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EMPIRICAL RESEARCH

The Impact of Degree of Exposure to Violent Video Games, Family Background, and Other Factors on Youth Violence

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Abstract Despite decades of study, no scholarly consensus has emerged regarding whether violent video games contribute to youth violence. Some skeptics contend that small correlations between violent game play and violence-related outcomes may be due to other factors, which include a wide range of possible effects from gender, mental health, and social influences. The current study examines this issue with a large and diverse (49 % white, 21 % black, 18 % Hispanic, and 12 % other or mixed race/ethnicity; 51 % female) sample of youth in eighth ($n = 5133$) and eleventh grade ($n = 3886$). Models examining video game play and violence-related outcomes without any controls tended to return small, but statistically significant relationships between violent games and violence-related outcomes. However, once other predictors were included in the models and once propensity scores were used to control for an underlying propensity for choosing or being allowed to play violent video games, these relationships vanished, became inverse, or were reduced to trivial effect sizes. These results offer further support to the conclusion that video game violence is not a meaningful predictor of youth violence and, instead, support the conclusion that family and social variables are more influential factors.

Keywords Video games · Violence · Aggression · Propensity scores · Adolescence

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Introduction

Concerns that violent video games are contributing to youth violence have been a part of societal dialogue for decades. Perhaps one of the most famous quotes on the matter was by Senator Joseph Lieberman who referred to violent video games as "digital poison" (CNN 1997). In 2005, Senator Hilary Clinton declared that "playing violent video games is to an adolescent's violent behavior what smoking tobacco is to lung cancer" (CBS News 2005)[1] and later that year introduced related legislation again citing this claim (Clinton 2005). The rhetoric on violent games by politicians became particularly pronounced following tragic mass shootings by youth, such as the 2012 Sandy Hook shooting (see Markey et al. 2015 for a listing of effects claims by politicians). As Markey et al. (2015) detail, such claims are not limited to politicians, as some scholars also have referenced mass shootings or claimed that the effects of violent video games on violence are similar to the effects of smoking on contracting lung cancer. Despite this, youth violence rates have steadily plummeted, even as violent video game consumption rates have soared (Ferguson 2015a). Other studies (Cunningham et al. 2016; Markey et al. 2015) have indicated that the release of popular violent video games is associated with immediate declines in

[1] Senator Clinton presented this statement as a quote of the American Academy of Pediatrics (AAP) via a report entitled Media Exposure Feeding Children's Violent Acts. The quote, however, actually appeared in news coverage (O'Keefe 2002), but did not appear in the original article by the AAP. To be sure, the article being reported on did make the claim that the effect was stronger than smoke on lung cancer (American Academy of Pediatrics Committee on Public Education 2001), which reached that conclusion using evidence without citations from a prepared statement given during testimony before congress (Committee on Commerce Science and Transportation 2000).

societal violence. As such, these claims of video game violence being connected to real-life violence are not supported using aggregate crime data.

Nonetheless, it is possible that some small video game effects may not be easily evidenced in societal data. Thus, a large pool of over one-hundred studies has accumulated, examining violent video game effects on a host of aggressive behaviors. Some scholars have concluded that the sum total of these studies is sufficient to claim that conclusive evidence for harmful effects exists (Anderson et al. 2010). In some cases, scholars have generalized this pool of studies to societal violent crime, asserting causal links (e.g., Strasburger 2007) despite most studies not incorporating violent crime as an outcome. Other scholars have suggested that violent games might interact negatively with preexisting mental health issues to produce aggression (Slater et al. 2003). In the typical variant of such a study, participants are recruited to play either a violent or non-violent game (randomly assigned), then measured on some form of aggression following (e.g., Li and Jin 2014). These measures of aggression range from filling in the missing letters of words (such that "kill" is more aggressive than "kiss" in response to the prompt "ki__") through administering bursts of white noise or hot sauce to other people.

However, other scholars dispute the consistency and value of these studies on aggression. Many aggression studies employ undergraduate samples, and the validity of the aggression measures used in such studies has sometimes been challenged (Elson et al. 2014). Further, meta-analyses of these studies have often disagreed as to their meaningfulness (Anderson et al. 2010; Sherry 2007). Thus, to answer questions related to youth violence, it is necessary to turn to a somewhat smaller pool of studies examining youth violence as an outcome.

Previous Literature on Youth Violence

The connection between video game violence and youth violence is one that relates to the general connection between exposure to violence and violent behavior. It is empirically supported, for example, that being the victim of violence and engaging in violent behavior are related (Lauritsen and Laub 2007) and even that victimization tends to follow similar trajectories to known trajectories of offending (DeCamp and Zaykowski 2015). There are also a number of theoretical arguments and mixed evidence suggesting that exposure to violence merely as a witness can influence violent behavior (Widom 1989). Some scholars have long been suspicious of impacts from media in comparison to those of family or peers (Sutherland and Cressey 1960), while other scholars have been arguing that there is such an effect for just as long (Bandura et al. 1963).

Studying youth violence in an experimental setting is obviously unethical. As such, most studies must rely on survey-based methods of assessment. One recent meta-analysis (Ferguson 2015b) reported that at least 50 such studies exist. Results from such studies tend to suggest that small to trivial bivariate effect sizes may exist between violent game exposure and youth violence, but that these tend to disappear once other factors (gender, race, neighborhood characteristics, family characteristics, relationship to parents, etc.) are controlled (Breuer et al. 2015; DeCamp 2015; Przybylski and Mishkin 2016; von Salisch et al. 2011; Wallenius and Punamäki 2008). These latter results have been confirmed by meta-analysis (Ferguson 2015b). Other studies have suggested that competitive playing rather than violent content may relate to youth aggression (Adachi and Willoughby 2013). Yet others have suggested that effects may be "dose dependent" with only heavy use players (three hours or more daily) demonstrating negative effects, although even these effects are very small (Przybylski 2014).

One area of research into the potential effects from video games has focused on an underlying propensity toward violent media. Specifically, these studies recognize and address the issue that children who choose to play violent video games (or are allowed to play them) are already different from their counterparts who do not, even before playing the games. An early study (Ward 2010) in this area found that controlling for the underlying propensity toward violent media resulted in reduced effects that were only present for heavy gamers, although the measure used for game play did not distinguish between violent and non-violent games and the design had limited controls. Another study (Gunter and Daly 2012) found that most of the relationships became non-significant or substantially weakened after controlling for this underlying propensity. Although that study did measure only violent games in its design, the measure did not allow for distinguishing the amount of exposure to violent games. Further analyses incorporating alternative predictors of violence indicate that the weak effects from violent games are smaller than effects from various other social predictors of violence (DeCamp 2015).

Other Factors That May Influence Youth Violence

Most scholars agree that youth violence is multidetermined, through a confluence of genetic and environmental factors (Schwartz and Beaver (in press)). Disagreement persists over whether video games are one of those factors or not. There are theoretical reasons for suspecting that some proximal environmental factors, such as family environment, may influence youth violence, whereas more distal factors, such as media violence, do not. The Catalyst Model (Ferguson and Beaver 2009) suggests that the initial

developmental path for violence propensity follows a combination of genetic risk with harsh initial environment and emotional distance from caregivers, a position well-supported by data (Caspi et al. 2002). Criminological theory also supports the importance of a strong familial bond as a way to prevent crime (Hirschi 1969) and suggests that ineffective parenting, particularly in regards to the handling of deviant behavior, increases risks for violent behavior (Gottfredson and Hirschi 1990). Media effects, by contrast, are considered too distal to have much impact on youth given that they do not have the immediate impact on the child's environment in the way real-life exposure to violence would. This theory has been supported by research with offender populations indicating that media do not provide motivational incentives for criminal behavior (Surette 2013; Surette and Maze 2015).

Developmentally, this suggests that researchers need to pay increasing attention to the distinction children and youth make regarding fictional media and real-life experiences. Unfortunately, some scholars (e.g., Bushman and Huesmann 2014) have occasionally conflated the two, but this approach conflicts with both the available data and theory. Increasing evidence suggests that reality-testing begins quite early in childhood, beginning by age 4, and the development of that ability is largely complete by age 12 (Woolley and Van Reet 2006). Similarly, brain imaging data does not support the argument that exposure to violent video games results in the emotional desensitization that one might expect from chronic exposure to real-life violence (Szycik et al. 2016). Thus, there are sound reasons, both from prior data and theoretically, to warrant the hypothesis that family environments might influence violent behavior problems in youth, even were video games to fail to predict such behaviors.

Research Questions

Although there have been a variety of studies examining the relationships between video games and violence, few of these studies have incorporated analytic methods for controlling for the self-selection bias in who chooses (or is allowed) to play violent video games. Those that have done so have only examined violent game play as a dichotomy—that is, comparing children by whether they ever or never play violent video games (DeCamp 2015; Gunter and Daly 2012)—or without measuring violence in games (Ward 2010). Given prior research, this study investigates the following research questions. First, does time spent playing violent games have a positive correlation with violent behavior? Prior research has found evidence of a correlational relationship, but using only dichotomous indicators for game play rather than the degree of exposure (e.g., Ferguson 2015b; Gunter and Daly 2012). Does the strength of that relationship decrease substantially with the introduction of violent media propensity as a control? Some studies have suggested that controls reduce or eliminate effects from violent games (e.g., Gunter and Daly 2012; Ward 2010), but this also has not been tested using the degree of exposure to violent media. Finally, do other social and environmental factors more strongly predict violent behavior? It has long been argued in criminology that familial and other more proximate effects have a stronger influence on behavior than media (Sutherland and Cressey 1960) and recent research suggests that this applies to video games as well (DeCamp 2015), but it is unclear whether a more precise measurement of degree of exposure would find similar results. By treating people who play violent games for a couple hours per year the same as those who do daily, there is potentially a great amount of measurement error that could wash out effects. The present study addresses this gap in the existing literature by using both a control for underlying propensity toward violent media and a measure for game play that taps into the amount of time spent playing violent video games rather than simply whether the individual does or does not.

Methods

The data for this study were collected as part of the Delaware School Survey (DSS), which is an annual survey of fifth, eighth, and eleventh grade students in Delaware's public and public-charter schools. Aside from a small portion of classrooms randomly selected to receive a different survey instead, all classrooms that make up a required course (e.g., required eighth grade English) are sampled to allow for a near-census design. Informed consent was obtained from all the individual participants included in the study. Under the approved IRB protocol, parental consent is obtained passively, which, combined with a 98–99 % response rate for students present on the day of survey administration, allows for a large, representative sample. The present study uses the 2015 DSS eighth grade ($n = 5133$) and eleventh grade ($n = 3886$) surveys. Students were asked to identify with the following racial/ethnicity categories: non-Hispanic white (49 %), non-Hispanic black (21 %), Hispanic (18 %), or various other or mixed racial and ethnic identities (12 % combined). In addition, the sample was roughly equal for males (49 %) and females (51 %). The questionnaire used for 2015 included 203 questions (counting each mark all that apply question as single questions) and could be completed by most students within 30–45 min (allowing for collection within a single class period). The DSS was designed primarily to measure drug and alcohol use and attitudes, but also includes questions

about family background/life, school, deviance, violence, health, social support, and various other topics.

Dependent Variables

Hit someone and Group Fight

Two measures of violence are used as outcome variables in these analyses.[2] They include questions that ask students whether they: "hit someone with the intention of hurting them" and "take part in a fight where a group of your friends are against another group." These are coded here as dichotomous indicators for any such behavior in the past year.

Independent Variables

The two key predictor variables of interest are violent video game play exposure and violent video game propensity. To serve as controls and comparisons to other possible influences on behavior, a variety of family-related variables were selected, including: parental attachment, youth disclosure, parental enforcement, yelling in the home, violence in the home, and having been hit by an adult.

Violent Game Play Exposure

The primary variable of interest is violent video game playing, which was measured with the question, "how often on average do you play violent video games, such as games that are rated M?" Responses included: never, very rarely, 1 h per week, 2–3 h per week, 4–5 h per week, 6–10 h per week, and more than 10 h per week.[3]

Violent Game Play Propensity

Given that there is a self-selection bias in which children choose (or are allowed to) play violent video games, a control for that underlying propensity is necessary. The exact proper method for controlling for extraneous variables is sometimes disputed. For instance, controlling for a few irrelevant variables may give the impression of including adequate controls without doing so. Further, including multiple correlated variables into a regression equation can sometimes create unusual results due to multicollinearity. Experimental designs with random assignment are generally preferable in order to establish causality, yet they are not always possible. In order to properly analyze data from non-random assignment, the underlying factors that might bias assignment must be dealt with. Using propensity scores is one such approach, and involves calculating each individual's propensity for selecting or experiencing the experimental stimulus. In this particular area of research, the underlying propensity is the propensity for choosing or being allowed to play violent video games. This propensity is calculated by using other variables to predict the focus stimulus, generally through a regression model with the predicted scores saved as the propensity. Propensity scores have been previously used in studying the effect of video games on violence in a limited number of studies (DeCamp 2015; Gunter and Daly 2012; Ward 2010).

A variety of indicators from the survey were used to construct the propensity for playing violent video games. Models used for creating propensity scores are often "kitchen sink" models that include many variables (Piquero and Weisburd 2010, p. 548).[4] A full list of indicators is included in the appendix. Imputation was used to retain cases missing on one or more of the variables used, but these imputed values were only used for the calculation of this score. The propensity was calculated by saving the predicted scores from an ordinal regression predicting violent game play. Although propensity scores are sometimes used to match participants to their counterparts who did not experience the stimulus, the ordinal rather than binary variable for the stimulus here favors the score being included as a regular control variable. The propensity score calculated here has a moderate correlation with violent video game play time ($r = .65$), which is ideal as it indicates that the measure is related to violent game exposure as expected, but not so much as to create collinearity issues. Predictor variables (including the ones listed below) were examined and found to not present any problems involving multicollinearity (VIFs ≤ 1.8).

Parental Attachment

Parental attachment was constructed using the following indicators: "my parent/guardian shows me they are proud of

[2] Although the questionnaire included several deviance-related questions, these two were the only ones that directly measured violence against another person.

[3] Only 12% of eighth grade students and 10% of eleventh grade students selected the highest category. Therefore, it appears that only minimal information about a greater range was lost given the "or more" nature of this response category.

[4] The reason this kitchen sink approach is often used is because the utility from propensity scores comes from having as accurate a score as possible through a model capable of predicting the variable of interest. The number of indicators, because they are reduced down via regression weights into a single score, is largely irrelevant other than that more variables will (usually) produce a more accurate score. In other words, a variable does not require a clear theoretical, direct, or non-spurious connection in order to be useful in creating a propensity score and regression assumptions are of reduced concern (Wooldridge 2010). In respect to maintaining time-order, however, the present study avoids using variables that could be outcomes from playing violent games.

Table 1 Descriptive statistics

	Eighth grade				Eleventh grade					
	Mean (total)	SD (total)	Mean (males)	Mean (females)	Mean (total)	SD (total)	Mean (males)	Mean (females)	Minimum	Maximum
Violent games	2.01	2.11	3.18	.91	1.80	2.05	2.96	.70	.00	6.00
Violent propensity	2.02	1.36	3.17	.93	1.79	1.34	2.94	.71	−1.72	5.67
Parental attachment	.00	1.00	.09	−0.07	.00	1.00	.10	−.08	−2.73	.94
Youth disclosure	3.71	.69	3.67	3.75	3.55	.79	3.51	3.60	.00	4.00
Parental enforcement	2.97	1.08	2.95	2.99	2.93	1.01	2.89	2.97	.00	4.00
Home yelling	.74	1.26	.58	.90	.78	1.26	.60	.94	.00	5.00
Home violence	.35	.87	.29	.41	.35	.83	.26	.43	.00	5.00
Hit by adult	.27	.73	.23	.31	.22	.59	.19	.26	.00	5.00
Black	21 %	–	19 %	24 %	25 %	–	24 %	26 %	.00	1.00
Hispanic	18 %	–	18 %	17 %	15 %	–	15 %	15 %	.00	1.00
Other race/ethnicity	12 %	–	11 %	12 %	10 %	–	11 %	10 %	.00	1.00
Free/reduced lunch	50 %	–	49 %	51 %	43 %	–	40 %	45 %	.00	1.00
Hit someone	19 %	–	22 %	17 %	15 %	–	16 %	14 %	.00	1.00
Group fight	9 %	–	11 %	8 %	5 %	–	7 %	4 %	.00	1.00
Female	51 %	–	0 %	100 %	51 %	–	0 %	100 %	.00	1.00

SD standard deviation

me," "my parent/guardian takes an interest in my activities," "my parent/guardian listens to me when I talk to them," "I can count on my parent/guardian to be there when I need them," "my parent/guardian and I talk about the things that really matter," and "I am comfortable sharing my thoughts and feelings with my parent/guardian." Each indicator had a three point response scale: never or almost never, sometimes, and always or almost always. A reliability analysis indicated very high reliability ($\alpha = .91$) and a factor analysis indicated a single factor solution retaining much of the variance (Eigenvalue = 4.15).

Youth Disclosure and Parental Enforcement

Youth disclosure and parental enforcement were measured using the statements, "my parents know where I am when I am not in school" and "my parents'/guardians' rules are strictly enforced," respectively. Both had a five-point ordinal response scale ranging from never to most of the time.

Yelling and Violence in the Home

Yelling in the home and violence in the home were measured using the questions, "how often do you hear name-calling, threats or yelling between adults in your home that makes you feel bad?" and "how often do you hear or see violence between adults in your home?," respectively. Both had six-point response scales ranging from never to almost every day.

Hit by Adult

Having been hit by an adult was measured using the question, "How often do you get hit by an adult who intends to hurt you?" This measure also used the six-point response scale ranging from never to almost every day.

Additional Controls

Other predictors used as controls in the models include indicators for gender, race/ethnicity (with non-Hispanic white as the reference category), and poverty (measured with an age-appropriate question about receiving a free or reduced-price lunch at school). Descriptive statistics for all variables are displayed in Table 1.

Analytic Strategy

Analyses begin with a brief bivariate examination of violent video game play and youth violence using a simple cross-tabulation to review differences in violence rates by game exposure time. The remaining analyses include regression analyses divided by gender, dependent variable, and grade.[5] For each of these combinations, four logistic regression

[5] Prior research has found substantial gender differences (e.g., DeCamp 2015; Gunter and Daly 2012), so separate models for males and females are necessary. Although there is no similar evidence of a difference between grades, we err on the side of caution in the absence of evidence to the contrary and do not merge the distinct grade samples.

models are calculated. The first model includes only violent game play as a predictor. The second model introduces the propensity score as a control. The third model excludes propensity, but adds all other independent variables to the model. The fourth model reintroduced propensity scores. This design allows for comparisons of the effect from violent video games with and without propensity controls and with and without other potential predictors of violent behavior.

Missing data were handled differently depending on the variable in question. Cases were deleted listwise if the student did not answer the questions about gender and video game play time. Also deleted listwise were cases missing on more than three other independent variables, but this affected fewer than 1 % of the remaining cases. The final sample sizes after listwise deletion are 4096 for eighth grade and 3117 for eleventh grade. For cases missing on three or fewer other independent variables (less than 10 % of cases, and about four-fifths of those were only missing on one variable) imputation (SAS's PROC MI) was used to calculate replacement scores. Cases were excluded from specific analyses if data were missing for the dependent variables of those analyses. A meta-analysis of the results using Comprehensive Meta-Analysis software conclude the analyses.

Results

The bivariate cross-tabulation results are presented in Table 2. For proportions of students hitting someone, both males and females who played violent video games more often were more likely to report having hit someone. The same was true for group fighting, although the relationship was only significant for females. The general (that is, mostly linear) increase in rates as violent game play time increases supports the use of this ordinal measure of violent video game play rather than a dichotomous indicator that would not capture this additional variation.

The results for the regressions predicting male violence are presented in Table 3. Beginning first with hitting someone among eighth grade students, there is a significant effect from violent game play in which the more someone plays violent games, the more likely they are to hit someone. This effect, however, is quite weak, as it only explains 2.8 % of the variance. Moreover, introducing the propensity score as a control (Model M2) reduces the effect further ($\beta = .182$ to $\beta = .015$) and results in no significance. Interestingly, the model's explanatory power increases dramatically ($R^2 = .028$ to $R^2 = .105$), indicating that the propensity toward violent media is a far stronger predictor than actual violent game play. Upon introducing additional predictors (Models M3 and M4), a variety of additional significant relationships can be observed. Specifically, greater levels of parental attachment and youth disclosure are associated with lower likelihoods for hitting someone, while having been hit by an adult and being black are both associated with higher risk. Additionally, experiencing yelling or violence in the home are associated with a higher risk of hitting someone, but only without the control for violent media propensity. Comparing the effect sizes in the final model (Model M4) indicates that propensity, victimization, and race are the strongest predictors, followed by youth disclosure and parental attachment.

The results for the eleventh grade are similar, but not identical, to those of eighth grade. Again, violent game play is a significant predictor of violence (Model M5), but it is very weak ($R^2 = .009$) and becomes non-significant after controlling for violent media propensity (Model M6). Parental attachment and youth disclosure are significantly related to lower risk for hitting, whereas being hit by an adult is associated with greater risk. In addition, some new findings emerge. In these models (M7-8), parental enforcement is also a significant predictor of lower risk, whereas violence in the home and identifying as a race/ethnicity other than white, black, or Hispanic are associated with greater risk even with the propensity control. Being Hispanic is associated with lower risks without controlling for propensity, and being Black is associated with greater risks with the propensity control. In this final model (M8), propensity, youth disclosure, having been hit, home violence, and race are the stronger predictors.

The models predicting group fights are also presented in Table 3. In the initial model (M9) for eighth grade students, violent games are not a significant predictor even without any controls and is a very weak predictor ($R^2 = .002$). Curiously, adding propensity as a control (Model M10) results in time playing violent games being a significant predictor of *lower* risk of being in a group fight, suggesting that children who play violent video games might be less likely to engage in violence after controlling for the propensity toward violent media. Subsequent models (M11–12) indicate that greater levels of youth disclosure are associated with lower risks, while experiencing violence in the home and being black or Hispanic are associated with greater risks. For this group, propensity, race, and youth disclosure are the strongest predictors.

In the eleventh grade models, violent game play is not significant in any of the models (M13–16). Nor, for that matter, is propensity. Only youth disclosure, which is associated with lower risks of group fighting, is significant. The explanatory power is much lower for these models ($R^2 \leq .127$) than for those at the eighth grade ($R^2 \leq .211$), which may be related to the lower prevalence (5 % rather

Table 2 Violence by video game play time per week

	Never	Very rarely	1 h	2–3 h	4–5 h	6–10 h	>10 h	Gamma sig.	*N*
Eighth grade									
Percent males hit someone	13.7	15.4	17.0	21.2	30.0	20.7	29.4	(.221)**	1963
Percent female hit someone	12.1	19.6	19.3	26.0	25.4	36.4	44.8	(.340)**	2077
Percent male group fight	9.3	7.7	13.2	11.1	13.7	15.2	9.8	(.070)	1981
Percent female group fight	5.9	8.5	10.1	9.4	12.7	11.6	25.9	(.281)**	2088
Eleventh grade									
Percent males hit someone	12.3	13.8	12.4	15.3	15.9	21.6	19.2	(.132)**	1486
Percent female hit someone	10.0	18.0	14.5	37.9	15.8	9.1	28.6	(.331)**	1589
Percent male group fight	7.3	5.7	3.3	4.4	6.7	7.9	10.0	(.128)	1503
Percent female group fight	3.1	3.5	3.6	12.1	7.9	4.5	20.7	(.315)**	1598

Q9 $^{*}p < .05$, $^{**}p < .01$

Table 3 Logistic regression predicting male violence

	Hit someone				Group fights			
	Grade 8 ($n = 1963$)		Grade 11 ($n = 1486$)		Grade 8 ($n = 1981$)		Grade 11 ($n = 1503$)	
Model	M1	M2	M5	M6	M9	M10	M13	M14
Violent games	.182 **	.015	.109 **	−.013	.059	−.132**	.111	.069
Violent media propensity	–	.363**	–	.248**	–	.398**	–	.084
-Nagelkerke R^2	(.028)	(.105)	(.009)	(.042)	(.002)	(.077)	(.006)	(.009)
Model	M3	M4	M7	M8	M11	M12	M15	M16
Violent games	.148**	.035	.112**	.003	.013	−.117*	.107	.088
Violent media propensity	–	.277**	–	.233**	–	.317**	–	.041
Parental attachment	−.118**	−.081*	−.093*	−.091*	−.055	−.003	−.112	−.113
Youth disclosure	−.106**	−.090**	−.224**	−.226**	−.233**	−.225**	−.233**	−.232**
Parental enforcement	.024	.062	−.109*	−.095*	−.092*	−.053	−.116	−.114
Home yelling	.075*	.059	−.052	−.061	−.009	−.024	.009	.008
Home violence	.073*	.054	.118**	.113**	.152**	.127**	.075	.073
Hit by adult	.195**	.183**	.194**	.192**	.032	.021	.046	.044
Black	.127**	.148**	.074	.106*	.258**	.282**	.086	.092
Hispanic	.029	.059	−.110*	−.095	.178**	.215**	.034	.037
Other race/ethnicity	−.052	−.015	.082*	.092*	.004	.048	.047	.048
Free/reduced lunch	.022	−.001	−.012	−.036	.000	−.018	.021	.016
-*Nagelkerke* R^2	(.161)	(.194)	(.182)	(.205)	(.178)	(.211)	(.127)	(.127)

Coefficients presented in the table are standardized coefficients

$^{*}p < .05$, $^{**}p < .01$

than 9 %) of group fighting at this age, possibly making the behavior more idiosyncratic.

The results for the regressions predicting female violence are presented in Table 4. Among eighth grade females, the more often one plays violent video games, the more likely one is to hit someone when no other controls are included in the model (F1). However, this effect explains little variance ($R^2 = .047$) and is substantially weakened (though still significant) after controlling for propensity ($\beta = .218$ to $\beta = .066$). Adding additional predictors (Model F4) results in several additional significant predictors, including youth disclosure, yelling in the home, being hit by an adult, and being black. The strongest predictors were propensity, race, victimization, and yelling in the home. For eleventh grade females, the results are mostly similar. Notably, violent game play is not significant after adding the propensity control (Model F6). Among the full range of predictors (Model F8), propensity, being black, parental enforcement, and being hit by an adult were among the strongest predictors, following by other significant predictors including

youth disclosure, other race/ethnicity, violence in the home, and free/reduced-price lunch.

Among eighth grade females, the more often one plays violent video games, the more likely one is to engage in group fights when no other controls are included in the model (Model F9), but this effect is substantially reduced and becomes non-significant after controlling for propensity (Model F10). The full set of predictors (Model F12) indicates that those with a propensity for violent media, those who experience violence in the home, and those who are black or Hispanic are at significantly increased risk for group fighting, whereas those who have greater levels of youth disclosure or parental enforcement are at significantly lower risk. At the eleventh grade, home violence and being black are predictive of significantly greater chances of being in group fights, while greater levels of youth disclosure corresponds to significantly lower chances. Violent game play retains its significance even with the full set of controls (Model F16), but is the weakest of the significant predictors.

Meta-Analysis of Results

Some fluctuation in effect size can occur through random error. Therefore, further examination of the effect sizes was performed using a random-effects meta-analysis. For each sample (male and female eighth grade, male and female eleventh grade) effect sizes were collapsed across the two outcomes to preserve independence of effect size estimates. Effect sizes from the models (M and F: 2, 6, 10, 14) with propensity only were included. The utility of well-controlled effect sizes in meta-analysis, and their advantages over bivariate effects has been established (Pratt et al. 2010; Savage and Yancey 2008).

Results indicated that the overall effect size across samples for the relationship between video games and violence-related outcomes using propensity score controls is weak and non-significant ($r = .038$, $p = .279$). Thus, evidence suggests the absence of a significant relationship between violent game playing and violent behavior in real life among youth.

Alternative Models

In addition to the results presented here, additional models were also estimated using an alternative dependent variable as replication check. A replication of these analyses using a dichotomous outcome variable indicating carrying a weapon during the past year produced similar results. Specifically, the effect of violent video games was substantially reduced in gender-specific eighth grade models and rendered non-significant in gender-specific eleventh grade models. In all models, other social influences were stronger predictors of weapon carrying. Separately, alternative models using the original non-recoded versions of the two violence outcome variables (coded on a six-point scale from "never" to "almost everyday") were also estimated using ordinal regression as a check for the robustness of the findings. These alternative coding schemes did not produce notably different results and would produce the same conclusions.

Discussion

Although much research has been conducted to examine whether violent video games have a connection to real-life violence, no consensus among scholars has yet been reached. Nevertheless, some scholars continue to argue that violent video games cause children to behave violently (Markey et al. 2015). The present study builds on recent research (DeCamp 2015; Gunter and Daly 2012; Ward 2010) that has analyzed data from youth to examine the relationship between video games and real-life violence using propensity scores. Using measures of time spent playing violent video games, this research yields overall mixed-to-null results that suggest that video games have very little or no role in youth violence.

To summarize the effects from violent video game play time, the significance of the effect varied between models. In the eight final models (M and F: 4, 8, 12, 16) with all controls included, violent game play was non-significant in five of the models. In one model (female, eighth grade, hit someone), the effect was significant, but trivial. In another (female, eleventh grade, group fights), it was significant with a weak-to-moderate effect size. For the other remaining model (male, eighth grade, group fights), the effect was significant with weak-to-moderate effect size, but it was a negative effect in which more violent game play was associated with lower odds of real-life violence. Thus, the final tally includes five null effects, one weak positive effect, one moderate positive effect, and one moderate negative effect. To be clear, the models without controls find a positive correlation between games and violent behavior more often than not, but models controlling for propensity and other context considerations suggest that those correlations are likely spurious rather than causal. These mixed-to-null findings are consistent with prior studies that used propensity scores limited by less nuanced measures for video game play (DeCamp 2015; Gunter and Daly 2012; Ward 2010), as well as various other studies of this relationship (see Ferguson 2015b).

Given that effects can sometime vary randomly, all outcomes were then included in meta-analysis, using models controlling only for propensity scores (using models with all controls included did not substantially influence outcomes). The meta-analysis revealed that overall results

Table 4 Logistic regression predicting female violence

	Hit someone				Group fights			
	Grade 8 ($n = 2077$)		Grade 11 ($n = 1589$)		Grade 8 ($n = 2088$)		Grade 11 ($n = 1598$)	
Model	F1	F2	F5	F6	F9	F10	F13	F14
Violent games	.218**	.066*	.157**	.056	.186**	.037	.217**	.156**
Violent media propensity	–	.467**	–	.306**	–	.419**	–	.180*
-Nagelkerke R^2	(.047)	(.164)	(.023)	(.077)	(.027)	(.105)	(.036)	(.048)
Model	F3	F4	F7	F8	F11	F12	F15	F16
Violent games	.156**	.068*	.129**	.043	.110**	.035	.181**	.151*
Violent media propensity	–	.392**	–	.264**	–	.308**	–	.094
Parental attachment	−.093*	−.035	−.039	−.070	.026	.072	−.040	−.053
Youth disclosure	−.074*	−.063*	−.139**	−.136**	−.175**	−.168**	−.304**	−.301**
Parental enforcement	−.049	.012	−.216**	−.188**	−.140**	−.096*	−.048	−.038
Home yelling	.115**	.108**	.035	.029	.060	.052	−.002	−.005
Home violence	.051	−.006	.131**	.112*	.152**	.110*	.165*	.156*
Hit by adult	.136**	.132**	.169**	.164**	.050	.038	.063	.057
Black	.191**	.212**	.197**	.210**	.267**	.280**	.193*	.198*
Hispanic	.044	.075	.012	.007	.143**	.172**	.108	.107
Other race/ethnicity	−.024	.004	.116**	.136**	.062	.081	.095	.102
Free/reduced lunch	.070	.011	.106*	.095*	−.004	−.053	.102	.094
-Nagelkerke R^2	(.166)	(.224)	(.221)	(.252)	(.162)	(.191)	(.205)	(.209)

Coefficients presented in the table are standardized coefficients

*$p < .05$, **$p < .01$

were supportive of null/trivial and non-significant effects, and that video game violence has minimal impact on youth violence.

Worth noting, however, is that, even where effects were statistically significant, these effects were weaker than many of the other variables in the model. Consistent with previous research (DeCamp 2015), indicators of home environment, relationship with parents, and demographics all were stronger predictors of violent behavior than video game play. Notable is that these represent only a small fraction of the criminological concepts known to influence behavior, so it is quite plausible that the effect would be even further weakened (either literally or merely by comparison) if such measures could also be included in the models.

In contrast, the models show strong support for many of the familial predictors of violence. Although the significance and effect size varied by model, higher scores of parental attachment, disclosure of behavior, and parental enforcement of rules were associated with reduced risk of violence, which supports criminological theories positing a negative connection between good parenting and crime (Gottfredson and Hirschi 1990; Hirschi 1969). Moreover, the more often youth report having witnessed violence between adults in their home or having been hit by an adult, the more likely they are to themselves engage in violent behavior, providing further support of the victim-offender overlap (DeCamp and Zaykowski 2015; Lauritsen and Laub 2007). Thus, while the effects of video games remain mixed and unclear, the effects from the family-context variables are consistent and relatively strong. Race and ethnicity were also significant in many models and out-performed video game play as predictors of violence.

The data used here, and consequentially the findings as well, do have certain limitations that must be noted. First, these are self-report data and, therefore, limited by the honesty and understanding of the participants. There is no reason to believe, however, that youth would be particularly likely to lie when answering the questions here given the anonymous design. Second, propensity scores can be used either for matching or as a control variable. Although the matching approach has the advantage of further helping to limit spuriousness, the control variable approach was selected for this research as it allowed for video game play to be used as a continuous predictor rather than as a simple dichotomy. The less robust (but still strong) guard against spuriousness is particularly not concerning given the already weak effects from game play found here. If anything, a stronger methodological design would likely only result in less strength and fewer significant effects, thus this limitation is more a caution against accepting significant effects than non-significant ones. Finally, these data are cross-sectional and, therefore, limited in their ability to

provide evidence for causality. However, this limitation does not necessarily apply to providing evidence against a causal relationship, as these data have largely done, so this weakness is not a concern in regards to the primary finding that the effect size from violent video game play is weak and largely eclipsed by other factors.

The analyses and findings of this study help to inform future research in a few ways. Although the results here are analogous to those of other studies that have used more limited measures of violent game play, future research should nonetheless make use of measures that go beyond dichotomous indicators for exposure to violent games. Additionally, not much is known about who chooses or is allowed to play violent games. The present study addressed this underlying issue using propensity scores, but this approach is unable to answer questions about the factors that may result in some children seeking out different game experiences than others or about what families are more restrictive in that regard. This separate research question has largely been neglected while researchers focus on the outcome rather than the causes of violent game play. Understanding youths' motivational structure for using games would be particularly valuable (Przybylski et al. 2010). Indeed, thwarting and meeting of needs may ultimately provide a clearer model for understanding developmental processes for media use than does focus on offensive content (Przybylski et al. 2014). Lastly, the present study identified a curious effect: the more time males spent playing violent games, the less likely they were to engage in a group fight. It is entirely possible that this effect is a statistical anomaly (with $p < .02$, there is approximately a one in fifty chance of that), or that the relationship is simply spurious. However, taken in conjunction with recent research that suggests that crime rates decrease after the release of popular violent video games (Cunningham et al. 2016; Markey et al. 2015), but that the drop is not seen after nonviolent games are released (Cunningham et al. 2016), it is possible that this negative relationship is related to a cathartic effect from simulated rather than actual violence. Additional research is needed to determine whether this is the case.

Conclusion

The results of this research suggest that caution is still warranted over claiming a relationship between violent video games and violent behavior. The final models with control variables included identified only two positive relationships between violent video games and violent acts, compared to five non-significant relationships and even one negative relationship. Moreover, significant positive effects, when present, were weak and effects from other social predictors were markedly stronger. A meta-analysis consolidating these effects indicated that increased time playing violent video games does not significantly affect the risk of violent behavior. Rather, it is the social and familial background that seems to play a larger role in determining risk of violent behavior instead of video games. Youth who are witness to actual violence in their home, for example, are at greater risk for acting violently. Thus, there is a clear need to differentiate between violent media use and real-life exposure to violence as developmentally distinct. Further, understanding youths' motivational structure for self-selecting exposure to violent media may be more valuable than the current focus on passive modeling of content.

One of the most important implications from the current data is that an understanding of youth development needs to take into account different developmental norms for how youth and children process fictional media events from real-life exposure to harsh environments. For instance, many development specialist acknowledge that children's self-selected exposure to fictional violence is developmentally normative (Olson 2010), yet exposure to real-life violence naturally is not. The perspective that fictional and real-life violence can easily be equated (e.g., Bushman and Huesmann 2014) is not satisfactory in light of data suggesting the opposite.

With this in mind, several important distinctions are worth noting. First, as has already been observed, youth often eagerly seek out violent fictional narratives, from fairy tales to video games, but rarely seek out direct exposure to violence in real life. From this first observation, we might reasonably conclude that the emotional and cognitive processing of fictional and real-life violence exposure follows distinct developmental paths with the brains of even young children processing fictional media far differently from real life. Given that, it should not be assumed that exposure to fictional violence would be likely to cause similar emotional responses—whether fear, depression, or behavioral disturbances—as is commonly seen for exposure to real-life violence. Some existing research has already indicated that exposure to fictional violence has minimal impact on children's emotional health across anxiety or depression (Merritt et al. 2016). The analyses presented here found only weak and mixed evidence of a relationship between playing violent video games and violent behavior among youth, but did find more consistent evidence of a relationship between exposure to real-life violence and youth violence. Taken together, this evidence points to the need to produce newer theories of youth media use that move beyond the presumptions of harm due to offensive content that have typically predominated in past decades.

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Compliance with ethical standards

Conflictof interest The authors declare that they have no conflict of interest.

Ethical approval The data used in this study were collected under a protocol approved by the University of Delaware Institutional Review Board.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Appendix

Indicators used in propensity score construction

The following is a list of variables used for the construction of the propensity scores. Some of these are multiple response questions, resulting in a total of 171 indicators (counting each mark all that apply response separately) used. Exact question wording and response categories are available from the authors upon request.

Free-lunch; age; gender; race and ethnicity; are either of your parents or other adults (18 years or older) in your family serving on active duty in the military?; which of the following people live with you most of the time? (list of family member-relations); which of the people who live with you right now work to earn money to pay the bills and buy the food? (same list as previous); 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 been identified by a doctor or other health-care professional as having difficulty concentrating, remembering, making decisions or doing things because of a physical, learning, or emotional disability? (list of disabilities); has your family experienced any of the following in the past year? (list of economic hardship indicators); have you had lessons in school about…? (substance use education and healthy relationships); have any of your family members been incarcerated (in a prison or detention center) in the past year? (list of family member-relations); how much schooling do you think you will complete?; are you deaf or do you have serious difficulty hearing?; do you have serious difficulty seeing, even when wearing glasses?; because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?; do you have serious difficulty walking or climbing stairs?; my parents know where I am when I am not in school; I feel safe in my neighborhood; I feel safe in my school; teachers here treat students with respect; I get along well with my parents/guardians; students here treat teachers with respect; students in this school are well-behaved in public (classes, assemblies, cafeterias); student violence is a problem at this school; school rules are fair; school rules are strictly enforced; my parents'/guardians' rules are strictly enforced; how often do you hear name-calling, threats or yelling between adults in your home that makes you feel bad?; hear or see violence between adults in your home?; see or hear a media message about the risks of teens drinking alcohol?; does anybody living in your home smoke cigarettes, cigars, little cigars, pipe or other tobacco products? (list of family member-relations); if you wanted to get cigarettes, where would you most likely get them? (list of relationships); do you take any medicine by prescription to help you concentrate better in school?; do you take any medicine by prescription for any of the following? (list of conditions); I know where students my age can buy… (list of substances); how much do people risk harming themselves (physically and other ways) when they: (list of substances and amounts); how often do you: get hit by an adult who intends to hurt you?; get hit by another teen with the intention of hurting you?; see crime in your neighborhood?; see drug sales in your neighborhood?; get bullied in your neighborhood?; get threatened or harassed electronically?; which of the following people give you a lot of support and encouragement? (list of relationships); which of the following are true for you? (statements about being able to trust and help people); during an average week, do you participate in organized activities at any of the following? (list of clubs and organizations); my parent/guardian shows me they are proud of me; my parent/guardian takes an interest in my activities; my parent/guardian listens to me when I talk to them; I can count on my parent/guardian to be there when I need them; my parent/guardian and I talk about the things that really matter; I am comfortable sharing my thoughts and feelings with my parent/guardian; how often did you feel really sad?; how often did you feel really worried?; how often did you feel afraid?; how often did you have trouble relaxing?; how often did you feel nervous?; how much time do you spend on a school day (before and after school): online on a computer (not for school work), tablet, phone, watching TV, or playing computer/video games?; doing school work at home?; reading for pleasure (not a school assignment)?; during the past 7 days: how

many times did you drink 100 % fruit juices such as orange juice, apple juice or grape juice?; how many times did you eat fruit?; how many times did you eat green salad?; how many times did you eat other vegetables?; how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite?; how many glasses of milk did you drink?; how many times did you drink a caffeinated drink such as coffee, tea, sodas, power drinks, energy drinks, or other drinks with caffeine added?; on an average school night, how many hours of sleep do you get?; how many text messages do you send on an average day?; how many days in an average week do you eat breakfast?; during the past 7 days, on how many days were you physically active for a total of at least 60 min per day?; in the past year, my parents have (list of positive and negative parental activities)

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