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VIOLENT VIDEO GAMES: SPECIFIC EFFECTS OF VIOLENT CONTENT ON AGGRESSIVE THOUGHTS AND BEHAVIOR

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Three experimental studies, one correlational study, and a meta-analysis tested key hypotheses concerning the short-term and long-term impact of exposure to violent video games. Experiment 1 found that violent video games in general increase the accessibility of aggressive thoughts. Experiments 2 and 3 found that playing violent video games increased aggression, even when arousal and affect were controlled. Experiments 2 and 3 also found that trait hostility and trait aggression were positively related to laboratory aggression. Furthermore, there was correlational evidence of a link between repeated exposure to violent video games and trait aggressiveness. Mediation analyses suggested that the trait effects and the violent video game effects on laboratory aggression were partially mediated by revenge motivation. The correlational study uncovered links between habitual exposure to violent video games, persistent aggressive cognitions, and self-reported aggressive behavior. A destructive testing regression approach found that the video game violence/aggression link remained significant even after stressing the link by partialling out sex, narcissism, emotional susceptibility, and Big Five personality factors. However, consistent with prior empirical and theoretical work emphasizing the importance of media violence in the creation of habitual aggressive patterns of thought, partialling out aggressive attitudes reduced the video game violent/aggression link to nonsignificance. The meta-analyses revealed significant effects of violent video

games on aggressive behavior, affect, and cognition; on cardiovascular arousal; and on prosocial behavior. A best-practices meta-analytic approach revealed that contrary to media industry claims, better conducted studies tend to yield stronger effects of violent video games on aggression and aggression-related variables than do more poorly conducted studies.

I. Introduction

A. CRITICAL INCIDENTS

Violent video games are popular with adolescent and adult males and females, are marketed to youth in ways that violate the video game industry's own standards, and are easily obtained regardless of age (e.g., Buchman & Funk, 1996; Federal Trade Commission, 2000; Walsh, 1999). School shootings by boys with a history of playing violent video games [e.g., West Paducah, KY (December 1997); Jonesboro, AR (March 1998); Springfield, OR (May 1998), Littleton, CO (April 1999), Santee, CA (March 2001), Wellsboro, PA (June 2003) and Red Lion, PA (April 2003)] heightened public debate about the role played by this relatively new violent entertainment medium, including a hearing by the U.S. Senate Committee on Commerce, Science, and Transportation held on March 21, 2000. Other recent violent crimes linked to violent video games include 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); and the Washington, D.C. "Beltway" sniper shootings (Fall 2002). However, such public incidents and outcries do not constitute scientific evidence of a true causal link. This chapter explores current work by media violence researchers and presents five new studies.

B. BRIEF HISTORY OF VIOLENT VIDEO GAMES

Video games first emerged in the late 1970s, but in the 1990s violent games came of age, with the first-person shooter "Wolfenstein 3D" and the third-person fighter "Mortal Kombat" leading the way. By the end of the 20th century, even more graphically violent games were available to virtually anyone who wanted to play them, regardless of age (Walsh, 1999). As early as the mid-1990s, fourth grade girls reported playing video games more than 5 1/2 hours a week, and boys reported playing more than 9 hours a week (Buchman & Funk, 1996). Furthermore, this same sample of fourth graders reported that the majority of their favorite games were violent ones (58.9%

for girls, 72.9% for boys). A survey of eighth and ninth grade students found boys playing about 13 hours a week and girls about 5 hours a week (Gentile, Lynch, Linder, & Walsh, 2004).

Data from the Cooperative Institutional Research Program (CIRP, 1998, 1999), which surveys entering college freshmen from more than 600 two- and four-year colleges, reveal that older students also are playing a lot of video games and that their time with such games is also increasing. In 1998 13.3% of the young men reported playing video games at least 6 hours per week during their senior year in high school. By 1999 that figure had increased to 14.8%. Increases are also occurring at the high end of the game playing distribution. In 1998, 2% of the young men reported playing video games more than 20 hours per week. By 1999, that figure had increased to 2.5%.

Another troubling aspect involves the lack of parental or societal oversight. A recent survey of teens in grades 8 through 12 (Walsh, 2000) found that 90% of their parents *never* check the ratings of video games before allowing a purchase, and only 1% reported that their parents had ever kept them from getting a game based on its rating. Furthermore, ratings provided by the video game industry do not match those provided by other adults and game-playing youngsters. Specifically, many games involving violence by cartoon-like characters are classified by the industry as being appropriate for general audiences, a classification with which adults and youngsters disagree (Funk, Flores, Buchman, & Germann, 1999). Also, 89% of the teens in Walsh's survey (2000) reported that their parents never limit the amount of time they are allowed to play video games. Finally, many of the most violent games have "demo" versions on the Internet that can be downloaded for free by anyone. Of the boys in the sample who play video games, 32% reported downloading them from the Internet (Walsh, 2000).

C. MEDIA VIOLENCE RESEARCH

Concern over video game violence would be misplaced if playing such games had little impact on aggression. Decades of research have revealed that viewing television and movie violence can cause short-term increases in aggression and long-term changes in trait aggressiveness (e.g., Bushman & Anderson, 2001; Bushman & Huesmann, 2001; Hearold, 1986; Huesmann & Miller, 1994; Paik & Comstock, 1994; Wood, Wong, & Chachere, 1991). The research literature on video games is smaller and less complete. Despite its relatively small size and the methodological difficulties inherent in the first studies of any "new" phenomenon, a consensus is emerging that violent video games can cause increases in aggressive behavior in children and in young adults (Anderson, 2000; Anderson & Bushman, 2001; Dill & Dill, 1998; Sherry, 2001; Walsh, 2000). We review this literature after considering theoretical issues.

II. The General Aggression Model

Good theoretical reasons support the belief that exposure to violent video games will increase aggressive behavior (Anderson & Dill, 2000; Dill & Dill, 1998). The General Aggression Model (GAM) integrates existing theory and data concerning the learning, development, instigation, and expression of human aggression (Anderson & Bushman, 2002; Anderson & Carnagey, 2004; Anderson & Huesmann, 2003). It does so by noting that the enactment of aggression is based largely on knowledge structures, such as scripts or schemas, created by social learning processes.

In brief, GAM describes a multistage process by which two kinds of input variables lead to aggressive (or nonaggressive) behavior. Figure 1 shows a simplified version of the single-episode portion of GAM. Both personological (e.g., trait hostility) and situational (e.g., recent violent video game play) variables influence behavior by affecting the person's present internal state, represented by cognitive, affective, and arousal variables. Playing a violent video game may influence aggression by means of the cognitive route, for example, if it primes aggressive thoughts or scripts, leading to hostile perception, expectation, and attributional biases (e.g., Bushman & Anderson, 2002; Calvert & Tan, 1994; Crick & Dodge, 1994; Dill, Anderson, Anderson, & Deuser, 1997; Kirsh, 1998). The three aspects of present internal state are themselves interrelated, as indicated by the dashed lines connecting them. For example, priming aggressive thoughts might subsequently increase feelings of anger and a desire for revenge if the person is provoked. In such a

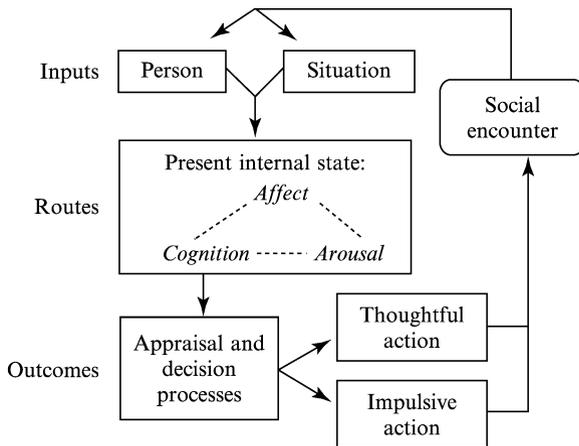


Fig. 1. The general aggression model: single episode cycle. *Source:* Anderson and Bushman, 2002.

case the cognitive effect is regarded as the *primary* route of impact and the affective effect as a *secondary* route of impact.

The present internal state influences how a person perceives events, interprets their meaning, and chooses behavioral responses. Whatever action the person takes (e.g., aggressive or nonaggressive) influences the present social encounter. This sets the stage for the next round in the social interaction cycle.

Of particular relevance to the present article is the fact that finding significant links between exposure to violent video games and aggression does not by itself reveal the primary route of the obtained effect; it could have occurred via cognition, affect, or arousal, or some combination. However, such fine distinctions are crucial to theoretical development and to the public policy debate over whether parents should be given tools to help them control their children's access to violent games. In both the theory and the public policy domains, the precise route(s) of primary impact are important because of the developmental aspects of GAM.

Long-term effects of media violence involve learning processes, such as learning how to perceive, interpret, judge, and respond to events in the physical and social environment. Various types of knowledge structures (e.g., perception, interpretation, judgment, and action) develop over time and are based on day-to-day observations of and interactions with other people, real (e.g., family) and imagined (e.g., media). Each violent episode, as outlined in Fig. 1, is essentially one more learning trial. Short-term effects become ingrained through the development of aggression-related knowledge structures, which persistently color the person's expectations and perceptions concerning social interactions, especially those with conflictual content.

In a very real sense, a person's set of chronically accessible knowledge structures defines that person's *personality*. Figure 2 displays this developmental aspect of GAM and identifies five types of variables that contribute to the development of an aggressive personality—aggressive beliefs and attitudes, aggressive perceptual schemata, aggressive expectation schemata, aggressive behavior scripts, and aggression desensitization. Four of these variables involve aggressive cognitions. For this reason, short-term effects of violent media on aggression via the cognitive route are particularly important. Temporary mood states and arousal dissipate over time, but rehearsal of aggressive cognitions can lead to long-term changes in multiple aspects of aggressive personality. Furthermore, the literature on the development of behavioral scripts suggests that even a few rehearsals can change a person's expectations and intentions involving important social behaviors (Anderson, 1983; Anderson & Godfrey, 1987; Marsh, Hicks, & Bink, 1998). Figure 3 illustrates the dynamic aspects of the episodic and developmental portions of GAM. Exposure to violent video games can serve as a proximate situational cause, increasing the likelihood that an aggressive behavior will occur

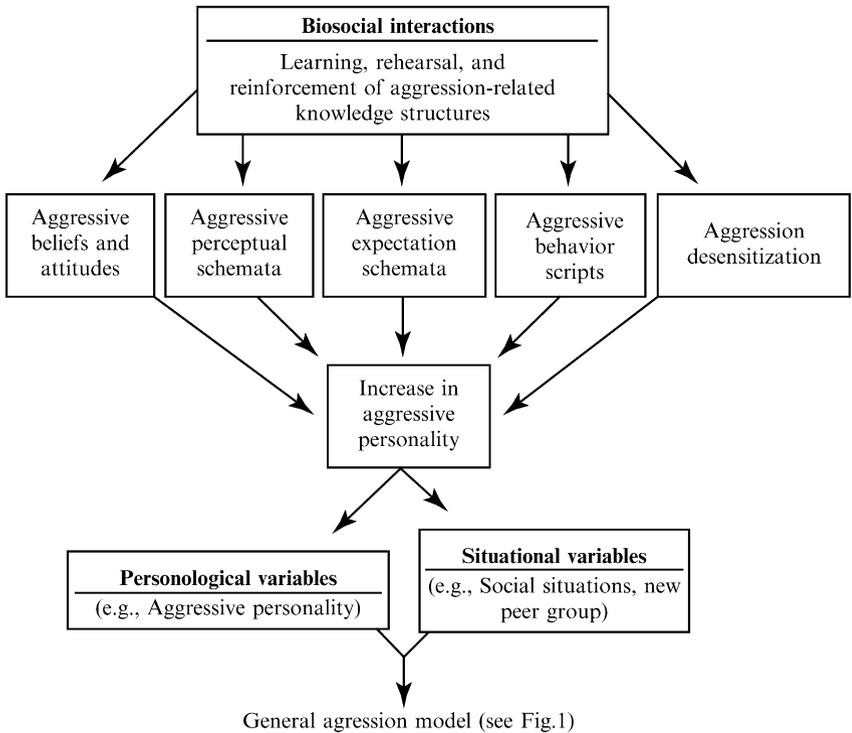


Fig. 2. The general aggression model: developmental/personality processes. *Source:* Anderson and Carnagey, 2004.

shortly after the exposure, but it also can serve as a distal environmental modifier, influencing the development of aggression-related knowledge structures and hence, aggressive personality.

III. GAM and Violent Video Games

A. BASIC ISSUES

Two levels of questions emerge from consideration of GAM and violent video games. First, can violent video games cause increases in aggression? Answering this question does not require a careful analysis of the multiple processes by which input variables can influence the expression of aggressive behavior. It merely requires a body of research in which the effects of violent games are compared to nonviolent games or other appropriate control

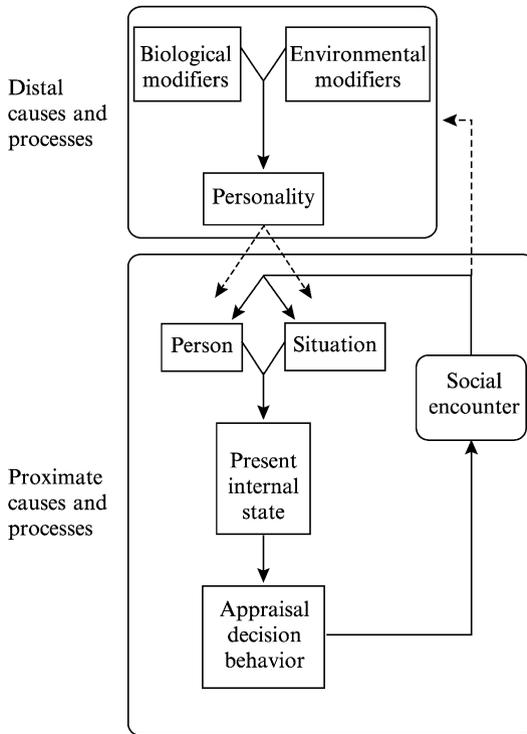


Fig. 3. The general aggression model: overall view. *Source:* Anderson and Carnagey, 2004.

conditions. Much of the existing video game literature is of exactly this nature, and it is at this level that a review of the literature reveals considerable support for the hypothesis that playing violent video games can increase aggression (Anderson & Bushman, 2001). Both experimental and correlational studies, on average, yield significant positive relations between exposure to violent video games and aggressive behavior, with average effect sizes in the $r + = 0.20$ range (Anderson & Bushman, 2001). The experimental studies demonstrate that a brief exposure to violent video games causes an immediate (and presumably short-lived) increase in aggressive behavior. The correlational studies link repeated exposure to violent video games with a variety of types of real-world aggressive behavior, including violent criminal behavior. In sum, despite its relatively small size and recent history, the research literature has demonstrated that violent video games can increase aggression.

The second level of questions to emerge concerns specificity of violent content effects on aggression via the cognitive route. Nonviolent games can

also increase aggressive feelings if, for example, they produce high levels of frustration. They also can increase arousal, if they are sufficiently demanding and engaging. Thus, both violent and nonviolent games may influence aggression in the immediate situation if they increase aggressive feelings or arousal. The real crux of the debate over effects of violent video games lies in their unique ability to directly increase aggressive cognitions, cognitions that can have a much longer lasting impact if their repeated instantiation (by repeated violent video game play, for instance) leads to persistent changes in key knowledge structures, such as more positive attitudes toward aggression.

B. KEY QUESTIONS

Three key second-level questions remain unanswered by existing research on violent video games. First, do violent video games generally increase aggressive cognitions? Several studies have found significant increases in aggressive thoughts as a function of exposure to violent video games (see Anderson & Bushman, 2001), but most have not explicitly controlled for other potential differences between the target video games, such as differences in affective or arousal properties. In fact, only one published experimental study has successfully controlled for both arousal and affective features (Anderson & Dill, 2000, Study 2); the violent game yielded higher aggressive cognition scores.

Second, does violent video game content *by itself* cause short-term increases in aggressive behavior tendencies? As GAM makes clear, to cleanly test this specific violent content question in an experimental setting the comparison violent and nonviolent video games should be equated on arousal level and affective factors such as enjoyment, frustration, and state hostility. Such controls can be done by selecting violent and nonviolent games that do not differ on these factors, or by including measures of arousal and affect and using them as statistical controls. Only two published experimental studies meet these criteria. Graybill, Strawniak, Hunter, and O'Leary (1987) pretested several video games and equated them on difficulty, excitement, and enjoyment. Interestingly, this is one of the few experimental studies that failed to find a significant effect of video game violence on aggressive behavior. One potential problem with this study is that the pretest ratings of the various games were done by graduate students, whereas the participant population was second through sixth graders. In other words, the "equating" process was somewhat less than optimal. The other experimental study meeting these control criteria was Study 2 of Anderson and Dill (2000), which found a significant increase in aggression attributable to differential violent content.

Third, is repeated exposure to violent video games associated with higher aggression levels, and is this mediated by persistently elevated levels of

aggressive thoughts? To show such an effect, significant positive associations between violent video game exposure, aggressive behavior, and persistent aggressive thoughts would have to be found. Furthermore, the link between video game violence exposure and aggression must be significantly weakened when the persistent aggressive thoughts measure is statistically controlled. As of this writing, there are no published correlational studies of this type.

IV. Overview of the Present Studies

Experiment 1 used 10 video games to examine the effects of violent content on the accessibility of aggressive thoughts, physiological arousal, and aggressive affect. The results of Experiment 1 were used to select a pair of violent and nonviolent video games matched on arousal and affective dimensions but differing in violent content for use in Experiments 2 and 3. Experiment 2 tested whether these two games produce different levels of short-term aggressive behavior. Experiment 3 used two violent and two nonviolent games and a different aggression paradigm in an attempt to replicate the specific violent video game content effect on aggression. It also provided our first test of one factor that might increase or decrease the violent video game effect, specifically the realism of the video game targets of aggression. Experiments 2 and 3 also examined trait hostility and revenge motivation effects on aggression. Correlation Study 1 assessed violent video game exposure, self-reported aggressive behavior, Big five personality factors, and attitudes toward violence. It tested a basic-personality-as-artifact hypothesis as well as an aggressive-cognition-mediation hypothesis. The final new study was an updated meta-analysis of violent video game effects on aggressive behavior, thoughts, and affect; physiological arousal; and prosocial behavior. This analysis also compared average effect sizes of the methodologically best studies to those with significant weaknesses.

V. Experiment 1

A. METHOD

1. *Participants*

Participants were 61 male and 69 female undergraduate students who participated in partial fulfillment of an introductory psychology research requirement. Participants were asked to refrain from alcohol, caffeine,

tobacco products, and exercise for 12 hours prior to the study start time. Participants were randomly assigned to play one of 10 video games.

2. *Materials*

a. Video Games. Ten video games were selected through a review of video game sites on the World Wide Web, popular magazines, and retail outlets. The five violent games were: Dark Forces, Marathon 2, Speed Demon, Street Fighter, and Wolfenstein 3-D. The five nonviolent games were: 3-D Ultra Pinball, Glider Pro, Indy Car II, Jewel Box, and Myst (see the Appendix for a description of the 10 games). We attempted to find games that did not require extensive practice to achieve at least marginal proficiency and that were relatively involving for a college student population. Street Fighter was played on the Super Nintendo Entertainment System, using a 19-inch Sony color television. All other games were played on a Macintosh computer.

b. Video Game Experience. Participants estimated the average number of hours per week spent playing video games in the past few months. Each participant also rated his or her experience with the 10 video games used in this study and an additional four games (SimCity, You Don't Know Jack, Computer Cribbage, A10 Attack) using a 7-point unipolar scale anchored at 1 (Never have played), 4 (Have played some), and 7 (Have played often).

c. Video Game Ratings. After playing the assigned video game, participants completed a 6-item rating scale about the game, rating how difficult the game was to learn, how enjoyable the game was to play, how much action the game had, how violent the game graphics were, how violent the game content was, and how frustrating the game was (Anderson & Ford, 1986). For all items, a response of 1 indicated "low" and a response of 7 indicated "high" on the adjective of interest. Preliminary analyses revealed that the two items measuring the violence of video game content and graphics were highly correlated, so they were averaged to form a composite measure of perceived video game violence.

d. Word Completion Task. The word completion task (Anderson, Carnagey, & Eubanks, 2003; Roediger, Weldon, Stadler, & Riegler, 1992) involves examining a list of 98 words with one or more letters missing, and filling in the missing letters. The missing letters are strategic, such that each item can make more than one word. For instance, one item is "explo_e," which may be completed as "explore" or "explode." Participants were told that their task was to fill in the blanks to make complete words. Participants were given 3 minutes to complete as much of the task as they could. An *accessibility of aggressive thoughts* score was calculated for each participant by dividing the number of aggressive word completions by the total number

of completions. Forty-nine of the items can yield an aggressive word when completed.

e. Cardiovascular Measures. Heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured with an A & D Medical automatic digital blood pressure monitor (model UA-751). The blood pressure cuff was attached to each participant's nondominant upper arm, approximately 1 inch above the elbow. All measurements were obtained while the participants were seated. At each of three measurement periods, HR, SBP, and DBP were collected twice, with approximately 1 minute elapsing between the end of the first measurement and the beginning of the second. The first measurement period (baseline) was after signing the consent form but before game play began. The second measurement was during video game play, and the third was after the video game task.

3. Procedure

Participants were told that the study concerned the ways people learn different types of computer tasks. They were informed that we were interested in possible differences between simple and complex tasks. After completing consent procedures, participants entered a cubicle and completed the Video Game Experience questionnaire. Participants then read directions for the assigned game. The experimenter started the game for the participants. Participants played for approximately 20 minutes. Physiological measures were collected before the start of the game, approximately 10 minutes into game play, and immediately after the game. Participants next performed the word completion task and the Video Game Ratings measure. Participants were debriefed and thanked for their participation.

B. RESULTS AND DISCUSSION

This study had two main goals. One was to compare violent and nonviolent video games on key dimensions so that a pair of games, matched on all dimensions except for violence, could be selected for further in-depth research. The second was to test the hypothesis that playing violent video games primes aggressive thoughts. For all analyses we tested a planned contrast that compared the mean score of participants who had played one of the violent games to the corresponding mean of those who had played one of the nonviolent games.

Sex effects were expected to occur on some measures (e.g., cardiovascular measures, enjoyment of the games) and not on others. When preliminary analyses revealed no sex effects, sex was dropped from the statistical model.

1. Cardiovascular Measures

a. Blood Pressure. A 10 (Video game) \times 2 (Sex: female vs. male) \times 2 (Type: diastolic vs. systolic) \times 3 (Time of assessment: before video game vs. during video game vs. after video game) ANOVA, with type and time as repeated factors, revealed several interesting effects. First, there were significant main effects of sex [$F(1, 86) = 26.11, P < .001, d = 0.43$], time [$F(2, 172) = 9.82, P < .001$], and type [$F(1, 86) = 2312.64, P < .001, d = 4.02$]. Males had higher blood pressure than females ($M_s = 93.46$ and 86.27).¹ Blood pressure increased from the baseline period (before playing the video game, $M = 89.92$) to the video game play period ($M = 91.73$) and then decreased after game play was complete ($M = 87.94$). Of course, SBP was greater than DBP ($M_s = 110.52$ and 69.21 , respectively). There was no main effect of which game was played [$F(9, 86) = 1.67, P > .10$], nor was there any hint of a violent vs. nonviolent game effect [$F(1, 86) = 0.02$, difference not significant]. However, the sex, time, and type main effects were all moderated by various two-way interactions.

The type \times sex interaction [$F(1, 86) = 18.33, P < .001, d = 0.32$] resulted from the fact that the sex effect was larger for SBP ($M_{\text{males}} = 115.95$ vs. $M_{\text{females}} = 105.8$) than for DBP ($M_{\text{males}} = 70.97$ vs. $M_{\text{females}} = 67.45$). The type \times time interaction [$F(2, 172) = 11.88, P < .001$] resulted from the fact that SBP remained relatively constant across the three time periods ($M_{\text{before}} = 111.64$ vs. $M_{\text{during}} = 111.09$ vs. $M_{\text{after}} = 108.83$), whereas DBP was highest during video game play ($M_{\text{before}} = 68.21$ vs. $M_{\text{during}} = 72.37$ vs. $M_{\text{after}} = 67.06$).

The omnibus time \times game interaction [$F(18, 172) = 1.93, P < .02$] is a bit difficult to comprehend. However, the more specific contrast testing the time \times violent vs. nonviolent game interaction was also significant [$F(2, 172) = 5.37, P < .01$] and accounted for much of the omnibus interaction.² On average, participants who played one of the nonviolent games showed a decline in blood pressure across the three time periods ($M_{\text{before}} = 91.41$ vs. $M_{\text{during}} = 90.41$ vs. $M_{\text{after}} = 88.07$). However, those who played one of the violent games showed an increase in blood pressure during video game play, followed by a decrease ($M_{\text{before}} = 88.44$ vs. $M_{\text{during}} = 93.04$ vs. $M_{\text{after}} = 87.81$). In other words, within the present sample of 10 games the violent ones increased arousal, as measured by blood pressure, whereas the nonviolent ones did not. This point is especially important to remember when

¹All reported means are the appropriate adjusted means. All P -levels are based on two-tailed tests. Sample sizes differ somewhat in different analyses as the result of occasional missing values. This occurred most frequently for the cardiovascular measures because of occasional equipment malfunctions.

²In fact, the residual omnibus time \times game interaction was nonsignificant [$F(16, 172) = 1.50, P > .10$].

selecting pairs of games for more in-depth research on the relation between violent content and aggressive behavior. It is also important to note, however, that the postgame assessment of blood pressure showed nearly identical means for the violent and nonviolent games. Therefore, the potential problem of arousal being confounded with violent vs. nonviolent content may not be as severe as many might assume.

b. Heart Rate. Preliminary analyses yielded no sex effects. A 10 (Video game) X 3 (Time of assessment) ANOVA with time as a repeated factor yielded only one marginally significant effect, the time main effect [$F(2, 190) = 2.82, P < .07$]. HR was highest when assessed during game play ($M = 77.50$), and was at about the same relatively low level before ($M = 74.73$) and after ($M = 74.28$) game play. Indeed, a specific contrast comparing HR during game play to the average HR before and after game play was statistically significant [$F(1, 95) = 4.43, P < .04, d = 0.30$]. None of the video game effects (omnibus or violent vs. nonviolent contrast) approached significance (all P values $> .40$).

2. Video Game Ratings

The mean ratings of the games on difficulty, enjoyment, action, frustration, and violence are shown in Table I. There was considerable variability on all five dimensions, which made selection of a pair of games differing primarily on violent content possible.

Ratings of game difficulty were affected by game [$F(9, 120) = 7.86, P < .001$]. The specific contrast comparing violent to nonviolent games was also significant and revealed the violent games to be more difficult ($M = 3.60$) than the nonviolent games ($M = 2.80$) [$F(1, 120) = 8.67, P < .01, d = 0.52$]. However, there was considerable variability within each game type and considerable overlap between the violent and nonviolent games. The violent game difficulty means ranged from 2.09 (Wolfenstein 3D) to 4.38 (Street Fighter). The nonviolent game difficulty means ranged from 1.54 (Ultra Pinball) to 4.83 (Myst).

Participants' enjoyment ratings were also affected by game [$F(9, 110) = 2.23, P < .05$]. However, the comparison between violent and nonviolent games showed that participants enjoyed the violent and nonviolent games equally ($F < 1$). In fact, the nonviolent games were enjoyed slightly more than the violent games. The game \times sex interaction was also significant [$F(9, 110) = 1.97, P < .05$]. However, the specific contrast testing the sex \times game violence interaction was only marginally significant [$F(1, 110) = 3.33, P < .08$]. The slight preference for the nonviolent games was marginally greater for females ($M_{\text{nonviolent}} = 3.81, M_{\text{violent}} = 3.53$) than for males ($M_{\text{nonviolent}} = 4.23, M_{\text{violent}} = 4.11$).

Ratings of game action were significantly affected by game [$F(9, 120) = 8.35, P < .001$]. As shown in Table I, participants found the violent games to

TABLE I
 MEAN RATING OF VIDEO GAME DIFFICULTY, ENJOYMENT, ACTION, FRUSTRATION, AND VIOLENCE
 AS A FUNCTION OF GAME, AND AVERAGES FOR NONVIOLENT AND VIOLENT GAMES

Nonviolent games	Difficulty	Enjoyment*	Action	Frustration	Violence*
Myst	4.83	3.06	1.67	5.33	1.25
Jewel Box	1.77	4.38	2.62	3.69	1.00
Indy Car II	2.21	3.31	2.71	3.79	1.43
3-D Ultra Pinball	1.54	5.40	4.08	2.69	1.62
Glider Pro	3.62	3.94	2.31	4.75	1.41
Average	2.80	4.02	2.68	4.05	1.34
Violent games	Difficulty	Enjoyment	Action	Frustration	Violence
Speed Demon	4.00	3.86	3.42	5.33	3.27
Dark Forces	3.27	4.10	3.18	4.27	4.35
Wolfenstein 3D	2.09	3.70	5.36	3.82	5.92
Marathon 2	4.25	3.69	3.67	4.25	4.86
Street Fighter	4.38	3.74	4.81	4.31	4.94
Average	3.60	3.82	4.09	4.40	4.67
Mean square error	2.37	2.35	2.01	2.38	.97

*Adjusted for sex effects. Possible range of ratings was 1 to 7.

contain more action ($M = 4.09$) than the nonviolent games ($M = 2.68$) [$F(1, 120) = 31.67, P < .001, d = 0.99$].

Participants' ratings of frustration showed a significant game effect [$F(9, 120) = 3.40, P < .001$]. However, the contrast between violent and nonviolent video games was nonsignificant, suggesting that participants found the violent games ($M = 4.40$) and nonviolent games ($M = 4.05$) equally frustrating [$F(1, 120) = 1.61, P > .20, d = 0.23$].

Ratings of the violence of game content showed a significant sex effect [$F(1, 110) = 4.82, P < .05, d = 0.40$]. Females rated the games as more violent than did males ($M_s = 3.20$ & 2.81 , respectively). More importantly, the violence ratings also yielded a significant game effect [$F(9, 110) = 45.81, P < .001$]. As expected, most of this omnibus game effect (87%) was due to the much higher violence ratings given for the violent games than for the nonviolent games ($M_s = 4.68$ & 1.35 , respectively,) [$F(1, 110) = 350.75, P < .001, d = 3.38$]. Furthermore, the sex by game type interaction was not significant [$F(1, 110) = 0.92, P > .3$], indicating that the sex effect did not systematically vary as a function of whether the game was violent or nonviolent.

3. Selection of a Matched Pair

We conducted a number of additional analyses to select a violent/nonviolent game pair most closely matched on irrelevant dimensions (i.e., difficulty, enjoyment, action, and frustration) and differing greatly on violence. Although several pairings appeared to meet our criteria fairly well, we ultimately chose Glider Pro and Marathon 2. We conducted a 2 (game) \times 2 (sex) \times 4 (rating dimension) ANOVA on ratings of these two games, treating the four “irrelevant” rating dimensions (difficulty, enjoyment, action, frustration) as a repeated measures factor. Differential effects of game would show up either as a game main effect or a game \times rating dimension interaction. The only effect that approached statistical significance was the main effect of rating dimension [$F(3, 72) = 3.93, P < .05$]. The adjusted means for difficulty, enjoyment, action, and frustration were 3.96, 3.81, 2.98, and 4.51, respectively. This effect, of course, is irrelevant to the issue of game selection. All other effects had P values $> .15$. We also compared cardiovascular effects of these two games. Differential game effects would appear as an interaction involving the game and time of assessment variables. None of the game \times time interactions (2-way or higher) were significant. Finally, we compared these two games on the violence ratings. The only significant effect was a large effect of game on the violence rating [$F(1, 24) = 53.81, P < .001, d = 2.82$]. Marathon 2 was rated as considerably more violent than Glider Pro [$M_s = 4.86$ and 1.41 , respectively]. The sex main effect approached significance [$F(1, 24) = 4.24, P < .06, d = 0.79$], with females rating the games as more violent than males [$M_s = 3.62$ and 2.65 , respectively]. The sex \times game interaction did not approach significance [$F(1, 24) = 0.11, P > .70$].

Thus, Glider Pro and Marathon 2 were well matched on the irrelevant dimensions and differed greatly on the desired dimension of violence. Of note, these specific game comparisons were based on a relatively small sample size. Therefore, in Experiment 2 on aggressive behavior (which used these two games), we measured these same rating dimensions, as well as blood pressure and HR, as additional statistical controls.

4. Accessibility of Aggressive Thoughts

The second major goal of this study was to test the hypothesis that playing a violent video game can increase the relative accessibility of aggressive thoughts. A series of analyses was conducted to compare the percentage of aggressive word completions after violent versus nonviolent video game play. Each analysis included a specific contrast comparing the average of the nonviolent game conditions to the average of the violent game conditions.

Preliminary analyses indicated that sex of participant did not have any significant impact on the accessibility of aggressive thoughts measure.

a. All 10 Games. Participants produced a significantly higher percentage of aggressive words after violent games ($M = 14.7$) than after nonviolent games ($M = 12.5$) [$F(1, 120) = 4.26, P < .05, d = 0.37$]. Thus, as predicted by GAM, playing violent games increased accessibility of aggressive thoughts, relative to playing nonviolent games.

We conducted several similar analyses with various covariates added to the model. When we controlled for the rating dimensions of difficulty, enjoyment, action, and frustration in this way, the violent vs. nonviolent contrast was still significant [$F(1, 116) = 5.29, P < .05$]. Similarly, the game violence effect was still significant when we controlled for video game experience (hours per week and average experience with 10 specific games) [$F(1, 110) = 4.54, P < .05$]. When physiological arousal changes were statistically controlled (baseline to after video game play), the game violence effect was still significant [$F(1, 103) = 5.74, P < .05$]. However, when we controlled for rated violence of the games, the game violence effect became nonsignificant [$F(1, 119) = 2.35, P > .12$], as expected. In fact, controlling for the rated violence of the games reduced the game violence effect on aggressive thoughts by 45%.

Finally, we performed an analysis that treated the specific games chosen to represent the violent and nonviolent types as random effects, rather than fixed (Winer, 1971). This entails using the between groups sums of squares, within each of the violent and nonviolent game types, to estimate measurement error, with 8 degrees of freedom. This tests the generalizability of the video game violence effect across specific games (Wells & Windschitl, 1999). It also yielded a significant game violence effect [$F(1, 8) = 8.96, P < .05$]. These results strongly support the hypothesis that violent content in video games causes increases in the accessibility of aggressive thoughts, independent of arousal and affective influences. This is the first study to conclusively demonstrate this specific effect of violent video game content.

b. Glider Pro vs. Marathon 2. We further examined the violent video game effect on aggressive thoughts by using only the two matched games Glider Pro and Marathon 2. Sex effects did not approach significance, so sex was dropped. Despite the small sample size, Marathon 2 participants produced a significantly higher percentage of aggressive words ($M = 15.4$) than did Glider Pro ($M = 10.8$) [$F(1, 26) = 6.03, P < .05, d = 0.95$]. A similar statistical model that included changes in physiological arousal (baseline to after video game play) as covariates yielded similar results. The effect of game was significant [$F(1, 21) = 10.96, P < .01$].

We then ran a series of analyses in which each of the video game rating dimensions were entered as covariates. The analyses with difficulty, enjoyment,

action, and frustration each yielded a significant game effect on aggressive thoughts [$F(1, 25) > 5.00$, P values $< .05$]. As expected, when rated violence of the game was entered as a covariate the game effect became nonsignificant [$F(1, 25) = 2.42$, $P > .10$], again demonstrating the specificity of violent content effects.

VI. Experiment 2

A. METHOD

1. *Participants*

Ninety-seven female and 93 male undergraduates participated, selected on the basis of their responses to the Trait Hostility (TH) scale, administered at the beginning of the semester as part of a battery of questionnaires. Half of the males and half of the females were selected from the top and bottom thirds of the TH distribution. All participated in return for partial course credit for their introductory psychology class.³

2. *Design*

The experiment can be conceived as a 2 (TH: high vs. low) \times 2 (Video game: violent vs. nonviolent) \times 2 (Provocation pattern: increasing vs. ambiguous) \times 2 (Sex: male vs. female) between subjects design. However, TH was used as a continuous variable in all analyses, rather than a two-level categorical variable. This regression approach is statistically more appropriate and more powerful. For all analyses that included a covariate (e.g., TH), we also tested all possible interaction terms involving the covariate. None of these interactions were statistically reliable, so they were dropped from the final statistical models reported in this article. For dependent variables that

³Six participants were dropped because they reported unusually high levels of video game experience or number of hours per week spent playing video games. Our concern was that participants who had extensive video game experience might respond somewhat differently than the normal population. We used the standard procedures described by Tukey (1971) for identifying outliers and "far outliers." Six far outliers were identified, two on the basis of the video game experience scale, four on the hours per week measure. For example, the far outliers on the latter measure reported playing video games from 18 to 24 hours per week in recent months. Five of the six far outliers were males. Supplemental analyses that included these participants yielded the same patterns of aggression as those reported in the Results section, albeit the effect sizes were slightly smaller.

were not significantly influenced by sex of participant, the reported results are based on analyses that dropped sex from the statistical model.

3. *Materials*

a. Trait Hostility. The Trait Hostility Scale is a 30-item self-report inventory designed to measure chronic individual differences in aggressiveness or irritability, adapted from the irritability scale developed by Caprara, Cinanni, D'Imperio, Passerini, Renzi, and Travaglia (1985) (see Anderson, 1997; Dill *et al.*, 1997). Sample items include (1) Whoever insults me or my family is looking for trouble, (2) Sometimes I shout, hit and kick and let off steam. The internal reliability of this scale is generally high; in the present sample coefficient alpha = .86.

b. Video Games. As described earlier, Marathon 2 (violent) and GliderPro (nonviolent) were selected because they were similar on a variety of dimensions in Experiment 1.

c. Competitive Reaction Time Task. A modified version of the Taylor Competitive Reaction Time (CRT) task was used to assess aggressive behavior. The CRT is a widely used and externally valid measure of aggressive behavior (Anderson & Bushman, 1997; Anderson, Lindsay, & Bushman, 1999; Carlson, Marcus-Newhall, & Miller, 1989; Giancola & Chermack, 1998). Participants believe they are competing with another person to see who can respond first upon presentation of a tone. In the standard version of the game, after each trial the "loser" receives an aversive punishment (e.g., loud noise), the intensity of which is supposedly set by the opponent. Prior to each trial, each participant sets the punishment level that supposedly will be delivered to the opponent, if the participant wins the trial. The possible settings range from 0 (no noise) to 10 (100 db). These settings constitute the measure of aggressive behavior.

In the present experiment we used a two-phase version of the task (Anderson, Anderson, Dorr, DeNeve, & Flanagan, 2000; Bartholow & Anderson, 2002; Lindsay & Anderson, 2000). In Phase 1 participants were told that their opponent would set the intensity of the noise blast that the participant would receive as "punishment" on "lose" trials, but that the opponent would not be punished on trials that the participant won. It was further explained that in Phase 2, the roles would be reversed so that the participant would set the intensity of the noise blasts for the opponent, but the participant would not receive punishments on "lose" trials. In actuality, a computer program determined wins and losses as well as the noise intensities and durations delivered to participants in Phase 1. After each trial the participant also saw what noise level was "set" by the opponent, displayed on the computer

screen. All participants were given sample noise blasts of level “2” (60 db) and “8” (90 db) before beginning Phase 1 of the task.

d. Provocation Pattern Manipulation. In Phase 1 of the CRT task, all participants received the same randomly ordered series of 13 wins and 12 losses determined by the computer program. They also received blasts of noise on the “lose” trials. The pattern of noise blasts was either an ambiguous or an increasing provocation pattern (Anderson et al., 2000). Participants in both provocation conditions saw exactly the same punishment settings—8 in the low range, 9 in the middle range, and 8 in the high range, and actually received the same punishments (4 in each range). In the *ambiguous provocation* condition the pattern of noise intensities was random, whereas the *increasing provocation* pattern consisted of mostly low noise intensities on the early trials, middle intensities on the middle trials, and high intensities on later trials. On completion of Phase 1, the experimenter reminded participants that in Phase 2 they would set noise intensities to be delivered to their opponent, and that they would not receive noise blasts on any trial in this phase.

4. Procedure

Participants were randomly assigned to one of the four experimental conditions (video game \times provocation), with the constraint that equal proportions of males and females and that equal proportions of high and low TH participants were run in each condition. Same-sex pairs were run in individual cubicles. On arrival, they were seated in cubicles and asked to read and sign the consent form and to then read instructions for the video game. Participants were told that the study was concerned with the ways people learn different types of computer tasks. Participants were informed that we were interested in possible differences between simple and complex tasks, and that we would be measuring HR and blood pressure throughout the session. Participants played the assigned video game for 20 minutes. Then the CRT task was explained. All participants were told that their opponent would set the noise blasts in Phase 1 while they would set the noise blasts for their opponent to hear in Phase 2. After the CRT task, participants completed a questionnaire that included a manipulation check, some motivation and affect items, some demographic information, and several suspicion check items.

Blood pressure and pulse were measured at five different points in time: (1) before playing the video game, (2) about 10 minutes into the video game, (3) after playing the video game, (4) after Phase 1 of the CRT task, and (5) after Phase 2 of the CRT task. Finally, the participants were debriefed. Care

was taken to ensure that each participant knew it was the computer and not the other participant in the session that set the noise blasts in Phase 1 and that the noise blasts they sent in Phase 2 were received only by the computer.

5. Measures

a. Aggressive Behavior. Aggressive behavior was operationalized as the noise intensity (0–10) sent by the participants to their opponents in Phase 2 of the CRT task. As is common with the CRT task, we examined four different intensity measures: intensity setting on the first trial, and the average settings on trials 2–9, 10–17, and 18–25. The early trials are the most important in this two-phase version of the CRT, especially Trial 1, because it is the first opportunity the participant has to retaliate after being provoked. Note that in the standard one-phase version Trial 1 occurs prior to any provocation, provocations continue throughout the 25 trials, and therefore all trials are of theoretical interest.

b. Cardiovascular Arousal. At each of the five measurement periods, blood pressure and pulse were assessed twice, with an interval of 1 minute between the completion of the first measurement and the beginning of the second.⁴

c. Questionnaires. After the last blood pressure and pulse measurements, participants answered a number of questions about the experiment. One item asked participants if they were ever “angry” during the reaction time task. Responses were on a 5-point unipolar scale anchored at 1 (not at all), 2 (a little bit), 3 (somewhat), 4 (quite a lot), and 5 (a lot). Also included were six items on which participants were to “indicate the extent to which this motive describes your motive when deciding on where to set the noise levels.” These items used the same 5-point scale described above. The six items were (1) I wanted to impair my opponent’s performance in order to win more; (2) I wanted to control my opponent’s level of responses; (3) I wanted to make my opponent mad; (4) I wanted to hurt my opponent; (5) I wanted to pay back my opponent for the noise levels he/she set; (6) I wanted to blast him/her harder than he/she blasted me. The first two items represent instrumental reasons for aggressing. Responses to these two

⁴Heart rate and blood pressure were assessed for two reasons. First, it was an important part of the cover story. Second, we wanted to be able to statistically control for any effects of the video game manipulation on aggression that might be due to changes in arousal. As expected, the video games did not produce differential changes in arousal. Including the cardiovascular change measures as covariates in later analyses of aggressive behavior did not alter the pattern of results in any appreciable way (but did reduce the error term and slightly increased the effect sizes of the video game and provocation manipulations). Thus, for the sake of simplicity these arousal measures are not further discussed.

items were positively correlated ($r = .57, P < .001$), and were combined to form a scale labeled “Instrumental Aggressive Motivation.” The latter four items represent a clearly revengeful type of aggressive motive, were highly correlated, and were combined to form a scale labeled “Revenge Motivation.” Coefficient alpha for this scale was .74.

One question asked “Did the pattern of noise levels that you received appear to be increasing, decreasing, or random?” This item was coded as +1 for increasing, -1 for decreasing, and 0 for random. We expected this manipulation check to yield smaller scores in the “ambiguous” than in the “increasing” provocation condition, because the actual pattern was random in the former and increasing in the latter. A 2 (video game) \times 2 (provocation pattern) analysis of variance (ANOVA) confirmed this expectation. Those in the increasing provocation conditions reported an increasing pattern of noises ($M = .43$), whereas those in the ambiguous condition reported that the pattern seemed random [$(M = .05), F(1, 178) = 43.91, P < .001, d = 0.95$].

An open-ended question asked “What do you think the purpose of this experiment was?” Responses to this item and to the final oral debriefing were used by the experimenter to rate each participant as either not suspicious (0), slightly suspicious (1), or suspicious (2). Fourteen participants were classified as suspicious. However, suspicion was unrelated to performance on the main dependent variables, so all were kept.

Participants then completed a “Background Questionnaire” assessing demographic information including height, weight, age, year in school, academic major, and time since using alcohol, caffeine, and exercising. Participants also estimated how many hours per week they had spent playing video games “in recent months.” They then indicated “How much you have ever played each of . . .” 12 specific video games, using a 5-point unipolar scale anchored at 1 (Never have played) and 5 (Have played a lot). The 12 games listed were Wolfenstein 3D, You Don’t Know Jack, Civilization II, A-10 Attack, Computer Cribbage, Street Fighter, Dark Forces, Myst, Indy Car II, Speed Demon, 3-D Ultra Pinball, and Jewelbox. Ratings on these 12 items were combined into a Video Game Experience composite, with a coefficient alpha of .63. Finally, a thorough oral debriefing was given, with notes recorded by the experimenter.

B. RESULTS

1. Aggressive Behavior

Four measures of aggressive behavior were based on the noise punishment levels that participants set for their opponents during Phase 2 of the CRT task. Recall that the key behavioral measure was noise intensity on Trial 1,

because it was the participant's first opportunity to retaliate for noise blasts received during Phase 1. The noise settings for the remaining 24 trials were averaged into three blocks of eight trials each.

The key prediction was that exposure to the violent video game would increase aggressive behavior in the two-phase CRT task. We believed that this effect was most likely to occur in the ambiguous provocation condition, especially on the first or early trials (a time \times video game \times provocation pattern interaction). This is based on an outburst/social justice model of aggressive behavior in the two-phase CRT first described in the Anderson *et al.* (2000) studies of temperature effects. Experiment 5 of that work used a very similar two-phase CRT task with both an ambiguous and an increasing provocation pattern and found that most of the interesting temperature effects occurred in the ambiguous pattern condition, especially on the early trials.

We also expected that TH would be positively related to aggression. All of these predictions were borne out.

We conducted a 2 (video game) \times 2 (provocation pattern) \times 4 (time: trial 1 vs. block 1 vs. block 2 vs. block 3) ANOVA, with the last factor as a repeated measures factor, and with TH as a covariate. We then conducted a set of planned contrasts examining the violent video game effect separately for the two provocation conditions, for each of the four aggression measures. Both the provocation and the TH main effects were significant [$F_s(1, 179) = 5.81$ and 4.69, respectively, $P_s < .05$]. Participants in the increasing provocation condition set lower noise punishments than those in the ambiguous provocation condition ($M_s = 5.06$ and 5.51, respectively, $d = 0.18$). Trait hostility was positively related to noise punishment level ($b = 0.23$). This latter finding provides additional evidence that the two-phase CRT task validly assesses aggressive behavior.

There was also a significant time effect, a time \times provocation pattern interaction, and a time \times video game \times provocation pattern interaction [$F_s(3, 537) = 27.90, 19.81, \text{ and } 4.06; P_s < .01$]. Figure 4 illustrates both the time main effect and the time \times provocation pattern interaction. A simple summary of these effects is that participants tended to produce the same pattern of noise punishments for their opponents in Phase 2 as they had received from their opponents in Phase 1. On average, those in the ambiguous condition gave moderate punishments across the four times, whereas those in the increasing provocation condition delivered punishments that started low and increased across time. Interestingly, this same aggression pattern has occurred in the other two experiments that used the two-phase CRT and both the ambiguous and the increasing provocation pattern (Anderson *et al.*, 2000, Experiment 5; Lindsay & Anderson, 2000, Experiment 4).

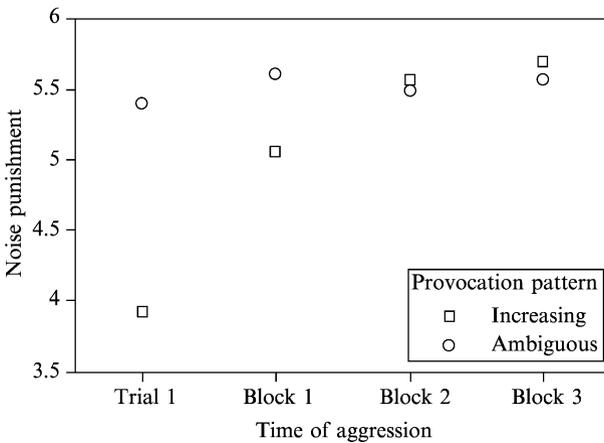


Fig. 4. Noise punishment settings as a function of provocation pattern and time of aggression in Phase 2 of the competitive reaction time task, Experiment 2.

TABLE II
AGGRESSIVE BEHAVIOR (AVERAGE NOISE PUNISHMENT SETTINGS) AS A FUNCTION OF
VIDEO GAME, PROVOCATION PATTERN, AND TIME OF AGGRESSION

Video game	Provocation pattern	<i>n</i>	Trial 1	Block 1	Block 2	Block 3
Violent	Ambiguous	44	5.93	5.64	5.52	5.66
Nonviolent	Ambiguous	46	4.86	5.55	5.48	5.47
Video game effect		—	1.07	0.08	0.04	0.19
Violent	Increasing	46	3.87	5.16	5.75	5.57
Nonviolent	Increasing	48	3.98	4.96	5.38	5.81
Video game effect		—	-0.11	0.20	0.38	-0.24

To more thoroughly examine the video game effects in the context of our main predictions as well as in context of the three-way interaction, we conducted 2 (video game) \times 2 (provocation pattern) ANOVAs with TH as a covariate on each measure of aggressive behavior separately, along with two planned contrasts testing separately the video game effect in ambiguous and increasing provocation pattern conditions. Table II presents the adjusted means. Figure 5 plots the mean differences between the violent and nonviolent video game conditions.

As can be seen, the pattern was essentially as predicted. On Trial 1, there were significant main effects of provocation pattern and trait hostility, and a marginally significant video game \times provocation pattern interaction

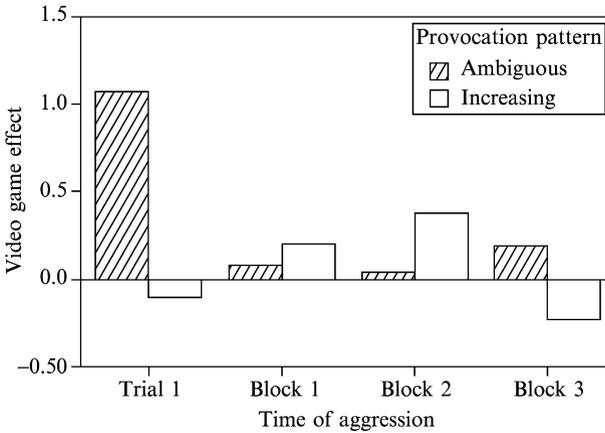


Fig. 5. Violent video game effect on noise punishment settings (violent–nonviolent game conditions) as a function of provocation pattern and time of aggression, controlling for trait hostility, experiment 2.

[$F_s(1, 179) = 22.35, 4.03, \text{ and } 3.56, P_s < .001, .05, \text{ \& } .07, \text{ respectively}$]. The ambiguous provocation pattern led to more aggression than the increasing pattern ($M_s = 5.39 \text{ and } 3.92, d = 0.70$). Trait hostility was positively related to aggression ($b = 0.35$). The specific planned contrasts testing the video game effect separately for the ambiguous and increasing provocation pattern conditions revealed that those who played the violent video game and who had received the ambiguous provocation pattern delivered significantly higher noise punishments to their opponents than did those in the corresponding nonviolent game condition [$F(1, 179) = 5.72, P < .02, d = 0.5$]. Interestingly, those who received the increasing provocation pattern were unaffected by the video games ($F < 1, d = -.05$).

In Block 1 (Trials 2–9) only the provocation and TH main effects were even close to significant. Those in ambiguous provocation conditions delivered greater punishments to their opponents than those in the increasing provocation conditions [$M_s = 5.60 \text{ and } 5.06, \text{ respectively; } F(1, 179) = 7.02, P < .01, d = 0.39$]. Trait hostility was again positively related to aggression [$b = 0.29, F(1, 179) = 6.67, P < .02$]. The video game effect was not significant under either provocation condition ($F_s < 1$). In Blocks 2 and 3, none of the effects of video game, provocation, or TH were significant ($P_s > .10$).

2. *Supplementary Analyses.* Table III presents the correlations among questionnaire variables. The most interesting findings involved the measure of revenge motivation. Revenge motivation correlated positively with feeling angry during the CRT task, instrumental aggressive motivation, and

TABLE III
CORRELATIONS AMONG QUESTIONNAIRE VARIABLES

Variable	Revenge motivation	Video game experience	Hours per week	Angry	Instrumental aggressive motivation
Trait hostility	.25*	.02	.05	.06	.09
Revenge motivation	—	.15 [‡]	.08	.44*	.26*
Video game experience		—	.46*	.05	.15 [‡]
Hours per week			—	.06	.12
Angry				—	.07

Hours per week indicates hours per week spent playing video games.

* $P < .001$. NS range from 174 to 184.

[†] $P < .01$.

[‡] $P < .05$.

experience with the 12 video games included in the questionnaire. To further explore the latter relationship we split the video game experience scale into two subscales and correlated each with revenge and instrumental aggressive motivation. Experience with the six violent video games correlated significantly with revenge motivation ($r = .21$, $P < .01$), and with instrumental aggressive motivation ($r = .15$, $P < .05$). Experience with the six nonviolent video games did not correlate significantly with either type of motivation ($P_s > .5$).

Revenge motivation also correlated positively with TH, which was measured several weeks prior to the laboratory session. This suggests that the TH effect on aggressive behavior may have been mediated by revenge motivation. To test this we ran the same regression ANOVAs on the four measures of aggression but with revenge motivation as a covariate. The TH effect disappeared. In the repeated measures ANOVA the main effect of revenge motivation was highly significant [$F(1, 178) = 52.08$, $P < .001$], but the TH effect did not approach significance ($F < 1$). Similarly, on both of the individual aggression measures that had previously yielded significant effects of TH (Trial 1, Block 1) the revenge motivation effect was quite strong [$F_s(1, 178) = 26.83$ and 35.52 , $b_s = 0.89$ & 0.65 , respectively; $P_s < .001$], and the trait hostility effects became nonsignificant ($P_s > .2$). These results suggest that trait hostility influenced aggression through its effect on revenge motivation.

Interestingly, revenge motivation was not affected by the video game manipulation ($F < 1$). Furthermore, the violent video game effect seen on Trial 1 aggression in the ambiguous provocation condition was not diminished by the inclusion of revenge motivation in the statistical model [$F(1, 178) = 6.96$, $p < .01$]. The difference in adjusted means between the violent and nonviolent video game conditions was essentially the same when

revenge motivation was in the model ($M_s = 5.89$ vs. 4.80) as when it was not in the model ($M_s = 5.93$ vs. 4.86). Thus, revenge motivation did not mediate the video game effect on aggression.

C. DISCUSSION

This experiment has four main findings. First and foremost, playing a violent video game for 20 minutes led to significantly more aggression than did playing a nonviolent game, in exactly the circumstances expected—on the first retaliation opportunity after an ambiguous pattern of provocations. This video game effect on aggression was specifically due to violent content; both the affective and arousal routes were controlled by the selection of games that do not differ on these two dimensions. Second, TH was positively related to aggressive behavior in the CRT task. Third, this effect was mediated by revenge motivation. Finally, the positive correlations between past experience with violent video games and both of the aggressive motive measures (revengeful and instrumental) suggest that repeated exposure to violent video games might increase the likelihood that minor provocations will elicit revengeful and instrumentally aggressive responses.

It is important to note that the violent video game effect occurred only on the first trial in the ambiguous provocation condition. This is the most critical set of circumstances for testing the violent content hypothesis in the two-phase CRT. The lack of video game effects in the increasing provocation condition confirms earlier reports that in the two-phase CRT the ambiguous provocation pattern results in more sensitive tests of other effects than does the increasing provocation pattern (Anderson *et al.*, 2000; Lindsay & Anderson, 2000). Therefore, the lack of a video game effect in the increasing provocation pattern condition should not be seen as a disconfirmation of the violent content hypothesis. Nonetheless, additional tests of the violent content hypothesis are needed. Experiment 3 was conducted in part to provide such a test.

VII. Experiment 3

One major goal was conceptual replication. We made several changes to maximize the gain from this replication test. First, we added two modified games (one violent and one nonviolent) that have not been used in previous studies, in addition to the two games used in Experiment 2 (Wells & Windschitl, 1999). Second, we used the standard one-phase version of the CRT task in which the participant and the “opponent” set punishment levels for each other

on the same set of 25 trials. In this paradigm, aggressive behavior emitted during all 25 trials is relevant, unlike the later trials in the two-phase version.

Two additional changes allowed for a reasonable correlational test of the hypothesis that exposure to media violence is positively associated with aggressive behavior. We used the physical aggression subscale of the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992) as a measure of "trait aggressiveness." We also created an overall media violence exposure variable by combining a shortened version of the violent video games measure used by Anderson and Dill (2000) with a measure of exposure to TV violence.

Finally, Experiment 3 provided a first attempt to examine the effects of varying the realism or the "humanness" of the targets of aggression within a game. It has often been assumed that cartoon-like characters in violent video games (as well as television and movies) would elicit less aggression than human characters, especially among participants older than 10 or 12 years (i.e., participants who can clearly distinguish between the fantasy world of cartoons and the real world). Half of the violent game participants played the original version of *Marathon 2*, in which the targets are humanoid aliens with green blood. The other half played the same game except that the targets were given a human appearance and spouted red blood when shot.

A. METHOD

1. Participants

Two hundred fourteen undergraduate female and male students enrolled in an introductory psychology class participated for course credit. Participants were randomly assigned to one of four conditions. Two of the conditions involved playing a violent video game; the other two involved playing a nonviolent video game. Ten participants were dropped for a variety of reasons, including failure to complete the materials, high confusion about how to play the games, declining to play the assigned video game, and giving impossible answers to some questionnaire items. For instance, one participant reported watching 70 hours of television per week while taking a full course load. Thus, the total final sample size consisted of 134 females and 70 males. The ratio of female/male participants was approximately equal across experimental conditions.

2. Materials & Design

a. Video Games. All video games were played on G3 Power Macintosh computers. The CRT task was conducted with LCIII Macintosh computers. Two of the games were essentially the same as those played in Experiment

2 (the green-blooded alien version of Marathon 2, labeled “Alien” hereafter in this article, and Glider Pro). One minor change was made in the Alien version; the human allies that appeared in the opening scene were removed. The other two games were major modifications of Marathon 2. The violent modified version (labeled “Human”) was identical to Alien except that human figures with red blood replaced the green-blooded aliens. The nonviolent version consisted of the same “world” as Marathon 2, but there were no enemies at which to shoot, and the player’s main task was to explore the world, find replacement oxygen cylinders, and eventually find the transporter in order to return to the ship. This game had a time element built into it, such that the player could “die” if he or she failed to find sufficient oxygen supplies while searching for the transporter. This was labelled the “Explore” condition.⁵

b. Aggression Paradigm. After playing the assigned video game, the participants performed a standard version of the CRT task. Participants were led to believe that they were competing against another college student, and that they would be setting punishment levels for each other prior to each trial. They were to click the mouse button as quickly as possible after hearing a tone. Participants were told, “Once you both have hit the mouse button and the winner is determined, the computer will display a sign that says either ‘YOU WON!’ or ‘YOU LOST!’ If you lose the trial, you will receive the noise your partner chose for you.” There were 25 such trials, the outcomes of which were actually controlled by the computer. The ambiguous win/loss and punishment patterns (described in Experiment 2) were used for all participants. The main measure of aggression was the average noise intensity level set by the participant.

c. Questionnaire. A questionnaire was administered at the end of the CRT task. It contained the following measures that were used in Experiment 2: revenge motivation (coefficient alpha = .85), instrumental aggressive motivation (two items $r = .40$), and angry feelings. Trait hostility was replaced by the nine-item Physical Aggression subscale of the Buss-Perry Aggression Questionnaire (coefficient alpha = .84). The format and style of the items is very similar to the TH scale used in Experiment 2, with scores ranging from 1 to 5. Sample items are “There are people who pushed me so far that we came to blows” and “I get into fights a little more than the

⁵We also modified the opening scenes of the Alien and Human versions to make it somewhat easier, so that novice game players didn’t “die” right away. We thank Brian C. Anderson for making these various changes to the Marathon 2 games. Note that to maximize the power of the comparisons of the two violent game conditions (Alien vs. Human), we set up our randomization schedule so that there would be about twice as many participants in the violent conditions as in the nonviolent conditions. The final sample sizes were: Alien = 70; Human = 62; Glider Pro = 36; Explore = 36.

average person.” Although previous research has shown that this scale loads on the same general factor as the TH scale used in Experiment 2 (Dill et al., 1997), the advantage of the Buss-Perry physical aggression subscale is that all nine items involve aggressive behavior, whereas the TH scale used in Experiment 2 includes several different types of items.

Video game experience was replaced with a composite measure of exposure to video game and television violence. To assess exposure to violent video games, we used a shortened version of the measure reported in Anderson and Dill (2000). Participants listed up to three favorite video games, indicated how often they have played each in recent years, and rated the level of violence in the games. The video game violence exposure measure is created by multiplying the violence rating for each game by the amount of time spent playing that game, and averaging across the three games. Participants also estimated how many hours per week they watch television, and what proportion of time they watch violent television shows. The television violence measure is simply the product of those two estimates. To create the media violence exposure composite, we standardized the video game and television violence scores and summed them.

d. Design. The overall design is thus a 2 (Sex: male vs. female) \times 2 (Content: violent vs. nonviolent) \times 2 (Game version: Old (Alien & Glider Pro) vs. New (Human & Explore). The Physical Aggression scale was used as a covariate.⁶

3. Procedure

Participants were escorted into the laboratory on arrival. After being seated by the video game equipment, participants read and signed a consent form. The cover story explained that the study involved examining how people learn simple and complex computer tasks. They were also told that they would be playing two games, one a single-player game and the other a competitive two-person game. Each participant was given an explanation of how the controller worked and how to play the single-player game, followed by instructions on how to play the CRT task. They were then told that they had been randomly assigned to play the single-player game first and were instructed to play the designated game for 20 minutes. After playing for 20

⁶This scale was not administered at the beginning of the session because we believed that doing so would increase suspicion about the true purpose of the study. To check on the possibility that the experimental manipulations might have systematically influenced scores on this “trait” measure, we conducted a 2 (Content: violent vs. nonviolent) \times 2 [Game version: Old (Alien & Glider Pro) vs. New (Human & Explore)] ANOVA on the trait physical aggression scores. None of the effects approached significance [all F s < 0.15, all P s > .70]. Thus, using this variable as a trait physical aggression covariate seemed appropriate.

minutes, the participant completed the CRT task. Participants were told that they would not meet, see, or learn who their opponent was, but that their opponent was the same sex. After completion of the CRT task, a questionnaire was administered to assess a number of affective and motivational variables, as well as suspicion. During the final debriefing, the experimenter probed for suspicion, explained all procedures, answered any questions, and thanked the participant.⁷

B. RESULTS

1. *Aggressive Behavior*

The main measure of aggressive behavior in this experiment was the average noise intensity level that participants set as punishments for their opponent, averaged across all 25 trials of the CRT task. Both the trait physical aggression effect and the main effect of video game violent content were significant, replicating the main findings of Experiment 2. Trait physical aggression was positively associated with aggression [$F(1, 195) = 15.32$, $P < .001$, $b = .42$]. More importantly, as shown in the left two columns of Fig. 6, participants who had played a violent video game set higher punishment levels than those who had played a nonviolent game [$F(1, 195) = 7.17$, $P < .01$, $d = .38$, $M_s = 5.41$ and 4.83 , respectively]. None of the other main effects or interactions were significant [all $F_s(1, 195) < 3.20$, all $P_s > .07$].

⁷As in Experiment 2, the final questionnaire included items asking participants about the true purpose of the study. In addition, the Experimenter conducted a structured interview designed to detect suspicion as well as to ease into the debriefing. The second author later examined the participants' written comments and the Experimenters' notes and rated each participant on a four-point suspicion scale (0–3). Twenty-two participants indicated that they knew (or strongly believed) that the study was about video games and aggression. These participants were excluded from all analyses. During the year in which this experiment was conducted, a number of stories about violent video games appeared in national, regional, and student newspapers and in a wide array of electronic media, which may account for the increased suspicion rate. Unlike Experiment 2, in which only a few participants were so suspicious and in which suspicion was unrelated to the key dependent variables, in the present study suspicion was highly related to the key measure of aggression. Specifically, the 22 highly suspicious participants produced significantly lower levels of aggression than did the remaining participants [$F(1, 238) = 26.47$, $P < .0001$, $d = .67$]. This finding is similar to other research on suspicion in aggression studies, in which suspicious participants tend to be relatively unaffected by experimental manipulations and tend to display low levels of aggression, presumably as a result of their deciding to not display aggressive inclinations (Berkowitz & Donnerstein, 1982; Carlson, Marcus-Newhall, & Miller, 1990; Kruglanski, 1975). Fortunately, there was no systematic relation between condition of the study and suspicion level [$F(7, 238) = 1.04$, $P > .40$].

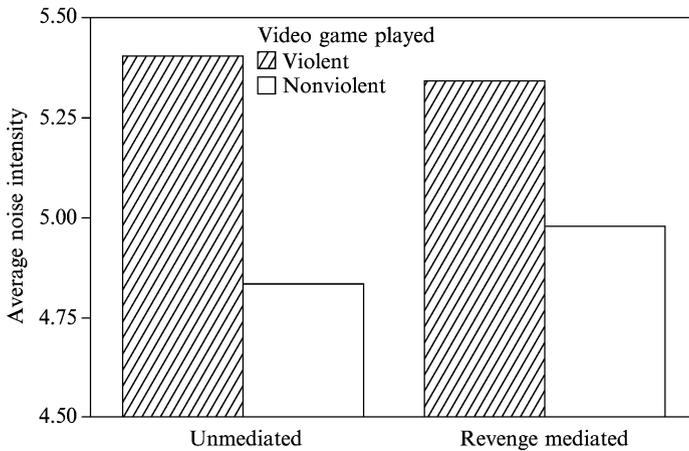


Fig. 6. Covariate adjusted average noise intensity settings as a function of video game violence, without (unmediated) and with revenge motivation as a mediating variable, Experiment 3.

2. Supplementary Analyses

a. Correlations. Table IV presents the correlations among the key questionnaire measures. The pattern of correlations was very similar to that found in Experiment 2. Revenge motivation was positively correlated with feeling angry, instrumental aggressive motivation, and trait physical aggression. The latter suggests that the trait physical aggression effect on aggressive behavior reported earlier may have been mediated by revenge motivation, similar to the TH effect in Experiment 2. We return to this idea shortly.

One of the most interesting correlational findings concerned the relation between media violence exposure and the trait physical aggression measure. As shown in Table 4, the correlation was positive, statistically significant, and in the small to medium range. Trait physical aggression also correlated positively with the number of hours spent with electronic entertainment in general. To further test the hypothesis that violent content is most important in this relation, rather than simply number of hours spent on electronic entertainment, we conducted a simple regression analysis that included media violence exposure and number of hours per week spent on video games and television as predictors of trait physical aggression. The media violence measure remained a significant predictor [$F(1, 200) = 18.79, P < .001, b = .43$]. When sex was also added to the model, the media violence effect remained significant [$F(1, 199) = 6.68, P < .02, b = .27$].

TABLE IV
CORRELATIONS AMONG KEY QUESTIONNAIRE VARIABLES

Variable	Revenge motivation	Hours per week	Angry	Instrumental aggressive motivation	Media violence
Trait physical aggression	.39*	.23*	.13	.10	.36*
Revenge motivation	—	.05	.48*	.49*	.07
Hours per week	—	—	-.04	-.02	.55*
Angry	—	—	—	.18 [†]	-.00
Instrumental aggressive motivation	—	—	—	—	-.03

Hours per week indicates hours per week spent playing video games and watching television.

* $P < .001$. NS range from 203 to 204.

[†] $P < .01$.

[‡] $P < .05$.

b. Mediation by Revenge. Revenge motivation was further analyzed with a 2 (Sex: male vs. female) \times 2 (Content: violent vs. nonviolent) \times 2 (Game version: Old (Alien and Glider Pro) vs. New (Human and Explore) ANCOVA, with trait physical aggression as a covariate. There was a significant main effect of violent content on revenge motivation [$F(1, 195) = 8.24, P < .01, d = .41$]. Participants in the violent game conditions reported higher levels of revenge motives than did those in the nonviolent game conditions [$M_s = 1.97$ and 1.63 , respectively]. There was also a significant effect of trait physical aggression [$b = .43, F(1, 195) = 31.83, P < .001$]. This suggests that both the trait physical aggression effect and the video game effect on aggression may have been mediated by revenge motivation.

To test the mediation hypothesis, we added revenge motivation to the ANCOVA model and examined the change in aggression score variance accounted for by trait physical aggression and by the video game violence manipulation. In both cases, the proportion of unique variance attributed to the predictor dropped significantly. Revenge motivation accounted for 77% of the variance attributed to the trait physical aggression [$F(1, 194) = 13.27, P < .001$]. Nonetheless, the unique variance accounted for by trait physical aggression still remained statistically significant [$F(1, 194) = 3.92, P < .05$]. Thus, it appeared that revenge motivation mediated most but not all of the trait physical aggression effect on aggression.

Revenge motivation accounted for 61% of the the violent video game variance [$F(1, 194) = 4.89, P < .05$]. However, when revenge motivation was partialled out, the video game effect was still marginally significant [$F(1, 194) = 3.16, P < .08$]. Revenge motivation appeared to mediate much

but not all of the video game effect on aggression. The two right columns of Fig. 6 show the video game violence effect after revenge motivation is partialled out of the adjusted means.

c. Alien vs. Human Targets. The two violent versions of Marathon 2 used in this experiment differed only in whether the enemy targets were green-blooded aliens or red-blooded humans. Supplemental analyses were performed on these two violent game conditions. The first set involved ratings of the games provided by participants on the standard dimensions used to select games in Experiment 1: difficulty, enjoyment, violence of graphics and content (averaged), frustration, and action. The 2 (sex) \times 2 (game) ANCOVAs with trait physical aggression as a covariate yielded no significant game main or interaction effects. Indeed, the only reliable effects to emerge from these analyses were main effects of sex on the enjoyment, violence, and frustration ratings [$F_s(1, 127) = 6.78, 8.94, \text{ and } 4.06$, respectively; all $P_s < .05$]. Males enjoyed these two violent games more than females ($M_s = 3.88$ and 3.09). They also rated the games as less violent ($M_s = 4.03$ and 4.87) and less frustrating ($M_s = 3.76$ and 4.38) than females. In sum, the two violent games were essentially equal on these game dimensions, although men and women viewed them somewhat differently.

The most important question concerning the two violent game conditions is whether the substitution of human characters with red blood increased aggression in this short-term context. It did not [$F(1, 127) = 0.36, P > .50$], although the means were slightly in that direction ($M_s = 5.49$ and 5.33 for the Human and Alien conditions, respectively).

C. DISCUSSION

Experiment 3 replicated the main findings of Experiment 2 using two similar violent games (the Alien and Human versions of Marathon 2) versus two nonviolent games (Glider Pro and the exploration version of Marathon 2) and did so with the more standard version of the CRT task. This replication strengthens the hypothesis that violent content in a video game can increase aggressive behavior after a minor provocation, even when the arousal and affective sequela are controlled. Furthermore, the positive association between trait physical aggression and CRT aggression further validates this noise-aggression paradigm. Finally, the trait physical aggression effect on aggressive behavior was partially mediated by revenge motivation, similar to the TH effect in Experiment 2.

Experiment 3 also found essentially equivalent effects of the two violent versions of Marathon 2—the green-blooded alien or red-blooded human

enemies. This strongly contradicts conventional wisdom and some research on television violence, both of which suggest that more realistic violence would have a relatively greater impact. Of course, failure to find a statistically significant effect is not sufficient to claim that the effect does not exist. Two alternative explanations for the lack of a “realism” effect are quite plausible. First, it may be that the realism effect occurs in repeated exposure long-term contexts but not in a short-term context. This would be true if the realism effect operates as a kind of systematic desensitization effect (Carnagey, Bushman, & Anderson, under review). Second, the high realism condition in Experiment 3 (i.e., the Human-red blood version of Marathon 2) may not have been sufficiently realistic. Further work (not speculation) is needed on the realism effect.

Finally, Experiment 3 found additional correlational support for the link between exposure to media violence and general level of trait physical aggression. By themselves, such correlational data are not conclusive regarding causality, but they lend support for the hypothesis that repeated exposure to violent media leads to relatively high levels of trait aggressiveness.

VIII. Correlation Study 1

A. OVERVIEW

The primary purpose was to test the hypothesis that repeated exposure to violent video games would be positively associated with aggressive behavior and persistent aggressive cognitions (e.g., attitudes toward aggression), and that these persistent aggressive cognitions would at least partially mediate the violent video game exposure–aggression link. A secondary purpose was to examine associations between violent video game exposure and several key personality indicators. Specifically, we included Goldberg’s Big Five scales, the Narcissism scale, and Caprara’s Emotional Susceptibility scale. If repeated exposure to violent video games does influence basic personality development, then associations should be found between such exposure and personality indicators known to be related to habitual aggressive behavior tendencies, such as Goldberg’s agreeableness and conscientiousness factors, narcissism, and emotional susceptibility. Of course, such associations could reflect the opposite causal direction. That is, basic personality factors favoring aggressiveness might well predispose some individuals to enjoying and playing violent video games. A cross-sectional correlation study of this type cannot, by itself, conclusively rule out this alternative. However, this alternative further implies that any significant correlations between violent video

game exposure and aggression should become nonsignificant when basic personality factors are statistically controlled.

In sum, strong support for the hypothesis that repeated exposure to violent video games increases aggressive behavior tendencies and does so through changes in persistent aggressive cognitions would consist of three parts. First, there must be significant associations between violent video game exposure and aggressive behavior tendencies. Second, these associations should persist even when basic personality factors are statistically controlled. Third, these associations should be substantially reduced when persistent aggressive cognitions are statistically controlled. Adequate testing of these ideas requires a large sample size, so that lack of statistical power does not lead to type I inferential errors.

B. METHOD

1. *Participants*

Three hundred seventeen male and 489 female college students at a large midwestern university participated in a large mass testing questionnaire session for partial credit toward introductory psychology course requirements.

2. *Measures*

a. Video Game Violence Exposure. Video game violence exposure (VGV) was assessed using the same shortened version of the Anderson and Dill (2000) measure described earlier in Experiment 3. Across the three video game items, coefficient alpha was .83, only slightly lower than the .86 alpha reported by Anderson and Dill (2000) for their five-game version of this measure.

b. Basic Personality. We measured seven basic personality factors, the Big Five as well as two more specific factors that have been theoretically and empirically related to aggression (narcissism and emotional susceptibility). Goldberg's (1992) Big Five measure of basic personality structure consists of 20 items for each factor. Coefficient alphas were: surgency (extraversion) = .87; agreeableness = .91; conscientiousness = .89; emotional stability (neuroticism) = .80; intellect (openness) = .85. The 40-item Narcissism scale (Raskin & Terry, 1988) yielded an alpha of .84. The 27-item Emotional Susceptibility scale (Caprara et al., 1985) yielded an alpha of .91.

c. Attitudes towards Violence. Two measures of attitudes toward violence were used. One was the recently revised 39-item Attitudes towards Violence scale (ATVS; Anderson, Benjamin, Wood, & Bonacci, in press),

with an alpha of .92. The other was the 15-item Adolescent Attitudes towards Violence scale (AATVS; Funk, Elliott, Urman, Flores, & Mock, 1999), with an alpha of .76.

d. Aggressive Behavior. Three measures of trait aggressive behavior were used. The nine-item physical and the five-item verbal aggression subscales of the Aggression Questionnaire (Buss & Perry, 1992) yielded alphas of .85 and .79, respectively. We also used the same standardized 10 physical aggression items used by Anderson and Dill (2000) from the National Youth Survey (Elliot, Huizinga, & Ageton, 1985), which includes behaviors that would be considered criminal if known to police (e.g., assault, robbery). For ease of exposition, the Buss-Perry physical aggression measure will be referred to as *mild physical aggression*, whereas the National Youth Survey measure will be referred to as *severe physical aggression*.

C. RESULTS AND DISCUSSION

1. Zero-order Correlations

As expected, VGV was positively related to each of the three aggression measures and to both attitudes towards violence measures, as can be seen in Table V. VGV was also negatively associated with the Big Five factors of agreeableness and conscientiousness, as expected. VGV was also slightly positively correlated with the Big Five factor of emotional stability. Finally, VGV was positively correlated with narcissism and negatively correlated with emotional susceptibility. There are a number of additional interesting correlations in Table V, but because they are less central to the main hypotheses we leave them for the reader to discover.

2. VGV–Aggression Link and Basic Personality

If the strong correlation between VGV and aggression is due solely to spurious relationships with basic personality factors, such that aggressive people also happen to like violent video games, then statistically controlling for basic personality factors should eliminate the VGV–aggression relationship. We used the destructive testing approach to assess this question (Anderson & Anderson, 1996; Anderson & Dill, 2000). In this approach, one first determines whether a specific predicted relationship exists (e.g., the VGV–aggression correlation). If so, then theoretically meaningful competitor variables (e.g., Big Five) are entered into the regression mode to determine whether these competitors break the target relation. Of primary interest is not whether the initial target link can be broken (i.e., made

TABLE V
CORRELATIONS AMONG KEY QUESTIONNAIRE VARIABLES

Variable	MPA	VA	SPA	ATVS	AATV	B5Su	B5Ag	B5Co	B5ES	B5In	NPI	ES
VGV	.312*	.196*	.166*	.237*	.321*	-.012	-.161*	-.121*	.076 [†]	.029	.159*	-.170*
MPA	—	.438*	.315*	.478*	.696*	-.012	-.319*	-.202*	-.080 [†]	-.043	.197*	.070 [†]
VA	—	—	.131*	.209*	.358*	.180*	-.223*	-.078 [†]	-.091 [†]	.055	.296*	.068
SPA	—	—	—	.250*	.322*	-.003	-.187*	-.130*	-.021	-.100 [†]	.112 [†]	.039
ATVS	—	—	—	—	.527*	-.097 [†]	-.307*	-.137*	-.009	-.220*	.132*	-.007
AATV	—	—	—	—	—	-.068	-.357*	-.235*	-.026	-.108 [†]	.167*	.045
B5Su	—	—	—	—	—	—	.320*	.198*	.137*	.380*	.499*	-.098 [†]
B5Ag	—	—	—	—	—	—	—	.607*	.205*	.489*	-.048	-.066
B5Co	—	—	—	—	—	—	—	—	.222*	.415*	.087 [†]	-.146*
B5ES	—	—	—	—	—	—	—	—	—	.055	.056	-.566*
B5In	—	—	—	—	—	—	—	—	—	—	.262*	-.050
NPI	—	—	—	—	—	—	—	—	—	—	—	-.212*

VGV, Video game violence exposure; *MPA*, mild physical aggression; *VA*, verbal aggression; *SPA*, severe physical aggression; *ATVS*, Attitudes towards Violence scale; *AATV*, Adolescent Attitudes towards Violence scale; *B5Su*, surgency; *B5Ag*, agreeableness; *B5Co*, conscientiousness; *B5ES*, emotional stability; *B5In*, intellect; *NPI*, narcissism; *ES*, emotional susceptibility.

* $P < .001$.

[†] $P < .05$.

$n = 806$.

nonsignificant), because even strong causal links between measured variables can eventually be broken by adding more correlated competitors into the model. Instead, the focus is the durability of the link, with consideration given to the theoretical and empirical strength of the competitor variables.

Table VI presents the results of this destructive testing procedure, displaying the raw slopes linking VGV to each of the three aggression measures, when only VGV is in the model (first column of slopes) and when other competitor variables are partialled out (columns 2–5). We first added sex to the model. The slopes decreased in magnitude but remained statistically significant.⁸ In turn, we added the Big Five factors, then the narcissism measure, and finally the emotional susceptibility measure. As shown in Table VI, the VGV–aggression link survived all of these competitor variables. These

⁸Because sex is highly correlated with exposure to violent video games, partialling out sex effects likely overcorrects for gender differences. Thus, the resulting estimate of the VGV–aggression relation is an extremely conservative one.

TABLE VI
DESTRUCTIVE TESTING RESULTS ON THE VGV/AGGRESSION RELATION

Aggression measure	VGV slopes with various predictor variables in the model				
	VGV	+Sex	+Big 5	+NPI	+ES
Mild physical aggression	.0286*	.0098 [†]	.0082 [†]	.0078 [‡]	.0081 [†]
Verbal aggression	.0182*	.0098 [†]	.0075 [‡]	.0068 [‡]	.0071 [‡]
Severe physical aggression	.0097*	.0058 [‡]	.0056 [‡]	.0053 [‡]	.0055 [‡]
df for <i>F</i> test of VGV effect	1, 804	1, 803	1, 798	1, 797	1, 796

VGV, Video game violence exposure; *Big Five*, five basic personality factors; *NPI*, narcissism personality inventory; *ES*, emotional susceptibility.

* $P < .001$.

[†] $P < .01$.

[‡] $P < .05$.

$n = 806$.

results support the view that the VGV–aggression link is not a spurious artifact of basic personality structure.

3. Persistent Aggressive Thoughts as a Mediator

Our next analysis used the same destructive testing approach, but here the meaning is considerably different because the “competitor” variables are potential mediators of the long-term VGV effect on aggressive tendencies. Our application of GAM to the video game domain explicitly states that the content of violent video games can create long-term changes in a host of aggression-related knowledge structures, many of which can be indexed by measures of general attitudes toward violence. Thus, we expected that adding such attitude measures to the statistical model would result in substantial reductions in the VGV–aggression relation.

Once again, we began with a model having only VGV as the predictor, and then added sex to the model (see columns 1 and 2 of Table VI). Next, we added both attitudes toward violence measures to the model (instead of the personality factors). As anticipated, the VGV – aggression slope decreased substantially for each of the three aggression measures. For mild physical aggression the VGV slope dropped from a significant .0098 ($P < .005$) to a nonsignificant .0013 [$F(1, 801) = 0.28$], an 87% decrease in the slope [(0.0098 - .0013)/.0098]. For verbal aggression the VGV slope dropped from a significant .0098 ($P < .01$) to a nonsignificant .0055 [$F(1, 801) = 2.44$], a 44% decrease. For severe physical aggression the VGV slope dropped from a significant .0058 ($P < .02$) to a nonsignificant .0031 [$F(1, 801) = 1.96$], a 47% decrease.

In sum, these results support the hypothesis that long-term effects of repeated exposure to violent video games on aggressive behavior tendencies are at least partially mediated by changes in persistent aggressive cognitions. Of course, as noted earlier the correlational nature of these results warrants some interpretative caution and further integrative research.

IX. Updated Meta-Analysis

A number of new studies have become available since Anderson and Bushman's (2001) meta-analysis of violent video game effects. We added all of the new studies we could locate to our database and made a few procedural changes to address two specific questions. One question concerned the possibility (frequently offered by media representatives and other critics) that the average effect sizes reported in prior meta-analyses might be inflated by the inclusion of studies with potentially important methodological weaknesses. In the present meta-analytic study, we identified nine methodological weaknesses found in at least some violent video game studies, and we categorized each sample as having none of them (the "Best Practices" studies) or at least one ("Not Best Practices" studies). We compared the average effect size results of this distinction. The second question concerned potential differences between experimental studies (which allow stronger causal statements on the basis of even a few studies) and correlational studies (which typically involve more serious and realistic forms of aggression, and address the long-term effect issue).

A. METHODS

1. *Study Sample*

A complete list of included studies can be found at the following web page: <http://www.psychology.iastate.edu/faculty/caa/abstracts/2000-2004/04AESPref.pdf>. We included all studies that we could locate that had data testing a possible link between exposure to violent video games and one of five types of outcome variables: aggressive behavior (defined as behavior intended to harm another person), aggressive cognition, aggressive affect, helping behavior, and physiological arousal. 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. We used one effect size for each sample for each of the available five dependent

variables. For example, if a sample had three different (and valid) measures of aggressive behavior and a composite of the three, we used the composite measure. If a composite could not be obtained, we used the average of the three separate effect sizes.

2. *Best Practices Coding*

The following potential methodological problems were examined for each sample:

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

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 (relative to a nonviolent video game) can increase aggressive behavior even when there are no arousal differences between the games, pretesting and selecting violent and nonviolent video games that produce equivalent levels of arousal is an excellent methodological feature (as in our Experiments 1–3). However, that same sample does not allow a good test of whether violent video games on average increase arousal. Thus, for aggressive behavior this sample would be coded as a “best practice” one, whereas it would be coded as a “not best practice” sample for physiological arousal.

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 reported 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.

B. RESULTS AND DISCUSSION

1. *Best vs. Not Best Practices*

Figure 7 presents the best vs. not best practices results. In each case the methodologically best samples yielded average effect sizes that were larger than methodologically weaker samples. This was especially pronounced for aggressive behavior and aggressive affect, wherein the 95% confidence intervals for the best and not best samples did not overlap. These results suggest that effect size estimates that include methodologically weaker studies (e.g., Anderson & Bushman, 2001) underestimate the true effect sizes of exposure to violent video games.

2. *Best Practices Samples: Experimental vs. Correlational*

Figure 8 presents the average effect sizes of the best practices samples categorized by type of study. There are no consistent differences in effect sizes for the experimental versus correlational samples. Correlational studies yielded a slightly larger average effect on aggressive and helping behavior than did experimental studies, whereas the opposite was true for aggressive cognition and affect. In all four of these cases the experimental and correlational 95% confidence intervals overlap. Furthermore, both the experimental and correlational effect sizes were significantly different from zero for each outcome variable except physiological arousal, and that was because there are no best practices correlational studies of this type. In sum, despite the relatively small size of this research domain, there is considerable correlational and experimental evidence linking exposure to violent video games with increases in aggressive behavior and to several aggression-related variables.

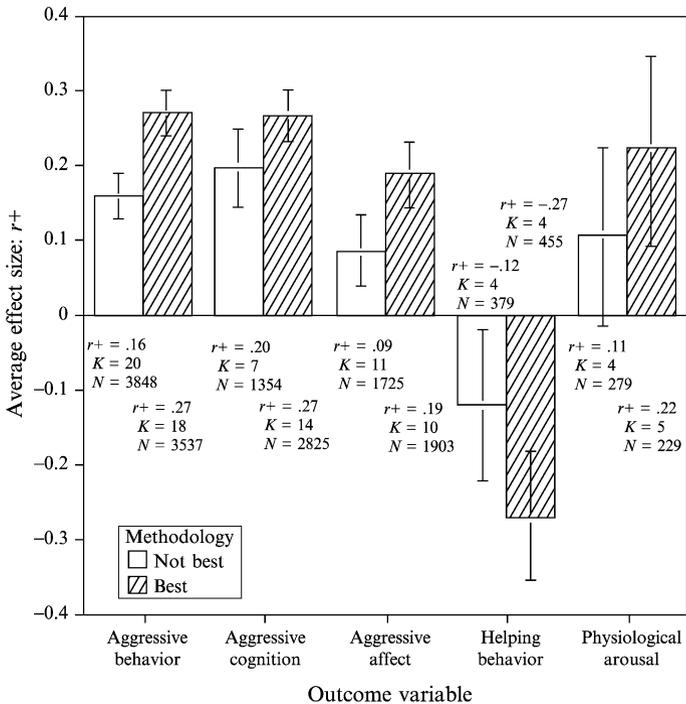


FIG. 7. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, helping behavior, and physiological arousal by best practices methodology. $r+$, average effect size; K , number of independent samples; N , total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals.

X. General Discussion

These five studies (three experiments, one correlational study, one meta-analytic study) contribute to our understanding of human aggression from both a personality processes and a situational effects perspective. We believe these results can best be understood within the GAM theoretical framework described earlier.

A. SITUATIONAL EFFECTS

The main situational finding was that brief exposure to violent video games increased aggressive behavior relative to nonviolent video games matched on arousal and affective dimensions. This occurred in both experiments that measured aggression, regardless of whether the violent game had

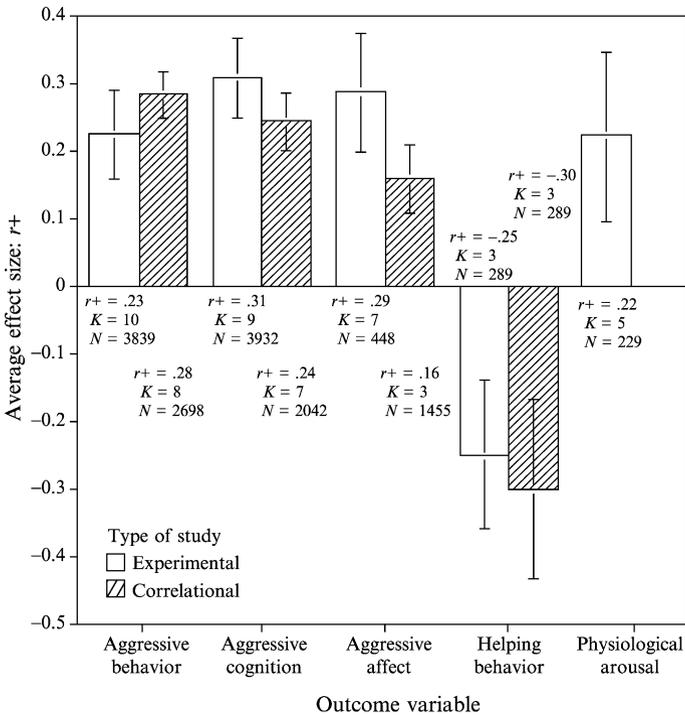


FIG. 8. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, helping behavior, and physiological arousal by type of study for best practices samples. r^+ , average effect size; K , number of independent samples; N , total number of participants. Vertical capped bars are the upper and lower 95% confidence intervals.

green-blooded aliens or red-blooded humans as the enemy targets, and occurred in both versions of the CRT task. The lack of reliable sex X game violence interactions suggests that the effect was similar in men and women.

A second situational finding concerns the cognitive effects of violent video games. Experiment 1 demonstrated that violent games in general produce increases in the relative accessibility of aggressive thoughts. The present findings make a very strong case for the hypothesis that violent video games can (and do) cause increases in aggression because of the violent content of such games, not just because of their arousal or affective properties. The present empirical results in combination with our theoretical analysis also lend support to the concern that repeated exposure to violent video games (or other violent media) might lead to development of an increasingly aggressive personality, and that much of this developmental effect may be the direct result of the violent content. In short, repeatedly thinking

about violent characters, choosing to be aggressive, enacting that aggressive choice, and being rewarded for it can be conceived as a series of learning trials influencing a variety of types of aggressive knowledge structures. Violent video games may well teach players to become more aggressive people.

One interesting difference between the results of Experiments 2 and 3 concerns revenge motivation. There was little evidence that the video game effect in Experiment 2 was mediated by an increase in desire for revenge, but there was considerable evidence that much of the video game effect was mediated by revenge motivation in Experiment 3. The various procedural differences between the two studies may account for these differences, particularly the timing of various measurements in the two-phase versus the standard one-phase CRT task. In any case, it may be useful in future research to explore the possibility that the violent content of violent video games may increase aggression by first priming aggressive cognitions, which in turn increase desire for revenge when mildly provoked.

B. PERSONALITY EFFECTS

Experiments 2 and 3 yielded several findings of general interest from a personality perspective. First, trait hostility (Experiment 2) and trait physical aggression (Experiment 3) were positively related to aggression in the CRT task. This further validates these trait measures and the two versions of the CRT task. Second, both of these effects were largely mediated by revenge motivation. Thus, it appears that one way in which highly hostile people are predisposed to be aggressive against others is through increased revenge motives that are aroused when mildly provoked. We believe that this is the first demonstration that such trait effects on aggressive behavior operate through increases in desire for revenge.

A third finding concerns the question of who is most susceptible to violent video game effects. There is some evidence from the television/movie violence literature that highly aggressive people tend to be more strongly influenced by exposure to violent media than nonaggressive people (e.g., Bushman & Huesmann, 2001). Such person \times situation interactions do not always occur in the media violence literature; sometimes the opposite pattern occurs (e.g., Anderson, 1997). Also, even when this pattern occurs, it is not the case that nonaggressive people are entirely unaffected. A common claim of skeptics and media industry representatives is that only a very few disturbed individuals might be affected at all. In the present studies neither trait hostility (Experiment 2) nor trait physical aggressiveness (Experiment 3) interacted with the violent video game manipulation. That is, the violent video game effect on aggression was not reliably bigger (or smaller) for those

participants who scored high on these traits than for those who scored low. Along these same lines, we did not obtain significant sex \times video game violence interactions on aggressive behavior. We suspect that with larger sample sizes such person \times situation interactions will emerge in some contexts. Nonetheless, the lack of such interactions in the present studies suggests that violent video games influence a sizeable proportion of people.

A fourth finding of interest, from Experiment 2, was that experience with violent video games correlated positively (and significantly) with both revenge motivation and instrumental aggressive motivation, whereas experience with nonviolent video games did not. Although Experiment 2 was not explicitly designed to test these relations, it is interesting that this pattern fits exactly what would be expected if repeated exposure to violent video games does create more aggressive individuals. It also fits with prior research designed to test such effects (e.g., Anderson & Dill, Study 1, 2000).

Fifth, the correlational findings of Experiment 3 that general media violence exposure is positively associated with trait physical aggression, even when time spent on electronic entertainment and sex were statistically controlled, support a long and increasingly strong line of research on media violence effects (e.g., Bushman & Anderson, 2001).

The correlational study provided support for the hypothesized link between repeated exposure to violent video games and increased aggressive tendencies, and did so for three types of aggression: mild physical, verbal, and severe physical aggression. This study also provided the first correlational support for the contention that such long-term effects on aggressive behavior are mediated by persistent aggressive thoughts, here indexed by two different attitudes toward violence measures. Furthermore, this study provided the first correlational evidence that the violent video game exposure link to aggression persists even when a host of basic personality factors are statistically controlled.

Finally, the meta-analysis further revealed consistent effects of violent video game exposure on aggressive behavior, cognition, and affect, as well as on arousal and prosocial behavior. The fact that these effects were stronger in the methodologically strongest studies, and occurred in both experimental and correlation designs (with the exception of arousal), lends further support for our application of GAM to both long- and short-term media violence effects.

C. IMPLICATIONS

There are many questions requiring additional empirical work. One is the need to identify specific features of violent video games that increase or decrease their impact on aggressive thoughts, feelings, and behaviors. Experiment 3

provided one test of the hypothesis that the realism or “humanness” of the game target might exacerbate the effect. It yielded no support for that hypothesis. Further tests using more extremely realistic and gory graphics are needed.

A second question concerns the long-term effects of repeated exposure to violent video games, especially on children and teens. Based on over 40 years of research on television and movie violence, one reasonable expectation is that repeatedly exposing youth to violent video games over a period of years will have a sizeable negative impact on their development. Indeed, there is reason to believe that the video game violence effect will be larger than television violence effects because of the highly engaging and active nature of video games compared with the relatively passive nature of watching TV. Nonetheless, longitudinal research is badly needed to test this prediction and to delineate protective and exacerbating factors.

A third set of questions concerns possible positive effects of games designed to promote prosocial behaviors. Do such games increase prosocial and decrease antisocial behavior? Virtually no research exists on this topic. However, video games are going to remain a major source of entertainment. Therefore we believe it is important to offer empirical evidence and quality theory on which types of features promote a prosocial gaming experience, as well as highlighting the potential antisocial effects of games with violent themes.

XI. Appendix

A. VIOLENT GAME DESCRIPTIONS

- **Dark Forces.** This is a standard first-person shooter. The player assumes the role of a special ops guy in the Rebellion with the objectives of stealing the Death Star plans and getting out alive. This game has a fairly high level of violence, with weapons like a blaster rifle and laser pistol to kill enemy guards and stormtroopers.
- **Marathon 2.** This is a standard first-person shooter, in which the player assumes the role of a space marine trapped in a base that has been taken over by aliens. Your main goal is to retake it and not die. This game has a high violence level, with the basic, underlying premise of the game being to shoot anything that moves and kill or be killed. The targets are mainly aliens, with some “compilers” or robots that the aliens use as slaves.
- **Speed Demon.** This is a 3D combat driving game. The player drives a heavily armed vehicle in a race with other similarly armed vehicles,

shooting at and crashing into them as they do likewise. One gets points for destroying other vehicles.

- **Street Fighter.** This is a third-person fighting game, similar in many ways to *Mortal Kombat*. The player chooses a character and then engages in a series of fights with other characters. Each character has specific strengths and weaknesses.
- **Wolfenstein 3D.** This is a first-person shooter. The player assumes the role of B. J. Blascowitz, an American soldier caught and taken prisoner trying to infiltrate a top-secret Nazi experimentation lab. The goal is to shoot your way out of the prison and kill everything that moves. You can pick up various weapons, including various guns. There is a very high violence rate, with you shooting dogs and Nazi guards, with gory bullet hits and “death poses.”

B. NONVIOLENT GAME DESCRIPTIONS

- **3D Ultra Pinball.** This is simply an electronic version of a pinball game, complete with flippers, buzzers, bells, and various visual and auditory effects.
- **Glider Pro.** Players of this game control the forward and backward motion of paper airplanes through a house. By flying over air ducts one can gain lift. The glider can turn various items on and off (such as light switches, computers). One can earn points by flying over certain objects. If the glider hits the floor or certain other items, it crumples and is replaced by another glider.
- **Indy Car 2.** The player assumes the role of driver in an Indy car race with the goal of winning the race. If you bump other cars or drive too fast on turns, you crash. This game can be played from the keyboard, but is much easier with a steering wheel and pedals.
- **Jewel Box.** This game is a colorful version of Tetris. Various colored shapes drop from the top of the screen. The player manipulates the objects as they fall, trying to create filled rows. When a row is completely filled, it disappears and the player receives points.
- **Myst.** This is a nonviolent exploration/mystery/adventure game with a first-person perspective. It begins on the Island of Myst. Players begin by appearing on the island with no knowledge of how or why they ended up there, or how to proceed. In an ancient library, players discover two mysterious books, which lay out the basic mystery. Players must then travel to several different worlds (“ages”) to unravel the mystery.

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