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An update on the effects of playing violent video games

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Abstract

This article presents a brief overview of existing research on the effects of exposure to violent video games. An updated meta-analysis reveals that exposure to violent video games is significantly linked to increases in aggressive behaviour, aggressive cognition, aggressive affect, and cardiovascular arousal, and to decreases in helping behaviour. Experimental studies reveal this linkage to be causal. Correlational studies reveal a linkage to serious, real-world types of aggression. Methodologically weaker studies yielded smaller effect sizes than methodologically stronger studies, suggesting that previous meta-analytic studies of violent video games underestimate the true magnitude of observed deleterious effects on behaviour, cognition, and affect.
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An update on the effects of violent video games

For many in the general public, the problem of video game violence first emerged with school shootings by avid players of such games at West Paducah, Kentucky (December, 1997); Jonesboro, Arkansas (March, 1998); Springfield, Oregon (May, 1998), and Littleton, Colorado (April, 1999). More recent violent crimes that have been linked to violent video games include a school shooting spree in Santee, California (March, 2001); a violent crime spree in Oakland, California (January, 2003); five homicides in Long Prairie and Minneapolis, Minnesota (May, 2003); beating deaths in Medina, Ohio (November, 2002) and Wyoming, Michigan (November, 2002); school shootings in Wellsboro, Pennsylvania (June, 2003) and Red Lion, Pennsylvania (April, 2003); and the Washington, DC. "Beltway" sniper shootings (Fall, 2002). Video game related violent crimes have also been reported in several other industrialized countries, including Germany (April, 2002), and Japan (Sakamoto, 2000).

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Of course, anecdotal accounts of such incidents do not provide a solid scientific basis for public policy decisions or for the testing and development of relevant scientific theories of aggression. But there is considerable theory and research on both the immediate impact of a single brief exposure to media violence and the long term impact of repeated exposure to such violence (e.g. Donnerstein, Slaby, & Eron, 1994; Huesmann & Miller, 1994; Anderson & Bushman, 2001; Bushman & Huesmann, 2001; Anderson & Bushman, 2002a; Anderson et al., in press; Anderson & Huesmann, 2003). A number of meta-analytic reviews have also been conducted, with the major focus on television and movie violence (e.g. Hearold, 1986; Wood, Wong, & Chachere, 1991; Paik & Comstock, 1994; Bushman & Anderson, 2001; Anderson & Bushman, 2002b). Basically, the scientific debate over *whether* media violence has an effect is over, and should have been over by 1975 (Bushman & Anderson, 2001). There are a number of negative behavioural, cognitive, and affective consequences of exposure to violent entertainment media, in both the immediate context as well as developmentally across time (for an excellent and current overview, see Gentile, 2003).

Past research on violent video games

The research literature on violent video games is considerably smaller than the literature on violent television and movies, in part because such games are a relatively recent phenomenon but also because there has been little government funding for such research (none in the US, to date). But as this special issue demonstrates, the pace of high quality research on violent video games is increasing, and there is a sufficiently large research base for some clear answers to basic questions. The first comprehensive *narrative* review of violent video game research found evidence that emerging concerns were well founded, but that there were many unanswered questions (Dill & Dill, 1998).

The first comprehensive *meta-analytic* review found considerably clearer support for those concerns. Specifically, Anderson and Bushman (2001) used modern meta-analytic techniques to combine the results of empirical studies of violent video game effects on five types of outcome variables: aggressive behaviour, aggressive cognition, aggressive affect, helping behaviour, and physiological arousal. They found significant effects of violent video games on each of these five variables. Exposure to violent video games increases aggressive thoughts, feelings, and behaviours, increases arousal, and decreases helping behaviour. There was no evidence of moderator effects. That is, these effects appeared to be about the same for males and females, for youths less than 18 years as well as older participants, and for experimental and correlational studies.

One meta-analysis cannot resolve all relevant issues, of course, especially when conducted on a relatively small and somewhat new research domain. Furthermore, the usual meta-analytic procedure is to include every relevant study that can be found, even those with serious methodological shortcomings. Using all studies contributes to one strength of meta-analysis, specifically, that the results do not depend on the arbitrary (and potentially biased) decisions of the reviewer concerning which studies to include and weight heavily (because of their methodological soundness) and which to exclude or weight lightly (because of their methodological weaknesses). If the research literature being reviewed is sufficiently large, then

specific methodological weaknesses can be coded and statistically analysed as well. The violent video game literature was not sufficiently large for Anderson and Bushman (2001) to conduct such a detailed meta-analyses of specific methodological features, and this is still the case. Thus, including all studies regardless of methodological features could bias the results in either a positive or negative direction, depending on whether the weaker studies tended to give spuriously positive or negative results. However, one can create a list of important methodological weaknesses, categorize each study according to whether or not it has at least one such shortcoming, and then examine the average effect size of the "best" studies to see whether they tend to yield larger or smaller effects than do "all" studies (see Anderson, 2002, 2003, for a similar approach).

Video game industry representatives and their "experts" have criticized the existing violent video game research literature, much as the tobacco industry found "experts" to criticize all research on the possible causal links between smoking and lung cancer. And of course, the "perfect" study doesn't exist in any domain of science, including video game research. Furthermore, there are very serious methodological problems with some video game studies, especially some of the earlier ones conducted with children. This is not uncommon in new areas of research because the researchers have to learn about a wide array of potential pitfalls in any new research domain. So it is important to examine criticisms of the research domain as a whole for two related reasons. First, we need to know whether methodological shortcomings are producing apparent effects that are in actuality artifacts. Second, future research can benefit by the identification of problems uncovered by past work. Indeed, the Call for Papers for this special issue specifically mentioned several such problems to be avoided.

The most common methodological complaints highlighted by the video game industry and associated critics have been effectively dealt with in multiple ways, many times by an earlier generation of media violence scholars (see Gentile & Anderson, 2003). Ironically, they have largely missed true key existing problems that should be taken into account when evaluating the research on violent video games. The present meta-analysis of "best" practice studies takes these problems into account.

The updated meta-analysis

Methods

Study sample

Relevant studies from this special issue as well as all other empirical reports of violent video game effects were included in the sample. A complete list of included studies can be found at the following web page: http://www.psychology.iastate.edu/faculty/caa/abstracts/2000-2004/03A2ref.pdf. Relevant studies were those that included data testing a possible link between exposure to violent video games and one of five types of outcome variables: aggressive behaviour (defined as behaviour intended to harm another person), aggressive cognition, aggressive affect, helping behaviour, and physiological arousal. These are the same five variables examined in Anderson and Bushman's (2001) earlier meta-analysis of violent video game effects. A given "study" might contain more than one independent "sample" of research participants. For example, some studies reported results separately for male and female participants.

For each sample, one effect size was calculated for each of the available five types of dependent variables. Therefore, if a sample had three different valid measures of aggressive behaviour, the effect of exposure to violent video games on aggressive behaviour used in the present meta-analysis was the average of the three separate effect sizes.

Best practices coding

The following potential methodological problems were examined for each sample:

1. Non-violent video game condition contained violence, and there was no suitable non-violent control condition.
2. Violent video game condition contained little or no violence.
3. Evidence that the violent and non-violent conditions differed significantly in ways that could contaminate the conditions, such as the non-violent condition being more (or less) difficult, boring, or frustrating than the violent condition.
4. A pre-post design was used, but only the average of the pre- and post-manipulation measures was reported.
5. Each research session involved both a video game player and an observer, but only the average of the player-observer measures was reported.
6. The aggressive behaviour measure was not aggression against another person (e.g. aggression against a non-human character, or against objects).
7. The outcome variable was physiological arousal, but arousal differences between the violent and non-violent video game conditions were already controlled by pretesting and/or game selection (i.e. equally arousing violent and non-violent games were intentionally chosen by the researchers to control for potential arousal effects on other outcome measures such as aggressive behaviour).
8. The outcome variable was aggressive affect, but affective differences between the violent and non-violent video game conditions were already controlled by pretesting and/or game selection (i.e. violent and non-violent games were intentionally chosen by the researchers to have the same affective impact, to control for potential affective influences on other outcome measures such as aggressive behaviour).
9. In a correlational study, the measure of video game exposure was not specifically tied to violent video games (e.g. the amount of time spent on any kind of video game was measured instead of time spent on violent video games).

Samples that had none of these weaknesses were classified as ''best practices'' samples, whereas those with at least one weakness were classified as ''not best practices'' samples. Note that some of these ''weaknesses'' are actually strengths for other aspects of the same research. For example, if one wants to study whether violent video game content can increase aggressive behaviour (relative to a non-violent video game) even when there are no arousal differences between the games, then pretesting and selecting violent and non-violent video games that produce equivalent levels of arousal is an excellent methodological feature. However, that same sample (and pair of video games) does not allow a good test of whether violent video games on average increase arousal more than non-violent ones. So, for the aggressive behaviour outcome variable this sample would be coded as a ''best practice'' one, whereas it would be coded as a ''not best practice'' sample for the physiological arousal outcome variable (see Anderson & Dill, 2000, Study 2).

For several samples it was possible to get effect sizes for both a best practices procedure and a not best practices procedure on the same outcome variable. For example, several correlational studies had both a best practices measure of time spent on violent video games and a not best practices measure of time spent on any type of video game, each of which was correlated with a measure of aggressive behaviour. For all analyses that did not explicitly compare best and not best practices samples, only the best practice effect size estimates were used.

Effect size, age, study type

Effect sizes were converted to the form of Pearson's *r*, regardless of whether they were from true experiments or from correlational designs. Age of participants was coded into samples that were primarily younger than 18 years versus those that were 18 or older. For aggressive behaviour, aggressive cognition, and helping behaviour, the majority of participants were under 18; for aggressive affect and physiological arousal the majority were 18 or older. The 18 and older samples were composed mostly of college students in the 18–21 age range, so overall, the samples can be characterized as being overwhelmingly composed of children and adolescents. There still is not a large enough body of samples in this domain for truly sensitive tests of potential age differences in susceptibility to violent video game effects. And, similar to Anderson and Bushman's (2001) results, preliminary analyses of the present data suggest no strong differences in effect size. Therefore, potential age differences will not be further explored in this article.[1]

Anderson and Bushman (2001) also found no evidence of differences between the average effects from experimental versus correlational types of studies. Nonetheless, this distinction is important because of differing strengths and weaknesses. Experimental studies allow strong causal statements because they effectively rule out plausible alternative interpretations. Correlational studies are important for two very different reasons: (1) they provide a falsification opportunity for the theory and hypotheses under consideration; (2) they typically use dependent measures that are more extreme and realistic than the kinds of aggression typically assessed in the

[1] Interestingly, there was a hint that the aggressive behaviour results might be slightly larger for the 18 and over group. However, in my view standard meta-analysis techniques are not the best way to assess age as a moderating factor. There are several reasons for this, all based on what people mean when they ask whether the effect of some factor (e.g. media violence) is larger for younger than for older individuals. Implicit in this question is a more precise question of the form, "Does the exact same independent variable have a bigger effect on the exact same dependent variable for younger versus older participants?" One problem with standard meta-analytic procedures for comparing older with younger participants in different studies is that the independent variables may be systematically different for different age samples. For example, in experiments younger samples tend to be exposed to fairly tame violent video games, whereas older samples tend to be exposed to very violent video games. Similarly, a second problem is that the dependent variable (e.g. aggression) may be systematically associated with the age of participants in different samples. A third problem concerns the use of standardized indicators of effect size (such as *r*). This is necessary when the specific independent and dependent variables differ, as they do when summarizing results across multiple studies. But the implicit question focuses on differences in raw slopes, not correlations, and raw slope is only one of three components of a correlation (variance of the independent variable and prediction error are the other two). The bottom line is that the best way to answer the more precise implicit question is to include multiple ages in the same study, using the same independent and dependent variables, and then testing for an age X media violence interaction. This can be done in both experimental and correlational designs. In other words, age needs to be a within study factor, not a between study factor. Once a sufficient number of such studies have been conducted and reported, one could then estimate the interaction effect size for each study, and then use meta-analytic procedures to test whether or not the set of within study age X media violence interactions was (on average) positive, negative, or fairly close to zero.

lab. If both types of studies yield evidence of significant effects, then the case can be made that the effects are real, causal, and consequential. Therefore, type of study was coded and analysed.

Results

All samples

Fig. 1 presents the average effect of violent video games on each of the five target outcome variables, for all samples (ignoring the best/not best and the experimental/correlational distinctions). For each outcome variable, there was a significant effect of exposure to violent video games. Playing violent video games was associated with increases in aggressive behaviour, aggressive cognition, aggressive affect, and physiological arousal, and with decreases in helping behaviour. For example, the average effect size on aggressive behaviour was $r+ = 0.20$, with a lower and upper 95% confidence interval of 0.17–0.22. These aggressive behaviour results were from 32 independent samples involving 5240 research participants.

As can be seen in Fig. 1, none of the 95% confidence intervals came close to including zero, indicating that overall the results are quite robust. In brief, a simple summary of the extant research literature on violent video game effects is that they are quite statistically significant.

Best practices

The results in Fig. 1 include studies known to have potentially serious weaknesses. A sceptic might reasonably ask whether the weak studies are producing artifactually strong effects, effects which would disappear if only the methodologically best samples were used. Fig. 2 presents the results broken down by best vs. not best practices samples. Interestingly, in every case the

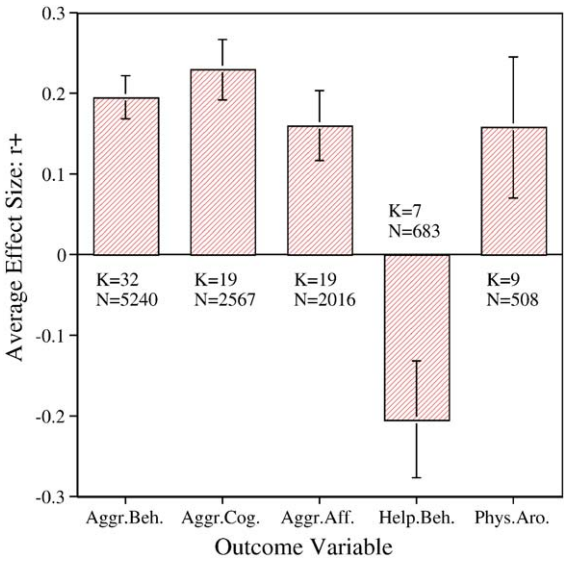

Fig. 1. Effects of violent video games on aggressive behaviour, aggressive cognition, aggressive affect, helping behaviour, and physiological arousal, all samples. K = number of independent samples. N = total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals.

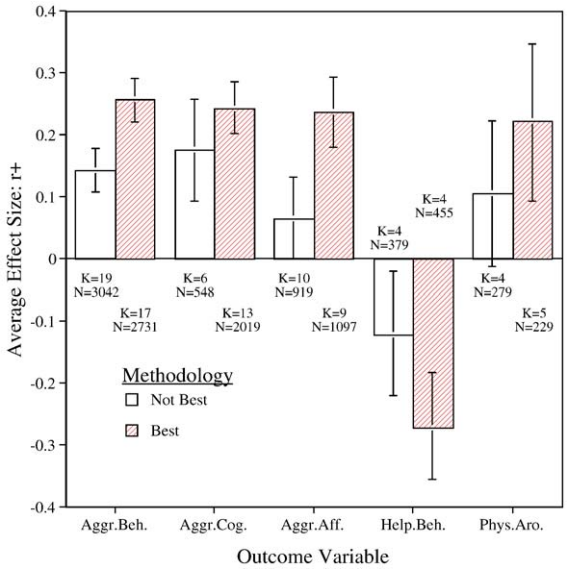

Fig. 2. Effects of violent video games on aggressive behaviour, aggressive cognition, aggressive affect, helping behaviour, and physiological arousal by best practices methodology. K = number of independent samples. N = total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals.

methodologically best samples yielded average effect sizes that were larger than methodologically weaker samples. This was particularly pronounced for aggressive behaviour and aggressive affect. In both of these cases, the 95% confidence intervals for the best and not best samples did not overlap. In essence, these results suggest that effect size estimates that include methodologically weaker studies (e.g. Anderson & Bushman, 2001; present Fig. 1) underestimate the true effect sizes of exposure to violent video games. There is no evidence that the weak studies produce artifactually large effects in this research domain.

Type of study, best practices samples

Fig. 3 presents the average effect sizes of the best practices samples broken down by type of study. There is little evidence of consistent differences in effect sizes of experimental versus correlational samples. For instance, correlational studies produced a slightly larger average effect on aggressive behaviour than did experimental studies, but there is considerable overlap in their 95% confidence intervals. Furthermore, for four of the five outcome variables the violent video game effect was individually significant for both experimental and correlational studies, despite the relatively small number of samples (*K*s) and participants (*N*s). The only exception was that there were no correlational studies of violent video game effects on physiological arousal.[2]

[2] The K and N totals from Fig. 3 do not always match the *K*s and *N*s from the best practices effects in Fig. 2. This results from the fact that 2 best practice samples had both an experimental and a correlational effect size on the same type of outcome variable. The experimental and correlational effects were averaged for the Fig. 2 analyses, but were not averaged for the Fig. 3 analyses.

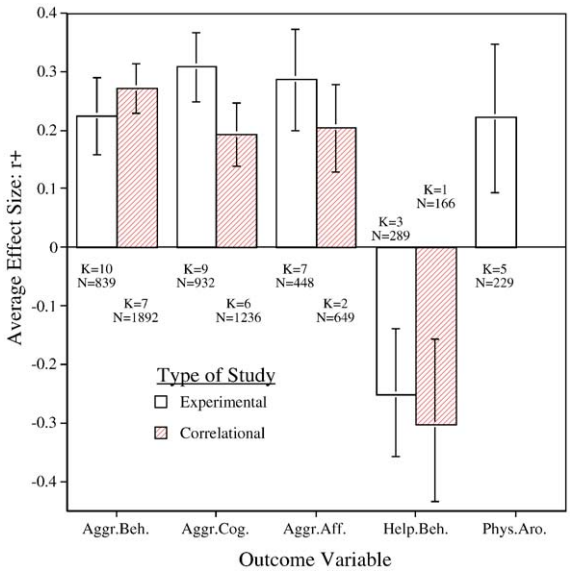

Fig. 3. Effects of violent video games on aggressive behaviour, aggressive cognition, aggressive affect, helping behaviour, and physiological arousal by type of study (experimental vs. correlational) for best practices samples. K = number of independent samples. N = total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals.

Discussion

Three findings are particularly important. First, as more studies of violent video games have been conducted, the significance of violent video game effects on key aggression and helping-related variables has become clearer. Second, the claim (or worry) that poor methodological characteristics of some studies has led to a false, inflated conclusion about violent video game effects is simply wrong. Third, video game studies with better methods typically yield bigger effects, suggesting that heightened concern about deleterious effects of exposure to violent video games is warranted.

The magnitude of these effects is also somewhat alarming. The best estimate of the effect size of exposure to violent video games on aggressive behaviour is about 0.26 (Fig. 2). This is larger than the effect of condom use on decreased HIV risk, the effect of exposure to passive smoke at work and lung cancer, and the effect of calcium intake on bone mass (Bushman & Huesmann, 2001). As a society, we have taken massive and expensive steps to educate the public about these smaller medical effects, but almost none to deal with the larger violent video game effects.

In assessing the potential societal harm of a risk factor, one must take into account the risk factor dosage as well as the effect size. In other words, if youths spent only a little time playing violent video games (e.g. less than 30 min per week), or if only a few youths spent a lot of time playing such games (e.g. 1 in 10,000), then the overall cost to society would likely be fairly small. But as documented in several articles in this special issue as well as in other recent reports, a lot of youths are playing violent video games for many hours per week. When large numbers of youths (including young adults) are exposed to many hours of media violence (including violent video

games), even a small effect can have extremely large societal consequences (see Abelson, 1985; Rosenthal, 1986, 1990).

A thorough understanding of any risk factor requires several key developments: (a) converging evidence from multiple empirical methods that the risk factor (e.g. exposure to violent video games) influences the main outcome variable (e.g. aggressive and violent behaviour); (b) a good theoretical model of the underlying processes; and (c) empirical evidence linking key theoretical processes and variables (e.g. aggressive cognitions) to the main outcome variable. At a general level, the huge media violence research literature has all of these components in place (Anderson et al., under review). Three major types of studies have clearly and consistently linked media violence to aggressive and violent behaviour: experimental, cross-sectional (correlational); and longitudinal. Social-cognitive models of human aggression clearly link exposure to media violence to subsequent aggressive and violent behaviour at both the theoretical and empirical levels (e.g. Huesmann, 1988; Anderson & Bushman, 2002a; Anderson & Huesmann, in press).

The same theoretical structure works for understanding violent video game effects. But when one considers violent video game research by itself, a glaring empirical gap emerges: the lack of longitudinal studies. It is a mistake to dismiss existing longitudinal studies of media violence effects, of course, because they are highly relevant to understanding and predicting the effects of repeated exposure to violent video games. Nonetheless, it is imperative that future video game research includes longitudinal designs.

References

Abelson, R. P. (1985). A variance explanation paradox: When a little is a lot. *Psychological Bulletin*, *97*, 129–133.

Anderson, C. A. (2002). Violent video games and aggressive thoughts, feelings, and behaviors. In S. L. Calvert, A. B. Jordan, & R. R. Cocking (Eds.), *Children in the digital age* (pp. 101–119). Westport, CT: Praeger Publishers.

Anderson, C. A. (2003). Video games and aggressive behavior. In D. Ravitch, & J. P. Viteritti (Eds.), *Kid stuff: marketing sex and violence to America's children* (pp. 143–167). Baltimore, MD: Johns Hopkins University Press.

Anderson, C. A., & Bushman, B. J. (2002a). Human aggression. *Annual Review of Psychology*, *53*, 27–51.

Anderson, C. A., & Bushman, B. J. (2002b). The effects of media violence on society. *Science*, *295*, 2377–2378.

Anderson, C. A., & Bushman, B. J. (2001). Effects of violent games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science*, *12*, 353–359.

Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology*, *78*, 772–790.

Anderson, C. A., & Huesmann, L. R. (2003). Human aggression a social-cognitive view. In M. A. Hogg, & J. Cooper (Eds.), *Handbook of Social Psychology* (pp. 296–323), London: Sage Publications.

Anderson, C. A., Berkowitz, L., Donnerstein, E., Huesmann, R. L., Johnson, J., Linz, D. Malamuth, N., & Wartella, E. (in press). The influence of media violence on youth. Psychological Science in the Public Interest.

Bushman, B. J., & Anderson, C. A. (2001). Media violence and the American public: Scientific facts versus media misinformation. *American Psychologist*, *56*, 477–489.

Bushman, B. J., & Huesmann, L. R. (2001). Effects of televised violence on aggression. In D. Singer, & J. Singer (Eds.), *Handbook of children and the media* (pp. 223–254). Thousand Oaks, CA: Sage Publications.

Dill, K. E., & Dill, J. C. (1998). Video game violence: A review of the empirical literature. *Aggression and Violent Behavior: A Review Journal*, *3*, 407–428.

Donnerstein, E., Slaby, R. G., & Eron, L. D. (1994). The mass media and youth aggression. In L. D. Eron, J. H. Gentry, & P. Schlegel (Eds.), *Reason to hope: A psychosocial perspective on violence and youth* (pp. 219–250). Washington, DC: American Psychological Association.

Gentile, D. (Ed.). (2003). *Media violence and children*. Westport, CT: Praeger.

Gentile, D. A., & Anderson, C. A. (2003). Violent video games: The newest media violence hazard. In D. A. Gentile (Ed.), *Media violence and children* (pp. 131–152). Westport, CT: Praeger.

Hearold, S. (1986). A synthesis of 1043 effects of television on social behavior. In G. Comstock (Ed.), *Public Communication and behavior*, Vol. 1 (pp. 65–133). New York: Academic Press.

Huesmann, L. R. (1988). An information processing model for the development of aggression. *Aggressive Behavior*, *14*, 13–24.

Huesmann, L. R., & Miller, L. S. (1994). Long-term effects of repeated exposure to media violence in childhood. In L. R. Huesmann (Ed.), *Aggressive behavior: Current perspectives* (pp. 153–186). New York: Plenum Press.

Paik, H., & Comstock, G. (1994). The effects of television violence on antisocial behavior: A meta-analysis. *Communication Research*, *21*, 516–546.

Rosenthal, R. (1986). Media violence, antisocial behavior, and the social consequences of small effects. *Journal of Social Issues*, *42*, 141–154.

Rosenthal, R. (1990). How are we doing in soft psychology? *American Psychologist*, *45*, 775–777.

Sakamoto, A. (2000). Video games and violence: Controversy and research in Japan. In C. von Feilitzen, & U. Carlsson (Eds.), *Children in the new media landscape: Games, pornography, and perceptions* (pp. 61–77). Goeteborg, Sweden: The UNESCO International Clearinghouse on Children and Violence on the Screen.

Wood, W., Wong, F. Y., & Chachere, J. G. (1991). Effects of media violence on viewers' aggression in unconstrained social interaction. *Psychological Bulletin*, *109*, 371–383.