smoking regularly, depression, getting into a serious fight, drug use (other than alcohol and marijuana), and carrying a weapon to school. Others, however, have reported finding no such relationships with substance use [20].

2.3 *The Missing Causal Link*

Based on empirical research, one's conclusion for whether there is a link between video games and violence depends very much on how critical one is of the research. Indeed, in a recent meta-analysis, one group of authors concluded that there is a clear and strong relationship between video games and aggressive behavior [21]. Yet, a response to the meta-analysis argued that the authors ignored issues of causality, such as third variables that could relate to a spurious relationship [22]. A recent article in *The Criminologist* summed the research by stating that "the research linking violent video games with youth violence is weak, inconsistent and beset with methodological problems" [23, p. 19].

It is the "methodological problems" aspect that is under scrutiny in this study. Specifically, prior studies generally have either: a) use experimental designs to test whether video games have a short-term effect on behavior, or b) use a survey design to test whether video games are correlated with violence. Though there are undoubtedly benefits to using these designs over lacking empirical tests, these designs by themselves do not provide the entire picture of causality. Specifically, the experimental designs are generally short-term studies designed to associate video games with increases in aggression or other attributes associated with violence. This design, however, does not necessarily translate to real-life violence outside laboratory conditions. Just as playing sports might increase aggression concurrently, these effects may be short lived and long-term experiments are generally impractical for both ethical and fiscal reasons. Conversely, the survey designs do often measure real-life violence or aggressive behavior. They, however, do so by forsaking the ability to show causality. Because correlations merely show a statistical connection, they are unable to indicate the nature of that relationship. Indeed, it could be concluded, using the same data, that violence causes someone to turn to video games or, more plausibly, that some other antecedent or personal characteristic results in an attraction to both violent video games and violent behavior, making the correlation spurious. In order to establish video games as a criminogenic factor, an empirical design is needed that incorporates both a measure of real-life behavior and some way to establish a causal relationship beyond mere correlations.

3.1 The Current Study

This study will estimate whether playing violent video games produces real-life behavioral differences by using propensity score matching, a quasi-experimental estimation technique that will later be more fully described. Two hypotheses will be tested with these analyses. First, that children who play violent video games are more likely to engage in violent or otherwise deviant behavior (a correlation). Given prior research on the subject that has found such a correlation [e.g., 5], it can be expected that this hypothesis will likely be supported. Second, that playing violent video games increases the likelihood of engaging in violent or deviant behaviors (causation). This hypothesis is the one that remains largely understudied, as

testing for causality rather than correlation requires a methodological approach more rigorous than prior research has provided. Though the present study is unable to provide the long-term experimental design that is necessary to truly test this hypothesis, the propensity score matching quasi-experimental design brings research one step closer towards a test of causality. Additionally, these hypotheses will also be tested for nonviolent deviance and substance use. Prior research has only rarely examined non-violent deviance as a potential product of violent video games [e.g., 19], so more fully examining negative outcomes such as pre-violent behavior is a logical expansion.

4.1 Methods

The data used for this study come from the 2008 Delaware School Survey, a survey of students in public and public-charter schools in the state of Delaware between January and May 2008. The sampling procedure is a census of all willing students in 5th, 8th, and 11th grade classrooms who are present on the day of administration. Students in select classrooms (about one fourth of classrooms), however, were asked to take a different survey instead. The data used here come from 8th grade students.¹ Overall, 7,706 students were enrolled in the classrooms selected for the main survey. Of those students, 6,629 were present on the day of survey administration, 62 of whom (<1%) refused to participate or were asked not to participate by a parent (parental consent for the survey is passive), resulting in a sample of 6,567 (an 85% response rate). The resulting sample was 48% male and 52% female. The racial breakdown of the sample was relatively representative of population, and is 49% non-Hispanic White, 27% non-Hispanic Black, 11% Hispanic, and 13% other/mixed.

4.2 Variables

The indicator used for the independent variable is a dichotomous variable measuring whether the participant had played “video games rated ‘M’ or ‘Mature?’”² within the past month. Approximately 4% of students did not answer this question and are excluded hereafter.

The dependent variables include three categories of deviant behavior: non-violent, violent, and substance use. The non-violent questions include six measures, asking whether participants: “Cheat on a test in class,” “Skip or miss classes (not the whole school day) without permission,” “Steal something from a store without paying for it,” “Sneak money from an adult's wallet, purse, or other place,” “Damage or destroy property that does not belong to you,” and “Break into a car, house or other building?” The violent questions include five measures, asking

¹ The design, results and conclusions presented here were also used with 11th grade student data. Though not shown here to conserve space and for simplicity, these results produce roughly the same substantive conclusions. The 11th grade male gamers (matched sample) were slightly more likely to be in a group fight or carry a weapon, but no higher for hitting, taking a weapon to school, or carrying a gun. In the 11th grade matched data, neither males nor females were significantly higher for violence overall. These results are available from the authors upon request.

² This measure is, admittedly, limited in two ways. First, most but not all M-rated games are violent and not all violent games are rated M. However, using an objective rating system is, arguably, preferable to a more subjective description of violence. For example, children more accustomed to seeing violence may be less likely to rate a game as violent. This objective measure is less prone to interpretation difference. Generally, M-rated games are more likely to include violence and more likely to have more extreme violence. Second, the measure does not address the amount of time spent playing violent video games. Unfortunately, this latter limitation was a necessary concession for including the question on this large omnibus survey. Other studies have similarly used the M-rating as a proxy for exposure to violent video games [e.g., 17].

participants whether they: “Hit someone with the intention of hurting them,” “Take part in a fight where a group of your friends are against another group,” “Carry a weapon other than a gun,” “Take some kind of weapon to school or to a school event,” and “Carry a gun when you're not in school.” The response categories for these the non-violent and violent questions indicated different timeframes during which one might have partaken in these activities. They coded here as dichotomous variables indicating whether the participant had engaged in the behavior in the past year.

The final category of questions, substance use, included three questions. Each question asked participants about a specific substance related behavior in the past month and addressed cigarettes, alcohol and marijuana. These variables are used here separately as dichotomous measures of whether the participant had used each substance at all during the past month. In addition to the 14 indicators of specific deviant behaviors, three overall measures were created for each category. These indicate whether a participant reported that they had engaged in *any* of the behaviors listed within each category (0 = did not, 1 = did engage in at least one behavior in that category).

4.3 Analyses

The first hypothesis to be tested asserts that children who play violent video games are more likely to engage in deviant behavior. This relationship will be tested using standard two-tailed significance tests comparing the means (prevalence rates) between students playing violent video games and those not. The second hypothesis presents a greater difficulty in testing given that it demands support for causation rather than mere correlation. To accomplish this, students playing violent video games will be matched with students not playing violent games using propensity scores. This approach has been previously used in testing for causality from media influences for other proposed relationships. Steinberg and Monahan [24], for example, used it to test the effect of sexuality in the media on youth sexual behavior.

First proposed by Rosenbaum and Rubin [25], matching participants using propensity scores is an approach that can create quasi-experimental data from otherwise non-experimental data. The ultimate goal of propensity score methods is to reduce the selection biases in analyses involving a variable that indicates some sort of self-selection by the participant [26]. In the case of this study, participants who play violent video games presumably do not do so at random. There is theoretically an underlying personality trait or traits that cause some children to desire playing violent video games and others to not. There may also be biases caused by external factors as well, such as parents who do not permit playing such video games. These and other factors may result in a correlation between playing violent video games and violent behavior that is spurious, not causal. Phrased differently, it is possible that children who engage in violent behavior are more attracted to violent video games. Matching participants with propensity scores offers the ability to at least partially eliminate such biases.

The first step of propensity score matching is to estimate a propensity score for each case [27]. To accomplish this, a logit regression is performed with the treatment variable as the dependent variable and all control variables as its predictors. These controls need not be theoretically related to the treatment variable, as long as they do not form a tautological relationship with either the treatment variable, or the variables the treatment variable might affect. The predicted probability of being in the treatment group (the propensity score) is then

retained for matching purposes. In the case of this study, 154 additional variables from the omnibus survey were used for predicting whether a participant played violent video games.³

Once propensity scores are obtained, there are various techniques/algorithms that can be used for matching participants. The algorithm used here is the SAS Greedy 5→1 Digit Matching Macro [28], which is a form of caliper matching often used for propensity score matching. The macro first sorts cases randomly. It then pairs the first treatment case with the first control case with a similar propensity score within a very specific caliper (.00001). The matched pair is segregated and the process repeats to identify the next pair. After all possible pairs within the caliper are identified, the macro increasingly broadens the caliper used in each successive phase. For purposes of this study, caliber matches were only continued until all matches within .01 of each other were identified. Essentially, the process takes a randomly selected participant who did play violent video games, matches it to a very similar person who did not, and repeats until all close matches are found. These matched pairs will be analyzed using a paired-sample t-test, and results will be compared to the pre-matched results. Though few studies have examined gender differences in video game effects, research has indicated that they may exist [17]. Therefore, all processes and analyses are fully segregated by gender, thus controlling for gender differences in both the propensity and the outcomes.

5.1 Results

The results for the unmatched sample are presented in Table 1. The first set of columns displays the prevalence rates for males based on whether they do or do not play violent video games. Those who do play violent games are clearly more likely to engage in deviant behavior than those who do not. In fact, they have higher prevalence rates for each of the 14 measures of deviance. Overall, in comparison to males who have not played violent games, males who play violent video games are 67% more likely to engage in non-violent deviant behavior, 63% more likely to commit a violent crime or a crime related to violence, and 81% more likely to have engaged in substance use.

The results for females, presented in the second set of columns in Table 1, indicate a similar relationship. Among females, those who play violent games are 38% more likely to engage in non-violent offenses, 69% more likely to report violent behaviors, and 65% more likely to use substances. Overall, while these differences for females are not as large as the ones for males, they are also significant for each of the 14 indicators. Thus, the results here clearly support the hypothesis that children who play violent video games are more likely to engage in violent or otherwise deviant behavior. Given the strength of the correlation between violent games and deviant behavior, it is understandable that the popular media and policy makers have inferred causality. However, such an inference from these statistics is premature. These results do not eliminate the possibility that the correlation is spurious. To test for causality, additional methodological rigor is necessary.

³ To conserve space, the 154 variables used in the creation of propensity scores are not discussed in this article. General categories for these questions included: demographic information, parental/family and peer characteristics, perceptions of school and school safety, victimization, impulsivity, perceptions of various health risks, and various other areas. A list of the questions used is included as an appendix. Due to the large number of variables, many participants did not provide a response for every question being used. Mean replacement was used to address this, but only for the purpose of creating propensity scores.

Table 1: Percent reporting deviant behaviors by violent video game use (unmatched sample)

		Males		Females	
		Non-Violent	M-Games	Non-Violent	M-Games
Non-Violent	Cheated	23.5	40.8*	33.8	45.7*
	Skip School	9.6	18.6*	14.5	27.2*
	Shoptlifted	9.2	20.3*	11.4	19.4*
	Stole	6.9	13.3*	9.6	17.5*
	Vandalized	12.8	32.6*	15.0	28.2*
	Break & Enter (Overall)	3.1 35.4	7.0* 59.1*	1.9 46.1	3.7* 63.6*
Violent	Hit Someone	22.0	41.5*	24.7	40.8*
	Group Fight	12.7	26.4*	11.3	23.6*
	Carried a Weapon	14.0	25.2*	2.8	9.9*
	Take Weapon	3.3	7.2*	1.4	3.6*
	Carried a Gun	6.6	12.9*	1.1	3.6*
	(Overall)	33.6	54.9*	30.0	50.6*
Substance Use	Cigarettes	4.1	8.7*	6.4	12.9*
	Alcohol	12.5	23.2*	20.5	33.4*
	Marijuana	6.6	12.8*	7.3	13.5*
	(Overall)	15.3	27.7*	22.9	37.8*
Sample Size		616	2,355	2,137	1,078

* $p < .05$

As already discussed, the next set of analyses use propensity score matching to create quasi-experimental analyses that are capable of more directly addressing possible causality. Because this procedure requires matched pairs, and because there is not an even split between gamers and non-gamers in the sample, the sample will be reduced for these analyses. Among the males in the study, 2,355 had played violent video games in the past month, while 616 had not, thus making the maximum number of pairs 616. Limiting the matches to a caliper difference of .01 in the propensity score resulted in 535 matches for male participants. Among the females in the study, 1,078 had played violent video games in the past month, while 2,137 had not, thus making the maximum number of pairs 1,078. Limiting the matches to a .01 difference in the score resulted in 873 matches for female participants. Overall, out of a possible 1,694 pairs, 1,408 pairs (83%) were matched.

With quasi-experimental matched pairs, the analyses were estimated with paired-sample t-tests. The results for these analyses are presented in Table 2, with the results for males listed in the first set of columns. In sharp contrast to the previous results, most relationships between playing violent games and deviant behavior are non-significant for males in these analyses. Males who played violent games experienced only a slightly higher likelihood of engaging in non-violent (10%) and violent (5%) deviant behaviors. Importantly, none of the relationships, neither with specific indicators nor with an overall category measure, are significant. For substance use, the findings actually support that playing violent video games may be beneficial. Though there was no significant difference overall in substance use, males who played violent games were significantly less likely (47%) to report having smoked marijuana in the past month.

Table 2: Percent reporting deviant behaviors by violent video game use (matched sample)

		Males		Females	
		Non-Violent	M-Games	Non-Violent	M-Games
Non-Violent	Cheated	26.9	30.8	41.3	43.6
	Skip School	10.8	10.4	20.2	24.2*
	Shoplifted	10.6	13.1	16.7	17.7
	Stole	7.7	6.7	13.5	15.4
	Vandalized	18.3	18.0	21.8	25.5
	Break & Enter (Overall)	3.6 40.0	3.6 44.2	3.0 56.8	2.4 59.8
Violent	Hit Someone	23.8	26.2	34.3	36.7
	Group Fight	14.3	14.9	15.5	19.6*
	Carried a Weapon	14.7	15.7	4.4	7.3*
	Take Weapon	3.7	4.7	2.1	2.8
	Carried a Gun	6.9	6.7	1.5	2.5
	(Overall)	36.9	38.4	40.7	45.8*
Substance Use	Cigarettes	4.6	3.2	9.8	10.1
	Alcohol	13.5	12.8	26.8	30.2
	Marijuana	7.6	4.0*	11.8	11.3
	(Overall)	16.8	15.0	30.5	33.3
Sample Size		535	535	873	873

* $p < .05$

Overall, the findings for males fail to support the hypothesis that playing violent video games increases the likelihood of engaging in violent/deviant behaviors. Specifically, none of the 14 measures used for deviant behavior indicated any significant differences caused by playing violent games for boys. This lack of significance is important, as it supports the assertion that the correlation between violent video games and violent behavior may be spurious, or at least partially spurious. These data suggest that there are no significant difference between gamers and non-gamers after controlling for personality and background differences. Thus suggesting that the differences in behavior are the result of the type of personality attracted to playing violent video games, not the actually video games themselves.

These analyses were also performed for the female sample and are presented in the second set of columns in Table 2. Though the results overall suggest a similar trend as the one found for boys, the analyses for girls are not as strongly supportive of pure spuriousness among the correlations. Aside from girls playing violent video games being more likely to skip school, non-violent deviant behavior and substance use both indicate overall that playing violent video games does not result in a significant increase in these behaviors. The violence measures, however, do appear to support the hypothesis that playing violent video games increases the likelihood of violent behavior. Female gamers were 7% more likely to hit someone, a non-significant difference. However, they were 26% more likely to take part in a group fight and 66% more likely to carry a weapon in general, both significant differences. Playing violent video games appeared to have no significant effects on taking a weapon to school or carrying a gun,

both relatively rare behaviors for girls. Overall, playing violent video games appears to increase the likelihood of violent behavior by 12% for female students.

It is important to note, however, that this does not mean that using the propensity score matching technique did not affect the correlation between violent games and violence for girls. Comparisons between the unmatched and matched results are presented in Table 3. For males, many of the relationships between violent games and deviant behavior were fully explained through propensity score matching and the rest were partially explained to the point of no longer retaining significance. For females, this is still partially true. Aside from skipping school, relationships in all non-violent forms of deviance and substance use were reduced to non-significance. Even for violence, the one consistent effect from violent video games that remains for girls, most of the relationship between gaming and violence was explained through the use of propensity score matching to control for personality and background. In fact, all relationships were cut by at least half after using the matched sample. Thus, while there remains a significant effect for females it is not as powerful as suggested by the correlation alone.

6.1 Discussion

Video games and their potential connection to real-life violence have been the subject of much debate in recent years. Though some research has indicated an empirical correlation [e.g., 4,5] and a relationship with short-term aggressive behavior [e.g., 6], other studies have reported disconfirming findings [e.g., 14]. In addition to findings that are contradictory, little attention has been given to the issue of spuriousness [22]; that is, a correlation, even if significant, does not necessarily equate to support for causation.

In order to address the issue of causation, the analyses presented here utilized propensity score matching to create quasi-experimental data. This provides a test of whether individuals who were virtually identical on most indicators, but differed by whether they regularly play violent video games, were differentially likely to engage in violent or otherwise deviant behavior. Despite significant correlations between violent video games and deviant behaviors, both violent and non-violent, in the unmatched sample, the findings indicated that playing violent video games did not significantly negatively affect males on any of the outcomes once a matched sample is used. This suggests that prior research finding a correlation [e.g., 4,5] cannot be assumed to extend to a causal effect as well.

Though little research has examined the issue, gender differences have been previously found when examining video game effects [17]. The present study similarly found different results by gender. Though both the males and females unmatched samples produced significant correlational findings, only the female matched sample retained some significant relationships. Specifically, though females were not significantly affected by violent video games on most measures, some of the results indicate that they may be at a slightly elevated likelihood for violent and violence-related behaviors. Even these remaining relationships, however, were less substantive after using a matched sample, with more than half the difference explained by propensity.

Table 3: Percent differences between non-violent or non-gamers and violent gamers

		Males			Females		
		Un- matched	Matched	Percent Explained	Un- matched	Matched	Percent Explained
Non-Violent	Cheated	17.3*	3.9	77	11.9*	2.3	81
	Skip School	9.0*	-0.4	100	12.7*	4.0*	69
	Shoplifted	11.1*	2.5	77	8.0*	1.0	88
	Stole	6.4*	-1.0	100	7.9*	1.9	76
	Vandalized	19.8*	-0.3	100	13.2*	3.7	72
	Break & Enter	3.9*	0.0	100	1.8*	-0.6	100
	(Overall)	23.7*	4.2	82	17.5*	3.0	83
Violent	Hit Someone	19.5*	2.4	88	16.1*	2.4	85
	Group Fight	13.7*	0.6	96	12.3*	4.1*	67
	Carried a Weapon	11.2*	1.0	91	7.1*	2.9*	59
	Take Weapon	3.9*	1.0	74	2.2*	0.7	68
	Carried a Gun	6.3*	-0.2	100	2.5*	1.0	60
	(Overall)	21.3*	1.5	93	20.6*	5.1*	75
Substance Use	Cigarettes	4.6*	-1.4	100	6.5*	0.3	95
	Alcohol	10.7*	-0.7	100	12.9*	3.4	74
	Marijuana	6.2*	-3.6*	100	6.2*	-0.5	100
	(Overall)	12.4*	-1.8	100	14.9*	2.8	81
Sample Size	2,971	1,070		3,215	1,746		

* p < .05

As in any study using survey data, these findings have some limitations. First, the time-order of the relationships may be questionable. Given that these data are cross-sectional, testing the time-order is beyond its ability. However, time-order is only a major concern when significance is found. In this case, the importance of the results comes largely from the non-significant relationships and the decreases in group differences. Because time-order is necessary to establish causality, but not to disconfirm it, time-order ultimately is unimportant in these analyses. Second, even though 154 variables were used to create the propensity score, it is possible that other characteristics related to the self-selection process of playing violent games were not adequately controlled. Importantly, neither of these weaknesses could have caused an underestimation of the effect of playing violent games. If anything, they would cause an overestimation of the effect. Thus, even if these issues were problematic, they cannot discount the non-significance found for most relationships. Importantly, both the time-order and spuriousness issue are relevant for the remaining significant relationships in the matched female sample. It could be, for example, that factors beyond the scope of the available measures play a role in both video games and the outcomes, or that violent behavior leads to females seeking out violent video games. Thus, it is the significant relationships that should be viewed critically rather than the non-significant ones. A final limitation to note is that this study focused only on behaviors as outcomes. Other, more cognitive, theorized links with violent video games, such as a desensitizing effect [7], are beyond the scope of this study.

Future research in this area should build on these findings and continue to look beyond correlations in this area. The findings suggest that there may be a causal link, even if relatively weak, between violent games and violent behavior for girls, and replication of these analyses is necessary to further understand this possible link. These analyses should also be replicated using other age groups. It is possible that the link between games and real life violence, if it does exist, does not manifest itself until a later age.

7.1 Conclusions

Given the lack of significance for most of the tested causal relationships, these findings suggest that assumptions made by the popular media and by policy-makers may be exaggerated at best and erroneous at worst. Though the results do not entirely dismiss a potential link with violence, they also clearly do not show the level of support that correlation-based research has shown. Thus, these findings do not entirely support the abandonment of efforts to control access to violent games by children. However, these findings also fail to provide more than weak support for the rationale for such efforts. Thus, as policy-makers and courts move forward in respectively creating and judging legislation designed to protect our children and society in general, these findings suggest the common assertion that there is a causal link between video games and violence is, if nothing else, highly suspect.

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Appendix: Variables Used in Calculating Propensity Scores

The following is a list of variables/questions used to determine the propensity for playing violent video games. Some mark all that apply style questions are included, and the responses (in parentheses) each represent separate variables. Because parsimony is not a goal in creating a propensity score, all variables are entered directly into the model rather than through scales, indices or other methods of data reduction.

Hispanic; White; Black; Asian; do you get a free or reduced lunch at school; age, which of the following people live with you most of the time (mother; father; grandparent(s); step-parent(s); siblings(s); non-family member(s)); how old is your mother; how old is your father; what is the highest level of schooling your mother or female guardian completed; what is the highest level of schooling your father or male guardian completed; have you had lessons in school to teach you (drug/alcohol education (ever); drug/alcohol education in past year; health education in past year; how to set short- and long-term goals for yourself; how to make decisions better; to understand things that influence your behavior; how to communicate better with others; my parents know where I am when I am not in school; my parents know what I am doing when I am not in school; I feel safe in my neighborhood; I feel safe in my school; I stay away from bathrooms and stairwells in my school to avoid trouble; when I do a good job at home or at school, my parents tell me about it; students at this school treat each other with respect; students treat teachers with respect; teachers treat students with respect; students at this school feel safe on their school bus; students in this school are well-behaved in public; students are bullied by other students when teachers are not around; the misbehavior of some students in this school keeps teachers from teaching the students who want to learn; students are bullied by other students at the bus stops; student violence is a problem at this school; how often do you attend religious services; how often do you spend time in a room with someone who was smoking cigarettes; how often do you hear or see violence between people in your home; how many of your friends smoke cigarettes; how many of your friends get drunk at least once a week; how many of your friends smoke marijuana; how many of your friends have ever been stopped by the police; how many of your friends drink alcohol; how many of your friends take, damage or destroy property that does not belong to them; victimization matrix measuring verbal abuse, bullying, threats, shoving/pushing, fights, and fights/threats with weapons by parents, siblings, boyfriend/girlfriend, adults in school, kids in school, and kids in neighborhood; does anybody living in your home smoke cigarettes or tobacco (no one, mother or stepmother, father or stepfather, brother(s) or stepbrother(s), sister(s) or stepsister(s), other household member(s)); if you wanted to get cigarettes, where would you most likely get them (from my friends or other kids I know, from my brothers, sisters, or cousins, from my parents/guardians (with them knowing), from my parents/guardians (without them knowing), from other adults (with them knowing), from other adults (without them knowing), from a vending machine, from a store cashier or clerk); do you take any medicine by prescription for any of the following (depression, blood pressure, anxiety, asthma, ADD/ADHD, allergies, bipolar disorder, weight loss, chronic skin conditions, other); I know where students my age can buy (cigarettes, alcohol, marijuana, prescription painkillers, other illegal drugs); I sometimes do crazy things just for fun; I like wild parties; I like to be around people who party a lot; I like to try new things even if they scare me or I know it's something I shouldn't do; I get a real kick out of doing things that are a little dangerous; I like to have new or exciting experiences even if they are illegal; how much do people risk harming themselves when they (smoke one or more packs of cigarettes per day, try one or two alcoholic drinks, have one or two alcoholic drinks nearly every day, have five drinks at a time once or twice a week, try marijuana once or twice, smoke marijuana occasionally, smoke marijuana regularly, inhale glue or aerosols or other inhalants regularly, use over-the-counter medication to get high); my parents have talked to me about what the risks are if I (use tobacco, drink alcohol, use marijuana, use illegal drugs, gamble); my parents have told me not to (use tobacco, drink alcohol, use marijuana, use illegal drugs, gamble); my parents know that I (use tobacco, drink alcohol, use marijuana, use illegal drugs, gamble); gambled at a casino; played the lottery or scratch-off tickets; bet on team sports; played cards for money; bet money on horse races; played bingo for money; bet on dice games such as craps; gambled on the Internet; bet on games of personal skill such as pool, darts or basketball; bet on video games.