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REVIEW ARTICLE

The Good, The Bad and the Ugly: A Meta-analytic Review of Positive and Negative Effects of Violent Video Games

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Abstract *Objective* Video game violence has become a highly politicized issue for scientists and the general public. There is continuing concern that playing violent video games may increase the risk of aggression in players. Less often discussed is the possibility that playing violent video games may promote certain positive developments, particularly related to visuospatial cognition. The objective of the current article was to conduct a meta-analytic review of studies that examine the impact of violent video games on both aggressive behavior and visuospatial cognition in order to understand the full impact of such games. *Methods* A detailed literature search was used to identify peer-reviewed articles addressing violent video game effects. Effect sizes r (a common measure of effect size based on the correlational coefficient) were calculated for all included studies. Effect sizes were adjusted for observed publication bias. *Results* Results indicated that publication bias was a problem for studies of both aggressive behavior and visuospatial cognition. Once corrected for publication bias, studies of video game violence provided no support for the hypothesis that violent video game playing is associated with higher aggression. However playing violent video games remained related to higher visuospatial cognition ($r_x = 0.36$). *Conclusions* Results from the current analysis did not support the conclusion that violent video game playing leads to aggressive behavior. However, violent video game playing was associated with higher visuospatial cognition. It may be advisable to reframe the violent video game debate in reference to potential costs and benefits of this medium.

Keywords Video games · Aggression · Cognition · Visual perception

At the time that this article is being written the mass-homicide at Virginia Tech University in which Seung Hui Cho killed 32 students and faculty, and wounded many more is but a few months old. Not surprisingly, as with the Columbine shooting in 1999 [1], news media have indulged in speculation that video game playing may be involved in the etiology of

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this shooting although information about the shooter has thus far not supported a substantial link [2]. It is not hard to "link" video game playing with violent acts if one wishes to do so, as one video game playing prevalence study indicated that 98.7% of adolescents play video games to some degree [3] with boys playing more hours and more violent games than girls. However is it possible that a behavior with such a high base rate (i.e. video game playing) is useful in explaining a behavior with a very low base rate (i.e. school shootings)? Put another way, can an almost universal behavior truly predict a rare behavior? This paper concerns itself with issues related to playing of violent video games. Namely, has the accumulated research evidence provided evidence that exposure to violent video games causes or is otherwise predictive of aggressive behavior? Is it possible also that exposure to violent video games specifically may be associated with positive developments, such as increases in visuospatial cognition? It is the goal of this paper to examine the overall impact of violent video games, positive and negative, in order to help guide the discussion of violent games in relation to aggression, crime and cognitive development.

Despite the intensity of the debate, research on the relationship between video game violence and aggression (most studies do not consider violent crime specifically) have produced mixed findings. Some articles find a relationship, either causal or correlational between video game violence and aggression [4–6] whereas others do not [7–9]. Examining one of the most cited studies a bit closer provides some illumination of the ambiguity of this research area. Anderson and Dill [6] claim to offer causal evidence for the video game—aggression link. However a close read of their article suggests otherwise. The authors use four separate measures of aggression provided by a "noise blast" program (which punishes players with an irritating white noise) and find significance for only one of the four. Had the authors examined the confidence intervals around the effect size for these findings they would have found that such a confidence interval crosses zero and thus should not be considered "proof" of a positive finding. Thus their experimental study questions the causal link between video game violence and aggression, rather than supports it. The authors also use an unstandardized version of the "noise blast" program. In a similar study, Ferguson et al. [7] using a newly standardized and reliable version of the "noise blast" program found no relationship between violent game exposure and aggression. Ferguson et al. also found that, once family violence exposure was controlled, no correlational relationship between violent game exposure and violent criminal behaviors remained. Thus, any correlational relationship between violent video games and violent criminal activity may simply be a byproduct of family violence.

Meta-analyses of violent video games and aggression have also produced mixed findings. Two meta-analyses [10, 11] have found small but positive relationships between violent games and aggression where as three others [12–14] have found no support for the causal link between video games and aggression. Ferguson [14] specifically found significant problems with publication bias in the video games effects literature, as well a tendency for the use of unstandardized measures of aggression to inflate the relationship between video game violence and aggression. Sherry [13] concludes that not only does the current body of evidence fail to support the video game violence—aggression causal link, but suggests that the catharsis hypothesis (that video games may reduce aggression) should be better examined in future studies.

The debate on video game violence has arguably been narrow, in that it assumes that such games have only negative effects and ignores the possibility of positive effects. Regarding the potential positive effects of violent video games, while some studies have focused on general well-being [15] most of the research in this regard has focused on visuospatial cognition [16–19]. Research in this area has indicated that exposure to violent

(or "action" which is used synonymously with violent) video games is associated with increases in visuospatial cognition. By contrast, practice with non-violent games does not appear to generalize to other visuospatial cognitive abilities even when they involve visual rotation tasks [20]. Why violent games are associated with broader visuospatial cognition whereas non-violent games are not remains poorly understood. It should be noted that few studies examine non-violent games specifically, and it may be that future research may provide evidence for the utility of non-violent games in relation to visuospatial cognition. At present no meta-analytic reviews have concerned themselves with violent games and visuospatial cognition. Thus, it is the purpose of the current study to examine the overall positive and negative influences of violent video game playing in regards to aggression and visuospatial cognition in order to better understand the overall impact of these games on child and adolescent development.

Meta-analysis 1 (The Bad): Violent Games Impact on Aggression

Methods

Most previous meta-analytic reviews [10–14] of video game violence have included a wide range of measures related to "aggression" including behavioral, cognitive, affective, physiological, and prosocial measures. This may result in some confusion about what exactly is being measured. For instance Ferguson [14] found that violent games may increase aggressive thoughts, but these thoughts do not appear to lead to aggressive behaviors. In the current study only dependent variables that involve actual aggressive behavior are included in order to better understand the behavioral outcomes of violent game playing.

Study Selection and Categorization

PsycINFO was searched for all articles published between the years of 1995 and April 2007 (this criteria discussed below) that included the following search terms: (video* or computer or arcade) and (game*) and (attack* or fight* or aggress* or violen* or hostil* or ang* or arous* or prosocial or help).

Articles were judged relevant if they met the following criteria:

(a) Articles had to have been published between the years of 1995–2007. There were two reasons for examining this time-frame. The first was to examine trends in effect size within "recent" research. Secondly, and perhaps more importantly, Carnagey and Anderson [21] have identified this period (1995-current) as the "third era" in which video game graphics improved markedly over previous eras, on-line playing has become more common, and first-person shooter type games have increasingly predominated the market. This "third era" is marked by a great increase in the inclusion of violent content in commercial video games. It was felt important that the meta-analysis conducted in this article reflect research on the most current gaming technology, as this "third era" is the period in gaming technology, which has caused the most controversy/concern regarding violent effects.

(b) Articles had to examine the effect of playing violent video games on some measure of aggressive behavior. Articles that did not distinguish between violent and non-violent

video games were not included in this analysis, nor were articles concerned only with cognitions, affect, or physiological arousal that did not consider aggressive behavior.

(c) As this study included an analysis of publication bias in peer-reviewed journals, only articles published in peer-reviewed journals were included in the analysis. Book chapters, dissertation manuscripts and unpublished manuscripts were not included in the analysis. Although it would be interesting and valuable to consider publication status (published or unpublished) as a moderator variable in the analysis, there was no evident method for assuring that all relevant unpublished manuscripts could be obtained (including those from unknown authors, or those intentionally or unintentionally suppressed by the authors).

A total of 17 published studies comprising of 21 independent observations were found that met the above criteria including a total sample size of 3,602.

Effect Size Calculation

Pearson's r, a flexible and easily interpreted index of effect size, was used as the effect size estimate in this study. Correlation coefficients were transformed to Fisher's z, weighted, averaged and transformed back to a pooled r, denoted r_+. In the case in which a study reported non-significant results but failed to provide statistical information (e.g. F-value) the effect size was calculated using the provided means and standard deviations. In the event of multiple measures for the same construct occurring within a study (i.e. multiple dependent or independent measures) simple mean correlations were computed [14]. In studies in which both univariate (e.g. bivariate correlations) and multivariate (e.g. partial correlations) were available, only the latter were included in the meta-analysis, as this provided a better indices of the unique shared variance between violent video game exposure and aggression (as opposed to that due to gender, trait aggression, etc.).

Statistical and Publication Bias Analyses

The comprehensive meta-analysis (CMA) software program was used to fit both random and fixed effects models. Hunter and Schmidt [22] argue that random effects models are appropriate when population parameters may vary across studies, as is likely here, thus only random effects models are presented. Publication bias was assessed using six individual methods. General agreement between the six measures was considered to be evidence for or against publication bias. Ferguson [14] discusses these publication bias analyses in some detail, although they are discussed briefly below:

(a) Visual examination of a "funnel plot", in which asymmetrical results are an indication of publication bias.

(b) The fail-safe N. This technique involves computing a combined p-value for all of the studies included in the meta-analysis, and calculating how many additional studies with a zero effect (average z of zero) would be necessary to create a non-significant p.

(c) Orwin's fail-safe N. An alternate formula for calculating the number of studies necessary to bring the effect size down to trivial levels (e.g. $r \leq 0.10$).

(d) Begg and Mazumdar's rank correlation test provides a rank-correlation for the relationship between effect size and the standard errors of the effects. Significant results indicate a relationship between effect size and precision.

Table 1 Meta-analytic results for aggressive behavior and visuospatial cognition

Dependent variable	*k*	*N*	r_+	95% C.I.	Homogeneity test
Aggressive behavior	17	3,602	0.14(0.04)	(0.08, 0.21)	$X^2(20) = 73.44$, $p \leq 0.05$
Visuospatial cognition	7	384	0.49(0.36)	(0.39, 0.59)	$X^2(13) = 18.69$, $p \geq 0.05$

Note: *k* = number of independent studies; *N* = number of participants; r_+ = pooled correlation coefficient (coefficient corrected for publication bias is in parenthesis); C.I. = confidence intervals

Table 2 Publication bias results for aggression and visuospatial cognition

Dependent variable	FSN	OFSN	RCT	RT	DTTF	95% CI	Bias
Aggressive behavior	277	1	$p < 0.02$	$p < 0.01$	0.04	(–0.03, 0.11)	Yes
Visuospatial cognition	330	54	$p < 0.01$	$p < 0.001$	0.36	(0.23, 0.48)	Yes

Note: FSN = Fail-safe N; OFSN = Orwin's fail-safe N; RCT = significance of Begg and Mazumdar's rank correlation test; RT = significance of Egger's Regression; DTTF = Corrected r_+ point value for publication bias from Duval and Tweedie's trim and fill; CI = confidence interval for Duval and Tweedie's trim and fill

(e) Egger's regression attempts to quantify the bias captured in the funnel plot. As this uses actual effect sizes and standard errors, rather than ranking, it is a more powerful test than the rank correlation test.
(f) Duvall and Tweedie's trim and fill. This iterative procedure provides and adjusted estimate of effect size that includes the expected value of missing studies that would create a symmetrical funnel plot. This provides an estimate of what the effect size would be if there was no publication bias in the meta-analysis.

Results

Results from both meta-analyses (aggressive behavior and visuospatial cognition which is discussed below) are presented together in Table 1. Results from the meta-analysis of video game violence and its impact on aggressive behavior suggests that the raw summed effect for violent video game exposure and aggression is $r_+ = 0.14$. This indicates only a 2% overlap in variance between violent video game playing and aggressive behavior. More critically, however, publication bias analyses (presented in Table 2) are in agreement that publication bias is a significant problem for this body of literature. Once corrected for publication bias, the relationship between violent video game exposure and aggression drops to $r_+ = 0.04$ with a confidence interval that crosses zero. This result does not support a relationship between violent video game playing and aggressive behavior.

Meta-analysis 1 (The Good): Violent Games Impact on Visuospatial Cognition

Methods

PsycINFO was searched for all articles published between the years of 1995 and April 2007 (as discussed above) that included the following search terms: (video* or computer or arcade) and (game) and (intelligen* or visuo* or visual or spatial or perception or atten*).

Criteria for inclusion were generally similar to those discussed under meta-analysis 1, with the exception of criterion (b). Rather than examining aggressive behavior, articles included in the current analyses were those that, as a dependent variable included measures of visuospatial cognition such as visual rotation, visual memory, visual attention and selection or related abilities. Only articles that considered violent games specifically were considered.

A total of seven published studies comprising of 14 independent observations were found that met the above criteria including a total sample size of 384.

Effect Size Calculation, Statistical and Publication Bias Analyses

All statistical procedures were identical to those discussed in meta-analysis 1.

Results

Results from both meta-analyses are presented together in Table 1. Results from the meta-analysis of video game violence studies and visuospatial cognition suggests that the raw summed effect for violent video game exposure and visuospatial cognition is $r_+ = 0.49$. This indicates a 24% overlap in variance between violent video game playing and visuospatial cognition, more than 10 times the effect size seen for aggression. Not surprisingly, however, publication bias analyses (presented in Table 2) are in agreement that publication bias is a significant problem for this body of literature as well. However, even corrected for publication bias the relationship between violent video game exposure and visuospatial cognition remains robust with $r_+ = 0.36$ with a confidence interval that does not zero. This result supports a relationship between violent video game playing and visuospatial cognition. These two variables present a 13% overlap in variance.

Conclusion

Results from the current analysis supported the conclusion that violent video game exposure is associated with increased visuospatial cognition. However, results of the current meta-analysis did not support a relationship between violent video game exposure and aggressive behavior. Taken together these results suggest that violent video game exposure is associated with some positive effects, but does not appear to be associated with negative effects in relation to aggressive behavior.

These results have some important implications for the way in which the debate on violent video game effects have been framed. Arguably the larger part of the discussion on violent video games has focused on their effects on aggressive behavior, with some researchers suggesting that the relationship between violent games and aggressive behavior is well demonstrated [11]. Results from the current analysis, however, suggest that such claims are unfounded. Video games may, however, be associated with increased visuospatial cognition. However, this body of literature is still fairly new and small and further research is necessary before true causal inferences are warranted.

Although video game violence appears to be of relatively little concern for most individuals, it still may be worth examining whether there are special populations for whom video game violence may pose a particular risk. Specifically, individuals already at

risk for violent behavior may respond more negatively to violent games than the majority of individuals. Although violent games are not likely a cause of violent behavior in such individuals, it may be possible that violent games may moderate existing violence predilections.

Given that the negative effects of violent video games on aggressive behavior may be overstated, and that such games are popular, it may be worth considering ways in which such games may be adopted for positive goals. For instance, research examining the utility of such games for educational purposes would be welcome. It may be that these games may prove valuable as learning tools, at minimum in areas related to visuospatial skills. For example, one game with violent content called Re-Mission, has been demonstrated to lead to greater treatment adherence, quality of life, cancer knowledge and self-efficacy in youths with cancer who were randomized to play the game in comparison to youths who did not play the game [23].

The current meta-analysis was designed to help elucidate the impact of violent video games on aggressive behavior and visuospatial cognition. It is believed that the current results will prove valuable in further discussion and debate on this topic. Specifically, it is hoped that this paper will stimulate a more balanced discussion of violent video games that focuses less on heightened concerns and more on practical outcomes.

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