



A longitudinal analysis of shooter games and their relationship with conduct disorder and self-reported delinquency☆



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ABSTRACT

Purpose: Despite several decades of research, little scholarly consensus has emerged regarding the role of violent video games in the development of youth psychopathology or crime.

Method: The current study employed the Avon Longitudinal Study of Parents and Children longitudinal dataset to examine the impact of the shooter game genre ownership in childhood on later adolescent conduct disorder and criminal behavior.

Analysis: Multivariate Poisson regressions with the robust estimator correlation matrix were performed comparing effects of independent and confounding variables.

Results: Results revealed that early childhood mental health symptoms at age seven related to ADHD, depression and early conduct disorder predicted criminal behavior at age fifteen. Male gender also predicted criminal behavior at age fifteen. However, exposure to shooter games did not predict adolescent conduct disorder or criminal behavior.

Conclusion: We have found support that suggests that the role of violent video games in the development of youth psychopathology or crime is very little if any. Lack of a relationship between exposure to shooter games and later conduct and criminal behavior problems may be understood within the context of the Catalyst Model.

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1. Introduction

For more than thirty years, there has been a concern among the public and lawmakers that violence depicted in video games may have an impact on violent behavior and delinquency in youth or young adults. Similarly, scholars have disagreed about whether violent video games impact behavior. Some researchers profess to have detected evidence of a strong relationship between video games and aggressive conduct (Anderson et al., 2008) whereas others have found evidence that such effects are weak (Etchells, Gage, Rutherford, & Munafò, 2016) or nonexistent (Durkin & Barber, 2002; Kutner & Olson, 2008; Unsworth, Devilly, & Ward, 2007). Researchers have also proposed that the effects of video games may only trigger aggression among individuals already exhibiting anger problems (Giumetti & Markey, 2007; Kirsh, 1998; Markey & Scherer, 2009).

Some scholars in the field of psychiatry have been concerned regarding the growing popularity of video games and their near ubiquity in contemporary culture. For instance, alongside issues related to violence, there has been much debate regarding whether video games are

addictive (Griffiths, 2008; Wood, 2008). Centers such as the American Academy of Child and Adolescent Psychiatry have produced statements claiming that the negative effects of media violence on children are well-established (Beresin, n.d.). Such statements can affect public opinion, policy and law, including efforts to regulate or censor media. Although evidence indicates that overuse of games may be correlated with problematic mental health outcomes (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010; Van Rooij, Meerkerk, Schoenmakers, Griffiths, & van de Mheen, 2010), however, other scholars express concern that effects may not be clear-cut or may reflect moral panics in society (Ferguson, 2010; Przybylski, Weinstein, & Murayama, 2017). Thus the statements and diagnoses related to overgaming such as those offered by the American Psychiatric Association remain controversial (Bean, Nielsen, van Rooij, & Ferguson, 2017).

One issue researchers have focused on has been the relationship between video games and crime. This issue has been difficult to discern given that many analyses rely on bivariate correlations which may result in proper controls not being used in studies. For example, video game studies that employ a relatively greater number of statistical controls tend to find weak or null results compared to studies including few numbers of statistical controls (Ferguson & Kilburn, 2009; Furuya-Kanamori & Doi, 2016). Similarly, when the effects of antisocial personality disorders as well as social variables are controlled, bivariate

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relationships between video game play and violence tend to disappear (e.g. Ybarra et al., 2008). The current study provides further evidence regarding this issue by examining the shooter game genre in a large longitudinal sample of youth.

1.1. Differing perspectives on potential video game effects

When analyzing the relationship between video games and aggression, there are three simple explanations of any possible correlations. The first is that video game playing influences the learning of others. This idea sources back to Bandura's social learning theory and social cognitive models of aggression (Anderson et al., 2008). The second is that video games are attractive to those who are overly aggressive and who seek out violent media, effectively exhibiting a selection effect. Evidence for this viewpoint has accumulated over the last two decades (Breuer, Vogelgesang, Quandt, & Festl, 2015; Etchells et al., 2016). The third is that any relationship between video game use and overly aggressive behavior is spurious and these two have little or no effect on each other. This third view suggests that there is little value in attempting to predict low base-rate behaviors (e.g. clinical conduct disorder, violent crime) from a high base-rate behavior (e.g. childhood exposure to action-oriented video games.)

As noted above, the idea that the violence in video games encourages children to be violent can be traced back to Bandura's broader propositions regarding social learning (Bandura, Ross, & Ross, 1961, 1963). Although Bandura did not discuss video games in these articles, he proposed that children's mere exposure to aggressive models encouraged aggression among youth. Much of the research in this area has been focused on whether this thesis is empirically strong and can be extended to violent media (Anderson, 2004; Huesmann, 2007). Despite the advocacy of supporters, many researchers suggest that the evidence base is shakier than often advertised (Cumberbatch, 2008; Mitrofan, Paul, & Spencer, 2009; Olson, 2004; Savage, 2004). Indeed, the Bandura studies themselves have come under criticism for lacking generalizability and potentially reflecting demand characteristics rather than true aggression (Tedeschi & Quigley, 1996.)

Another view of the possible correlation between video game use and aggression is that aggressive traits within the child encourage violent video game usage. This, in essence, refers to a selection effect in which individuals who are more aggressive are drawn to violent video games. In such a circumstance correlation may exist between violent games and aggression, but the direction of causality moves from aggressive traits to violent game play, and not the inverse. Both aggressive traits and being drawn to violent video games may be influenced by underlying genetic influences, for instance. Genetic influences and social forces (e.g., family relationships and peer networks) that are more influential than video games encourage an aggressive personality that seeks out certain forms of media like violent video games (McCown, Keiser, Mulhearn, & Williamson, 1997; Rentfrow & Gosling, 2003). Some evidence has suggested that genetics may predict violent media preferences (Nikkelen et al., 2014) and that genetics may explain correlations between violent media use and criminal violence, such that correlations disappear once genetics are controlled for (Schwartz & Beaver, 2016). Other studies have found evidence that suggests aggressive personalities are drawn to violent video games but that violent video games do not, in turn, promote aggression or violence (Breuer et al., 2015).

Finally, there is the "null" point of view which maintains that video games and delinquency or excessive aggression have little or no influence on each other and any correlation is spurious. Although small correlations may exist between violent game play and aggressive outcomes, these are not likely causal and are due to other, underlying variables. They argue that there may be a spurious, zero-order correlation between video game play and aggressive outcomes, that disappear when proper control variables are put into place. For instance, boys both play more violent video games and

are more physically aggressive (Kutner & Olson, 2008); thus, any correlation between games and aggression may merely be effected by gender differences. Controlling for gender may eliminate or reduce spurious correlations between violent game play and aggression.

1.2. The need for longitudinal studies

As part of the difficulty in distinguishing among these views, it is not always clear what evidence is most conclusive. Researchers have recognized (Breuer et al., 2015; Etchells et al., 2016) that longitudinal studies are particularly helpful in elucidating on the time sequence between action oriented game use and violent or criminal behaviors, particularly once other relevant control variables are included in analyses.

There have been a few prospective/longitudinal studies that have examined the issue of video game violence, typically returning fairly weak to no evidence for video game effects (Ferguson, 2010; Furuya-Kanamori & Doi, 2016). With these studies, the more careful and comprehensive the controls, the weaker the effects of video games. However, most of these prospective studies span only a few years, and they do not use multiple assessment periods over the wider span of years that typically mark longitudinal designs. There is a lack of studies with robust methodology that look at prolonged use or long-term effects particularly beginning in early childhood.

Another issue that has recently been addressed is the complexity of games that are lumped together under one overly broad penumbra of "violent" (Etchells et al., 2016). Although the label "violent video game" has emotional appeal, its conceptual utility is limited. Typical academic definitions of "violent video game" involve any aggressive and unwanted action by one character against another (Thompson & Haninger, 2001). However, such definitions are so broad as to include almost all games, even mild games such as *Pac Man* or *Space Invaders*. This is similar to including religious texts such as the Bible or Ramayana, horror fiction, Shakespearean plays, comic books, Harry Potter, etc., under a "violent literature" penumbra.

One approach to working around this conceptual problem is to consider specific genres of video games rather than assuming an omnibus label, such as "violent video game", has much utility. The downside to using genres is a straightforward one. If "violence" is the conceptual unit of interest, most genres (even fairly innocuous sounding genres such as puzzle games) include both violent and non-violent exemplars. However, certain genres such as shoot 'em up or shooter (henceforth called shooter) games contain violence, at least to some degree, as a default. Etchells et al. (2016) provide one excellent example of a longitudinal study (using the Avon Longitudinal Study of Parents and Children dataset) employing shooter games as a predictor variable for later development of conduct disorder while still controlling for other confounding variables, ultimately finding very weak effects. The Avon Longitudinal Study of Parents and Children (ALSPAC), also known as Children of the 90s, is a world-leading birth cohort study, charting the health of 14,500 families in the Bristol area. However, this study did not look at the effect of the model on delinquency, only conduct disorder. In addition, although the Etchells et al. study included an impressive array of potential control variables, some child history of mental health symptoms was not included. Some prior research has indicated that prior childhood difficulties with mental health are a reliable predictor of later delinquency (Ferguson & Kilburn, 2009). Although Etchells et al. is an example of a well-done longitudinal study, we felt considering additional mental health variables as well as delinquency as an outcome was worth considering. Given prior evidence (Adachi & Willoughby, 2011) that competitiveness in games may also increase aggression, it seemed reasonable to include competitive (i.e. sports games) and violent games (i.e. shooter games).

1.3. Confounding variables that may explain links between video games and crime

To get a better sense of the relationship between video games and juvenile delinquency, it is important to consider other variables the literature suggests may have a confounding effect. Scholars generally acknowledge that it is important to control for theoretically relevant explanatory variables when considering the meaningfulness of potential correlations between two variables (Ferguson, Ivory, & Beaver, 2013; Savage & Yancey, 2008). For example, developmental trajectories that lead to video game use may also lead to later criminality, without video game use and criminality being causally connected. One such variable is sex; males offend at much higher rates than females for all violent crimes (Steffensmeier & Allan, 1996).

Psychiatric research suggests that psychological variables are related to criminal behavior. Excessive aggression in childhood has been linked by previous research with violent, criminal outcomes in childhood later years, and adults (Rosenfield, Phillips, & White, 2006). Early depression or attention deficit hyperactivity disorder (ADHD) has been found to predict delinquency in youth and crime in adults (Babinski, Hartsough, & Lambert, 1999; Ferguson & Kilburn, 2009; Young & Thome, 2011). It is sensible to control for these mental health variables.

1.4. Current study

We seek to extend upon the limited longitudinal literature regarding video game ownership and its potential association with delinquency or conduct disorder by analyzing data from a longitudinal study of youth in the United Kingdom (UK). Instead of focusing only on the effects of shooter games on possible aggression or conduct disorder, we extend prior work and examine the potential association with delinquency. We propose that video game ownership will be associated with later criminal behavior and conduct disorder even after controlling for other factors. We also assess any relationship between the degree of violence in the games played and any behavioral outcomes.

As part of the current analyses, we sought to conduct an exploratory study looking for relationships between shooter games and later criminality or conduct disorder while controlling for other variables the literature (and the concerns of policy makers) suggest may be relevant. We examined whether relationships between early shooter game ownership and adolescent delinquency and conduct disorder are maintained once other theoretically relevant variables are controlled.

2. Method

2.1. Participants

The Avon Longitudinal Study of Parents and Children (“ALSPAC”) recruited 14,541 pregnant women residents in Avon, UK with expected dates of delivery April 1, 1991 to December 31, 1992. 14,541 is the initial number of pregnancies for which the mother enrolled in the ALSPAC study and had either returned at least one questionnaire or attended a “Children In Focus” clinic by 19/07/99. Of these initial pregnancies, there was 13,988 children who were alive at one year of age. An attempt was made to bolster the initial sample when the oldest children were seven years of age, increasing the number beyond 14,541 by two more phases of participants to be paired up with previous cohorts by age. The phases of enrollment and cohort are described with detail in Boyd et al. (2013). Please note that the study website contains details of all the data that is available through a fully searchable data dictionary and reference the following webpage: <http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary>. The total number of participants was increased to 15,445 children.

The study then revisited these children at several different intervals during their life, through to adulthood. Independent variables were collected from the mother when the child was almost five years old

(fifty-seven months) and then again at seven years old. Outcome variables related to criminal delinquency were collected from the child when the child was fifteen years six months old. Complete data on violent delinquency, conduct disorder and video game ownership were available for 2019 participants. As such, this subset constitutes the sample of the present study. Further details of the study aims and design as well as data dictionary are available (www.ich.bris.ac.uk/alspacext/). Ethical approval was obtained from the study’s ethics committee and local ethics committees. The sample was about equal male (50.6%) and female. The sample was also overwhelmingly White European (99.8%). It is important to note here that the sample was a general population sample, not a clinical one, and therefore the incidences of clinical disorders or juvenile criminality were fairly small. Nonetheless, a significant proportion of our sample did meet varying criteria for diagnosis and/or had engaged in criminal behaviors. This approach is similar to other studies with general populations which have proved capable of demonstrating robust predictors of criminal behavior or conduct disorder (e.g. Etchells et al., 2016; Ferguson et al., 2013).

2.2. Measures

Table 1 includes basic information on all scales included in the current analysis. All measures comprised continuous scales unless otherwise indicated.

2.2.1. Video game ownership

Children were asked if they have shooter (i.e., shoot ‘em up), sport, and racing games at home in respective, individual questions. These genres of games are useful as they include one that, by definition, includes at least some mild violence, and two that generally are competitive but non-violent (i.e. sport, racing). This allowed the current design to test for both the effects of competitive and violent games, distinguishing between the two. These competitive games were summed across variables; each participant received a “1” for each category of competitive game the child “has at home”. These items were assessed at 103 months.

2.2.2. Development and Well-Being Assessment (DAWBA) measures of mental health: conduct disorder, ADHD, and depression

Data regarding conduct disorder, ADHD and depression were collected through a semi-structured interview when the children participants were age seven. ADHD interviews were with the parent report whereas the depression and conduct disorder data was collected through the child interview report. DAWBA “bands” are created, with each band corresponding to ordered categorical measures of likelihood of conduct disorder, ADHD and depression. The bands are in six levels from “very unlikely” to “probable”. The bands are the result of computer algorithms and have been found to be valid in other research conducted in the United Kingdom (Etchells et al., 2016); The DAWBA has been validated in clinical and community samples, and is a useful assessment for large-scale data collection such as that occurring in cohort studies.

ADHD traits were assessed in ALSPAC when the participants were seven years seven months of age using the parent-completed DAWBA.

Table 1

Descriptive: independent variables, delinquency variable and conduct disorder variable (15 years).

Variable	Min	Max	Mean	sd
Competitive game scale	0	3	1.46	1.10
Shooter game binary	0	1	0.353	0.478
Conduct disorder DAWBA band	0	5	0.6726	1.02
Depression DAWBA band	0	5	0.4436	0.686
ADHD DAWBA band	0	5	0.673	1.02
Delinquency	12	48	13.96	3.64
Conduct disorder at 15	1	5	1.386	0.654

Note: sd = standard deviation.

For each ADHD item, parents marked boxes to say whether their child showed the behavior; these were coded 0 for “no,” 1 for “a little more than others,” and 2 for “a lot more than others.” A total ADHD trait score was calculated by summing these responses to give a possible range of 0 to 36. The DAWBA then assigns children to “bands” based upon their levels of symptoms relatively to other children and likelihood of having a clinical diagnosis. These bands were used as control variables.

As with ADHD, seven-year-old depression and conduct disorder symptoms were assessed using the DAWBA system. As noted above, the DAWBA then assigns children to “bands” based upon their levels of symptoms relatively to other children and likelihood of having a clinical diagnosis. These bands were used as control variables. Conduct disorder DAWBA bands were also computed based on responses when the children were fifteen and a half years of age. This conduct disorder variable serves as one of the outcome variables. Controlling for earlier conduct disorder at age seven, when predicting later conduct disorder at age fifteen, is crucial in understanding the unique contributors of intermediary predictor variables such as video game playing.

2.2.3. Delinquency scale

Delinquency traits were assessed in ALSPAC when the participants were fifteen years and six months of age. They were asked via a child-completed questionnaire regarding the frequency they had performed certain aggressive/delinquent activities in the last year. The twelve questions asking these included topics regarding how often the young person hit, spat or thrown stones at someone they know; hit/kicked/punched someone else on purpose with the intention of really hurting them; and deliberately damaged or destroyed property that did not belong to them. A total delinquent trait score was calculated by summing these responses ($\alpha = 0.813$). This was a four point Likert scale wherein “1” represented never committing the act, “2” represented one time committing the act, “3” represented more than one but <6, and “4” represented 6 or more. After all responses indicating an inadequacy of response (i.e. missing) were removed, we summed the total of the responses to amass a score between a min of 12 and max of 48.

In summary, the outcome variable was the aforementioned criminality scale; the predictor variables were Competitive Game ownership, the Shooter Game ownership, the ADHD DAWBA, the Cond Disorder DAWBA, the Depression DAWBA, and a variable a measuring whether the respondent was male, white, black, Indian, or Asian.

2.3. Analyses

To determine if playing with shooter and competitive games video games correlated with greater or lower levels of aggression, a multivariate regression analysis was conducted including the video games independent variables, the aforementioned confounding variables including sex and ethnicity, with the conduct disorder scale (at age fifteen) and delinquency scales as outcomes. Ordinary least squares (OLS) regression was not employed due to the lack of a normal distribution in the dependent variables. Instead, multivariate analyses were conducted using Poisson regressions with the robust estimator correlation matrix. Examination of the predictor variables did not indicate the presence of multicollinearity (all VIF values were below 2.0). The log odds of the bivariate relationship were compared to the log odds of the relationship once controlling for all variables within the ultimate model.

3. Results

In the first model, sex, ethnicity were parsed out as dummy variables, Time 1 conduct disorder, ADHD, and depression were included as predictors along with shooter game and competitive game ownership on violent, criminal delinquency. The resultant model had a good fit to the data ($\chi^2 (10) = 199.282, p < .001$.) Being male, and having ADHD in

Table 2

The effect of competitive game play on criminality, Poisson regression.

Predictor variable	B	SE	Wald	Sig.	Exp(B)
Competitive game	0.011	0.006	3.074	0.080	1.024
Shooter game binary	-0.020	0.014	1.970	0.160	0.980
ADHD DAWBA	0.023	0.0059	15.523	0.000	1.023
Cond dis DAWBA	0.015	0.006	6.597	0.010	1.015
Depress DAWBA	0.008	0.008	1.118	0.290	1.008
Being male	-0.096	0.0104	84.417	0.000	0.909
Being White	0.048	0.031	2.497	0.114	1.050
Being Black	0.037	0.0768	0.228	0.633	1.037
Being Indian	0.055	0.0997	0.300	0.584	1.056
Being Asian	0.180	0.1114	2.622	0.105	1.198

early childhood were significant predictors of future delinquency. Having a conduct disorder at seven was significant at the 0.01 level. The size of each effect, in most cases however, was very small, with ADHD have the strongest effect. Video game play variables were not predictive of delinquency. The regression model data are presented in Table 2.

In the second model, sex, ethnicity, Time 1 conduct disorder, ADHD, and depression were included as predictors along with shooter game and competitive game ownership on conduct disorder DAWBA score at fifteen. The resultant model had a moderate fit to the data ($\chi^2 (10) = 54.468, p < .001$.) ADHD, Depression, and Conduct Disorder at age seven were the only significant predictors of being likelier to have Conduct Disorder at age fifteen. Similar to the other model, the size of each effect, in most cases however, was very small, with ADHD having the strongest effect. Neither video game variable predicted later likelihood of having conduct disorder. The regression model data are presented in Table 3.

4. Discussion

Whether playing video games influences children's behavior continues to be a major issue in the Western World. The US State of California (in the *Brown v EMA*, 2011 US Supreme court case, where the court ruled efforts to regulate violent games were ruled unconstitutional and scientifically unwarranted), as well as nations ranging from Australia and Germany to Switzerland and Venezuela and other nations have, in the past, considered restricting youth access to video games. Generally, we found no evidence to support predictive value for shooter or competitive games relating to later conduct disorder or juvenile delinquency within the dataset. The presence of games in a respondent's home at an early age does not correlate with later conduct disorder or violent delinquency. Several important conclusions can be made from the current study. Video game ownership, both shooter (binary coded) and overall competitive, does not correlate with violent delinquency. In addition, the notion that video game ownership, both shooter and competitive, would correlate with conduct disorder was unsupported. As such, our results best support the null perspective of video game influences.

Table 3

The effect of competitive game play on conduct disorder in adolescence, Poisson regression.

Predictor variable	B	SE	Wald	Sig.	Exp(B)
Competitive game	0.016	0.0214	0.542	0.462	1.016
Shooter game	-0.021	0.0481	0.193	0.660	0.979
ADHD DAWBA	0.081	0.0187	18.915	0.000	1.085
Cond dis DAWBA	0.042	0.0195	4.621	0.032	1.043
Depress DAWBA	0.083	0.0239	11.917	0.001	1.086
Being male	0.011	0.0350	0.100	0.752	1.011
Being White	0.036	0.106	0.115	0.735	1.037
Being Black	-0.121	0.2380	0.261	0.610	0.886
Being Indian	0.020	0.3499	-0.003	0.955	1.020
Being Asian	0.075	0.3496	0.047	0.829	1.07

In our study, little evidence supported a significant predictive relationship between violent video game exposure and violent delinquency. These results are parallel with previous prospective studies, most of which have found null or very small effects of video game violence on later aggression (Breuer et al., 2015; Etchells et al., 2016). At this juncture it can be reasonably concluded that longitudinal analyses have not provided support for beliefs that exposure to “violent” games is a demonstrable risk factor for clinically significant aggressive or delinquent behavior or criminal acts later in life. These results are consistent with the Catalyst Model of criminal aggression (Ferguson et al., 2013; Surette, 2013) which suggests that media effects are too weak and distal to influence criminal aggression. The Catalyst Model concludes that genetics and more proximal environmental factors such as early parenting environment are more crucial to the development of aggressive and antisocial personalities.

It is important to mention again here that because of the well-stated confusion and overlap between shooter games and competitive games (Etchells et al., 2016), we took the approach of comparing shooter games with other competitive games that were non-violent in order that we could look at the distinction between competitive non-violent and violent games. The current results did not find a relationship between either category of game with clinically significant conduct disorder or delinquency. Nonetheless, we agree with past studies that suggest that we should continue to explore this relationship between competitive and shooter games, which might still have some short-term effects, even if longitudinal effects appear to be minimal (Adachi & Willoughby, 2011).

5. Conclusion

The absence of significant relationships in our analyses support the conclusion that factors other than violent game content may be associated with delinquent behavior or conduct disorder. Specifically, the current research parallels the cadre of studies that support the concern that ADHD, depression, and early conduct disorder can lead to later conduct disorders and delinquency in later life (Babinski et al., 1999; Ferguson & Kilburn, 2009; Rosenfield et al., 2006; Schaeffer, Petras, Ialongo, Poduska, & Kellam, 2003; Young & Thome, 2011). It is important to note that most individuals with disorders such as ADHD or depression do not commit criminal acts of violence (although this is more common for conduct disorder). However, we would benefit from a clearer and more honest understanding of the relationship between mental illness and crime. The Catalyst Model notes that individuals who are under stress (particularly when combined with the genetic risk and early childhood environment noted earlier) are more likely to commit criminal violence. Individuals with certain mental illnesses are likely to be under significant stress which, when coupled with other risk factors, may trigger criminal violence for some individuals.

The current results highlight the need for greater caution in studies which consider the impact of violent content in isolation from other potentially important factors. Multivariate analyses including reasonable confounding variables should be considered state of the art and bivariate correlations between game play and aggressive outcomes should no longer be considered significant evidence, due to the high potential for spurious effects from such analyses (Furuya-Kanamori & Doi, 2016). Future research should also continue to explore the relationships between both competitiveness and violent content on subsequent behavior. Also, future research should include measures of actual gameplay.

Like all studies, the current one has some limitations. These include the correlational nature of our analyses, which do not allow for causal inferences. However, we remind that this is longitudinal research which included controls for a number of potential confounding variables. Second, although the genre variables allowed for a contrast between violent and non-violent competitive games, not all genres are

clearly violent or non-violent. Third, our analyses are all survey based with the usual limitations of survey research. Along these lines, the current data do not provide a full measure of actual gameplay, rather the presence or absence of certain genres of games in the home. Nonetheless, we believe that the current study is an important contribution to scholarly debates on violent video game effects. Increasing evidence suggests that violent video games have little impact on youth well-being and fears of such games may parallel prior moral panics over a wide variety of media.

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Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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