

REVIEW ARTICLE

Video Games and Real-Life Aggression: Review of the Literature

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Review

Concern about violent video games has been widely expressed [1-3]. A professor of military science has asserted that some games are "very definitely enabling violence" in a way analogous to training programs used by the military and police agencies [4, p. 315]. Also, violent video games have been suggested as a contributing factor in recent school shootings by adolescent males who played violent games [5].

However, population-level evidence suggests that between 1991 and 1997, there was a linear decrease in adolescent weapon-carrying and physical fighting [6], and this downward trend continued in 1999 [7]. Also, between 1993 and 1998 (the most recent year available), national homicide rates dropped from 2.5 to 1.5 per 100,000 for 10- to 14-year-olds and from 20.5 to 11.7 per 100,000 for 15- to 19-year-olds. During this period, video games were ubiquitous, and most games contained violence [8,9], calling into question the notion that video games have a large-scale harmful effect on youth violence. We reviewed the scientific literature to determine whether the

evidence supports a public health concern that violent video games contribute to real-life aggression.

Youth violence and delinquency have been consistently associated with family factors such as child abuse and neglect, parental rejection of the child, and parental criminality and alcoholism [10]. Individual factors such as poor performance in school and on standardized tests, truancy, gang membership, and attention-deficit-hyperactivity and conduct disorders are also consistent predictors of youth violence and delinquency, although these factors may be early manifestations or "markers" rather than causes of later problem behavior.

Violent video games may be considered in the context of war play and other forms of aggressive play by youth. Societal attitudes toward aggressive play differ among adults [11]. Aggressive play differs from real aggression by the fact that it does not include an attempt to injure someone. Although opponents of aggressive play argue that such play fosters real-life violence, proponents argue that it is a natural, even inevitable, aspect of boys' play and provides an opportunity to try to come to terms with war, violence, and death [11].

Several psychological theories are relevant to the possible role of video game violence in youth aggression. J. L. Sherry [personal communication, October 25, 1999] identified six theories used to predict either increased or decreased aggression after violent video game play. First, social learning theory [12,13] suggests that at least some aggression is learned by observing, and then by imitating, a model who acts aggressively. Aggressive video game characters might serve as models for aggressive behavior. Further, rewards such as higher points and longer playing times within the game and increased status

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accorded by peers for success at the game could provide a motivation for increased aggression by reinforcing the behavior.

Second, an arousal theory [14,15] predicts that, if the video game player has an aggressive disposition or is angered, playing an arousing video game might cause increased aggression owing to a generalized increase in energy and intensity. According to this theory, violent video games would be expected to increase aggression only in the presence of anger from some other cause.

Third, a cognitive "priming" theory and a social information-processing model [5,16-18] suggest that violent video games will activate related cognitive structures, making it more likely that other incoming information would be processed in an "aggression" framework, possibly increasing aggressive behavior. For example, someone for whom thoughts of aggression have been evoked might be more likely to interpret an ambiguous behavior as aggressive and respond accordingly.

Fourth, catharsis theory [19] suggests that violent video games can provide a safe outlet for aggressive thoughts and feelings. Fifth, drive-reduction theory suggests, similar to catharsis theory, that violent video games may be useful in managing aggression. According to this theory, highly stressed or frustrated individuals may play violent video games to reestablish emotional equilibrium through arousal or relaxation [20].

A sixth theory, the general affective aggression Model [5], integrates social learning, arousal, and cognitive processing theories and includes individual variables (such as aggressive personality) as well as situational variables (such as video game play). According to this model, whenever exposure to violent media primes aggressive thoughts, increases hostile feelings, or increases arousal, short-term increases in aggression would be expected. Long-term increases in aggression might also result if video game-playing led to changes in aggression-related knowledge structures or "scripts."

Methods

Methods Used in Identifying Relevant Studies

To access the scientific literature in June, 1999, we searched three computerized databases containing psychological (PsycInfo), educational (ERIC), and medical (MEDLINE) literature. For the PsycInfo database, the terms "video games," "computer games," "human machine systems," and "audiovisual com-

munications media" were crossed with the terms "violence," "aggressiveness," "antisocial behavior," "hostility," and "emotional responses." For the other two databases, the terms "video games" and "computer games" were crossed with the terms "violence" and "aggression." The differences in terms reflected differences in the content and indexing terms used by the three databases.

From the database searches, from a bibliography of literature on electronic games [21], from contacts with several researchers and others interested in this area asking if they knew about unpublished studies or very recent studies, and from references from the obtained articles, we continued identifying articles through mid-2000. We selected for review those studies that examined an association between video game-playing or violent video game-playing and measures of aggressive, hostile, or antisocial behavior; personality; ideation; or mood. We included studies that measured any video game-playing, even if the studies did not measure violent games specifically, because many, if not most, popular video games include violence [9,22]. We included measures of antisocial behavior because aggression is an important component of antisocial behavior.

We did not include in our review possible effects on behaviors other than aggression (e.g., prosocial behaviors or task performance). Also, we did not include other moods or psychological states or traits (e.g., depression, anxiety, self-concept, extroversion, or neuroticism). Although we recognize that mood and psychological states are complex and that aggression may be a factor in some of the measures we excluded (e.g., depression may involve anger directed toward the self), we wanted to focus on the most direct measures of aggression possible. We did not include measures of thoughts or feelings during video game play [13,23] unless these were linked to feelings before or after play, because we were not interested in the experience of video game play *per se*, but rather the effect on aggression outside of the video game.

Finally, we excluded two correlational studies [24,25] because analyses did not control for gender, and it appeared that there were gender differences on both the video game-playing and aggression measures.

Identification of Study Features

To summarize the research findings for each of the studies, we identified four features: (a) study design, (b) ages of participants, (c) the video game variable,

and (d) the type or types of measures of aggression that were used.

Study designs included: (a) experimental (participants were randomly assigned to play a violent or nonviolent video game and then an outcome related to aggression was measured), (b) quasi-experimental (a pretest–posttest design), (c) correlational (participants were asked about their video game-playing habits and about some feeling or behavior related to aggression), and (d) descriptive (participants were asked how video game play affected them).

Participants were categorized into three age groups: (a) preschool and elementary school children, (b) middle and high school students, and (c) college students and young adults. A study that included a wide age range but averaged 18–20 years was coded as college students and young adults, and a study of individuals aged 10–20 years, which did not indicate the average age, was coded as middle and high school students.

The video game variable varied depending on the study design. For experimental studies, we noted whether there was evidence that the violent video game contained significantly more violence than the nonviolent game. For correlational studies, we noted the nature of the questions about video game use (e.g., preference for violent or nonviolent games).

The measures of aggression included: (a) behavioral observations, (b) self-reports, (c) projective tests and scenarios, and (d) teacher and peer ratings. Behavioral observations included observer ratings of children during free-play on behaviors such as physical aggression (e.g., hitting or kicking), verbal aggression (e.g., teasing), and aggression against objects (e.g., hitting a punching bag). Behavioral observations generally occurred for 5–10 minutes after the end of video game play. In some studies, observers also measured the amount of time spent playing with aggressive toys as compared with non-aggressive toys. Aggressive toys included “Bobo doll” punching bags and warrior toys.

Behavioral measures also included responses on machines that participants were told would inflict harm on another individual or that the participant used to indicate the extent of punishment that should be inflicted on another individual. The machines were actually preprogrammed computers. A machine for young children had a “hurt” button and a “help” button, which participants were told would either assist a child playing a game in a next room or make the game more difficult for the (hypothetical) child by making a handle hot [26]. A machine for college students required the students to push a

button faster than his or her (hypothetical) opponent. If the participant was slower, he or she received a noise blast of white noise from the opponent; if faster, he or she determined the duration of the noise blast the opponent would receive. The duration of aversive noise the participant administered was the measure of aggression [5].

Self-reports included paper-and-pencil personality tests and measures of aggressive, antisocial, or hostile behavior; questions about aggressive or antisocial behavior in real or hypothetical situations; and mood checklists in which participants checked off which of a list of adjectives described their current mood. This category also included self-reports of relaxation or pleasure associated with game play.

Projective tests included descriptions of what cartoon figures, depicted in interpersonally frustrating situations, would say, and ratings of the behaviors or feelings of individuals who were described in frustrating or potentially aggressive scenarios. It was assumed that the participants would put themselves in the position of the individual in the situation.

Teacher or peer ratings were made by teachers or peers of the participants as to their levels of aggression or antisocial behavior.

Finally, we noted any tests of whether individual-difference factors, such as gender, influenced reactions to violent video game play. In experimental studies, this notation included tests of whether some groups responded differently to video game play (e.g., whether males or females were more likely to respond aggressively to this type of play). In correlational studies, this notation included whether controlling for individual-difference variables eliminated associations that were found.

Evaluating Results

Where possible, we evaluated results separately for each age group and outcome type, because effects might differ between age groups and because outcomes varied in seriousness (e.g., reporting negative mood versus police contacts). We evaluated the strength of the evidence that video game violence contributes to real-life aggression by using two criteria: strength of design of the available studies and consistency of findings. We also noted other strengths and limitations of the studies (e.g., whether manipulation checks were included) and commented on them in the Results section below and in the “Study Limitations” columns of Tables 1–3.

Table 1. Studies Examining the Association Between Video Game Aggression and Aggressive Thoughts or Behaviors: Preschool and Elementary School Children

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
Brusa (1987) [27]	Experimental	16 male and 16 female 6-year-olds	Aggressive game was rated in a previous study (Anderson and Ford, 1986) as containing mild aggression. Nonaggressive game was pinball.	Behavioral observations of physical and verbal aggression during free play.	No effect of aggressive versus nonaggressive video games. Boys were more aggressive than girls before video game play and reduced aggression to a level similar to girls after play.	Manipulation of video game violence may have been weak, although Anderson and Ford (1986) found increased hostile mood using this same game.
Cooper & Mackie (1986) [28]	Experimental	44 boys and 40 girls in grades 4 and 5	A high- and low-aggression video game and nonaggression pen-and-paper game. Participants rated the games in the intended order of aggression.	Choice between aggressive or nonaggressive toys during 8-min free play and aggression-measurement machine (time spent pressing buzzer indicating punishment level for imagined misbehaving child).	Girls, not boys, played more with an aggressive toy and less with a quiet toy after "aggressive" video game. No effect on aggressive behavior on aggression-measurement machine.	Weak manipulation of video game violence (relatively low violence level of "violent" game). No control for difficulty or enjoyment level: Girls reported less liking for and worse performance on the aggressive game compared with other games, providing a possible alternative explanation for results.
Graybill et al. (1985) [29]	Experimental	116 children in grades 2, 4, and 6	Boxing versus basketball; participants identified more violence in boxing.	Projective test of aggression in which participants described responses of hypothetical person in frustrating situations.	After playing aggressive game, (1) participants showed a beneficial effect of decreased blame of others and (2) nonaggressive females showed more focus on barriers causing frustration. However, (1) was not replicated and it did not appear that (2) was tested in Graybill et al. (1987).	Difficulty or enjoyment levels of violent and nonviolent games may have been different, providing a possible alternative explanation for results. Scoring of one of scales (focus on frustrating barriers) not reliable according to author. No behavioral measure of aggression.
Graybill et al. (1987) [26]	Experimental	146 children in grades 2-6	Three violent and three nonviolent games. Psychology graduate students and participants both identified more violence in the violent than nonviolent games and similar difficulty levels in the two games.	Projective test (describing responses of hypothetical person in frustrating situations); self-reports of aggressive behavior in conflict situations; and aggression-measurement machine (pressing "hurt" button believed to interfere with another child playing game).	No effect of video games.	Scoring of one of scales (regarding focus on frustrating barriers) not reliable according to author. In this study, intended to replicate Graybill et al. [29], games had similar difficulty levels.

Table 1. (Continued)

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
Irwin & Gross (1995) [30]	Experimental	60 boys in grade 2	A martial arts game with physical aggression and a nonaggressive motorcycle race game. Aggressive content not rated independently.	Behavioral observations of physical and verbal aggression to others and objects during free play and in a competitive/frustrating situation; choice of aggressive or nonaggressive toys.	Aggressive video game play associated with more physical and verbal aggression to objects and more verbal aggression to another child during free play, and more physical aggression to another child during competitive/frustrating situation. No effects on toy choice. No differences between reflective and impulsive children.	Difficulty or enjoyment levels of games not controlled. Measure of impulsive/reflective characteristics of children may not have provided sensitive test of differences in responses between these two groups.
Kirsch (1998) [16]	Experimental	29 boys and 23 girls in grades 3 and 4	<i>Mortal Kombat II</i> versus basketball. Aggression levels were not independently rated, but violent game contained physical aggression and nonviolent game did not.	Participant ratings of hypothetical children who injured other children on measures of intention, feelings and extent to which they should be punished.	No consistent findings for intentions, feelings, or punishment.	
Lin & Lepper (1987) [33]	Correlational	122 boys and 88 girls in grades 4–6; 189 rated by teacher	Frequency of playing video games at home and in arcades.	Teacher ratings of aggressiveness.	More aggressive boys reported more frequently playing video games in arcades but not at home. No associations found for girls.	Interpretation of difference between video arcade play and home play is not clear. Study design cannot establish causality.
Schutte et al. (1988) [31]	Experimental	16 boys and 15 girls ages 5–7	Karate versus jungle vine-swinging game. Aggression levels were not independently rated, but aggressive game included physical aggression and nonaggressive game did not.	Behavioral observations of aggressive behavior toward others and objects and toy choice (jungle swing or Bobo doll punching bag toy dressed in karate robe) during free play.	More aggressive behavior after violent video game. Also, children who played a jungle video game played more with the jungle toy; those who played a karate game more aggressive to Bobo doll.	Difficulty or enjoyment levels of aggressive and nonaggressive games not controlled.
Silvern & Williamson (1987) [32]	Experimental for comparison between video game and television, quasi-experimental for change in behavior after play	14 boys and 14 girls ages 4–6	Video game (<i>Space Invaders</i>) was described as violent, but there were no independent ratings of violence level.	Behavioral observations of physical and verbal aggression toward others, physical aggression toward objects, and fantasy aggression during free play.	More aggressive behavior after playing or observing violent game and after watching violent cartoon than at baseline. No effect on fantasy behavior.	No nonaggressive game control group.

Table 2. Studies Examining the Association Between Video Game Aggression and Aggressive Thoughts or Behaviors: Middle and High School Students

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
Dominick (1984) [36]	Correlational	250 students (including 44% males) in grades 11 and 12	Time spent playing video games at home and in arcades (treated as continuous variables).	Self-reports of physical aggression, aggressive delinquency, and aggression in hypothetical situations.	No associations with playing at home. Time playing in arcades associated with aggressive delinquency for both genders and with physical aggression for girls.	Interpretation of differences between associations for home and arcade video game play is not known. Study design cannot establish causality.
Egli & Meyers (1984) [41]	Descriptive	141 male and 10 female video arcade patrons, age range 10–20 yr		Questionnaire asked whether playing video games calmed participants when upset.	Video game play rated as moderately calming.	No objective measure of calming effect. Study design cannot establish causality.
Funk et al. (1999) [37]	Correlational	15 male and 17 female students in middle school (mean age, 12.6 yr; range 11–15)	Preference for violent video games. (At least half, compared with less than half, of favorite video games were violent.)	Self-reports of delinquency, aggression, and total externalizing (outward-directed) problem behaviors.	Boys who reported low preference for violent video games had clinically significant elevation in delinquency, and boys who reported high preference for violent games did not. No significant differences between groups or differences on measures of aggression or total externalizing behaviors.	Study design cannot establish causality.
Griffiths & Hunt (1995) [42]	Descriptive	387 adolescents (58% male and 42% female) aged 12–16 yr		Self-reports of aggressive behavior resulting from computer game playing.	21% of respondents "admitted to aggressive behavior as a direct result of their playing."	No objective measure of aggression after video game play. Study design cannot establish causality.
Kestenbaum & Weinstein (1985) [19]	Correlational	178 male junior high school students aged 11–14 yr	Time and money spent playing video games (High-users spent at least 5 hours or \$5/week on pay video games; Low- users played and spent less than this.)	Self reports of frustration tolerance and problems with police; self ratings of tension before and relaxation after playing video games	High users reported lower frustration tolerance, more trouble with police, more playing when tense and feeling more relaxed after playing.	Home video game play not measured. No objective measure of tension and relaxation. Study design cannot establish causality.

Table 2. (Continued)

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
McClure & Mears (1986) [38]	Correlational	290 students in grades 9–12	Time spent playing video games (Generally, high-rate users = every day; low-rate users = once or twice a month).	Personality measure of psychopathic deviance and self-reports of being sent to principal's office or expelled and receiving speeding tickets.	High users were more likely to report being sent to principal's office but not more likely to report being expelled or to score high on personality measure.	Did not differentiate between home and arcade play. Did not control for gender. Being sent to principal's office may not have been due to aggressive behavior. Study design cannot establish causality.
Nelson & Carlson (1985) [35]	Quasi-experimental	24 males aged 9–15 yr	Ratings pre- and postplaying a violent driving game. Also measured preference for violent or nonviolent games.	Self-rated hostile mood and "psychoticism" (antisocial tendencies).	No change in hostile mood after playing violent games. No associations of game preference with mood or psychoticism.	No nonviolent game for comparison of mood.
Rushbrook (1986) [39]	Correlational	379 females and 304 males in grade 5, 8, and 11	Time spent playing video games (less than 1/2 hour once a week or 1 hour very seldomly versus more than this amount).	Self-reported attitudes toward aggression and rebelliousness.	Time spent playing video games was associated with attitudes accepting of aggression for both genders and attitudes in favor of rebelliousness for girls.	Did not differentiate between home and arcade play. Study design cannot establish causality.
Wiegman & van Schie (1998) [40]	Correlational	144 females and 134 males in grades 7 and 8, aged 10–14 yr	Time spent playing video games (none less than half an hour a day, or more than half an hour a day) and preference for aggressive games. Levels of aggression in video games reported by youth were rated by experts.	Peer ratings of aggressiveness.	Time spent playing video games was not associated with aggression for either gender, but boys rated as more aggressive by peers expressed more preference for aggressive games.	Did not differentiate between home and arcade play. Study design cannot establish causality. Note: an association between video game play and less prosocial behavior, which disappeared when gender was statistically controlled, was apparently due to less video game playing and more prosocial behavior by girls.
Winkle et al. (1987) [34]	Experimental	28 males and 28 females in grade 8	A very aggressive, aggressive, and nonaggressive video games and a no-game control. Aggressive content of games determined by rankings of college students.	Aggression-measurement machine (monetary deductions for mistakes in a "teacher-learner" situation).	No effect of video games on aggression-measurement machine. No differences in responses to aggressive video games by level of aggressive personality.	Aggression-measurement machine may not have been an adequate measure of aggression. Difficulty or enjoyment levels of games not controlled.

Table 3. Studies Examining the Association Between Video Game Aggression and Aggressive Thoughts or Behaviors: College Students and Young Adults

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
Alman (1992) [46]	Experimental	21 male and 24 female college students	Playing or observing playing of a boxing game involved punching opponent.	Self-reports of physical and verbal aggression, backing away, and positive coping in provoking situations.	No differences between playing and observing games on any of the outcome measures.	There was no nonviolent comparison game, and the players' games had less total violence (fewer overall punches) than the observers' games.
Anderson & Dill (2000) [5]	Study 1: Correlational	78 male and 149 female college students	Participants reported on violence level of favorite games and on how much time they spent playing video games.	Self-reported aggressive delinquency (e.g., hitting) and nonaggressive delinquency (e.g., substance use).	Preference for violent games, but not time spent playing, was associated with both aggressive and nonaggressive delinquency. The association with aggressive delinquency was strongest for males with more aggressive/irritable personalities.	Study design does not allow for determination of causality. Arcade and home play not differentiated.
	Study 2: Experimental	106 male and 104 female college students	Violent and nonviolent games were rated by college students as different in violence and similar in difficulty, enjoyment, frustration, and action speed. Violent game rated as more exciting.	Aggression-measurement machine allowed participants to deliver punishment (blasts of white noise) to a "competitor," actually a preprogrammed computer. Reaction time for reading aggressive words compared to other words. Self-reports of hostile mood.	Individuals who played a violent game gave more punishment than those who played a nonviolent game. Also, individuals who played a violent game had relatively faster reaction times to aggressive words than those who played a nonviolent game. No differences in hostile mood.	
Anderson & Ford (1986) [43]	Experimental	60 college students	Highly aggressive game rated by participants as more aggressive than mildly aggressive game, which was in turn rated above neutral point for aggression.	Self-reports of hostile mood.	Self-reports of hostile mood were higher after playing either video game than after no game. Difference between mildly and highly aggressive game was in predicted direction but not statistically significant.	Difficulty or enjoyment levels of games not controlled.

Table 3. (Continued)

Authors	Study Design	Ages and No. of Participants	Video Game Variable	Outcome Measures of Aggression	Findings	Study Limitations
Austin (1987) [44]	Experimental	44 male and 58 female college students	Highly aggressive video game was rated as 8 and moderately aggressive game as 4 on a 10-point violence scale.	Self-reports of hostile mood.	No association between violence level of game and hostile mood after frustration (all participants were angered before video game play).	
Ballard & Wiest (1996) [15]	Experimental	30 male college students	More/less violent versions of <i>Mortal Kombat</i> , based on manufacturer's information, and nonviolent game (billiards).	Self-report of hostile mood and two personality measures of hostility.	Dose-response relationships between violence levels of video games and hostile mood and both personality measures of hostility.	No independent rating of violence level of games. Difficulty or enjoyment levels of games not controlled.
Calvert & Tan (1994) [13]	Experimental	18 male and 18 female college students	Virtual reality game involved shooting a cartoon-like opponent and a pterodactyl. Comparison conditions observed the game or moved around in way similar to movements during game play.	Self-reports of hostile mood.	No association between experimental conditions and hostile mood.	No independent rating of violence level of games.
Gibb et al. (1983) [47]	Correlational	201 male and 79 female video arcade patrons; average age 18–20 yr, range 12–34	Time spent playing video games per week and months of experience with video game play.	Personality measures of hostility-kindness and social deviancy-social conformity.	No associations between hostility or social deviancy and video game play (hours per week, or months of experience) for either males or females.	Did not report associations separately for arcade and home play, which other studies have found to be important.
Nelson & Carlson (1985) [35]	Experimental	48 male college students	Violent driving games involved striking others with cars; nonviolent games involved driving skill.	Self-rated hostile/aggressive mood.	Compared with a pretest, both violent and nonviolent games increased hostile/aggressive moods. No differences were found between aggressive and nonaggressive games.	No independent rating of violence level of games. Difficulty or enjoyment levels not controlled: nonviolent games rated as more preferred and more skill demanding than violent games.
Scott (1995) [45]	Experimental	42 male and 75 female college students	Participants rated games in intended order of aggression (highly aggressive > moderately aggressive > nonaggressive).	Scores on personality measure of aggressiveness.	No dose-response relationship between aggression level of games and self-reported aggressiveness. No differences by level of antisocial personality.	Difficulty or enjoyment levels of games not controlled.

Results

Here we provide a summary of our findings for three age groups and, where numbers of studies were adequate, by outcome type. Detail about individual studies is provided in Tables 1–3.

Preschool Children and Elementary School Students

We identified eight experimental studies [16,26–32] and one correlational study [33] of the youngest age group.

Behavioral observations. Three of four studies using behavioral observations of aggression during free-play found that violent video game play causes increased aggression or aggressive play immediately after the video game. This finding included two studies showing more aggression after an aggressive compared with a nonaggressive video game [30,31] and one study showing more aggression after exposure to either an aggressive video game or a cartoon than before such exposure, with no differences between the game and the cartoon [32]. One of those studies [30] measured aggression in a provoking situation and found increased aggression in this situation as well. The remaining study [27] did not find a difference between aggressive and nonaggressive games. In that study, boys were more aggressive than girls before playing any video game but reduced their aggression to a level similar to that of girls after the video games.

Studies of toy choice yielded inconsistent findings. One study showed that children were more likely to play with a Bobo doll dressed in a karate robe after watching a karate movie [31], one study showed increased play with aggressive toys after a violent video game for girls but not boys [28], and one study (which included only boys) did not show any significant effect of video games on choice of toys [30]. Aggression-measurement machines did not yield significant findings in either of the two studies that used these machines (e.g., children did not press the hurt button longer after playing an aggressive video), although this type of machine had yielded significant effects in research on the effects of television watching [26,28].

Other outcome measures. Results based on other outcome measures were mixed. Hostile attributions were significantly increased after aggressive video game play on half of the measures in one study that

measured these attributions [16]. A set of two studies that used projective tests of aggression showed a beneficial effect of violent video games on less blaming of others, but this effect disappeared when controlling for difficulty levels [26,29]. In the one study that used teacher ratings, ratings of aggression for boys were related to video game play in arcades but not at home; no associations were found for girls [33].

Middle and High School Students

We identified one experimental study [34], one study with quasi-experimental and correlational components [35], six correlational studies [19,36–40], and two descriptive studies [41,42].

Self-reported aggression and antisocial behavior and mood. Results of six correlational studies and one descriptive study of the possible link between self-reported video game play and aggressive behaviors or moods provided mixed results. Two of those studies examined boys' preferences for violent or nonviolent games and found either no association with antisocial behavior [35] or heightened delinquency in boys who preferred less (not more) violent games [37].

Four other studies found associations between the amount of time spent playing video games and at least one measure of self-reported aggression, but specific patterns varied. The first such study found that boys who reported more video game play in arcades but not at home also reported more aggressive delinquency [36]. A similar association for girls became nonsignificant when grades in school and time watching violent television were statistically controlled. The second study found an association of high levels of video game play with problems with police and low frustration tolerance, as well as with feeling more relaxed after play, leading that author to suggest that the games may be helpful to some youth in dealing with developmental conflicts [19]. The third study [38] found more self-reported visits to the principal's office but not more serious antisocial behavior among high video game users. That study did not control for gender, and so, if boys went to the principal's office more often, these results may have been owing to gender differences. The fourth study found that attitudes accepting of aggression were associated with more video game play for both males and females, and attitudes in favor of rebelliousness were associated with more video game play for females [39]. In addition, a descriptive study

[42] reported that 21% of respondents who played computer games indicated increased aggressive behavior owing to the games.

In addition to the finding of more relaxing effects among high video game users [19], a descriptive study reported that participants, overall, rated video game play as being calming when they were upset [41]. However, a quasi-experimental study that measured self-reported mood before and after video game play did not find a significant change in hostile or aggressive mood [35].

Other outcome measures. Other outcome measures showed mixed results. One study that used an aggression-measurement machine did not show an effect of video game play [34]. A study examining the correlation between self-reported time spent playing video games and peer ratings of aggressiveness found that total time spent playing video games was not correlated with aggression, but boys rated as more aggressive by their peers expressed more preference for violent games [40].

College Students and Young Adults

We identified seven experimental studies that compared violent with nonviolent or less violent games [5,13,15,35,43–45], one study that experimentally compared playing to observing a violent game [46], and two correlational studies [5,47] in this age group.

Self-reported aggression and antisocial behavior and mood. Studies examining the possible effects of video games on hostile mood and other measures of aggression and hostility yielded mixed results. Of six experimental studies examining hostile mood, two showed increased hostility after violent video game play [15,43] and four did not [5,13,35,44]. One of those studies not showing a significant mood effect angered the subjects before game play [44]. Also, in that study, those individuals who reported having played video games when tense most often reported that game play made them slightly less tense, and those who reported playing when calm or relaxed most often reported that game play made them slightly less calm or relaxed, suggesting that any tension-reduction or energizing effects of game play may depend on initial mood.

Only one of four studies examining other self-reported measures of aggression and hostility revealed more aggression and hostility after violent video game play [15]. The other studies did not show an association between aggression/hostility and

video game play [45–47]. One of those studies [46] compared the effects of violent video game play with watching the same game (intended to be comparable to watching television) and found that subsequent self-rated aggression was similar for the two groups. Information about the strength of the manipulations did not suggest that the manipulations were stronger in the studies showing significant effects than the other studies that did not show effects [45].

Other outcome measures. We found only one study that used outcome measures other than self-reports in this age group. Anderson and Dill [5] found that college students who had played a violent video game gave more punishment in the form of noise blasts to a supposed competitor (actually a preprogrammed computer) compared with students who played a nonviolent game. Also, immediately after video game play, those individuals who played a violent game processed aggressive words faster relative to other words compared with individuals who played a nonviolent game, suggesting an increased openness to aggression-related information.

Gender Differences in Responses to Video Game Play

In addition to comparing video games with different levels of aggressive content, several studies compared males and females in their responses to video game violence. Generally, gender differences in the ability of violent video games to cause subsequent aggression were not found in experimental studies [13,16, 26–29,34,43,45]. Among correlational studies, no gender differences were reported by more than one study. If gender differences exist, they may depend on specific circumstances, such as whether participants are angered or the target of possible aggression [34].

Other Types of Individual Differences

Several studies looked at other types of individual differences. Graybill et al. [29] differentiated more or less aggressive children, and Irwin and Gross [30] differentiated impulsive and reflective children in experimental studies without identifying consistent differences between these groups. Anderson and Dill [5] found that males who were high in aggression and irritability showed the strongest association between video game play and aggressive behavior.

Discussion

Among young children (about aged 4–8 years), playing an aggressive video game caused increased aggression or aggressive play during free-play immediately after the video game in 3 of the 4 studies. For teenagers, because of the nonexperimental designs and mixed results of these studies, it was not possible to determine whether video game violence affects aggressive behavior. Among college students, there is not consistent evidence that video game play affects aggression or hostility. However, one recent study of college students showed increased aggression in a laboratory task after violent video game play [5].

Other Reviews

We identified three other recent reviews of research on violent video games and aggression. Dill and Dill concluded that “the preponderance of the evidence from the existing literature suggests that exposure to video game violence increases aggressive behavior . . . However, the paucity of empirical data, coupled with a variety of methodological problems and inconsistencies in these data, clearly demonstrate the need for additional research” [48, p. 407]. Griffiths concluded that “the one consistent finding is that the majority of the studies on very young children—as opposed to those in their teens upwards—tend to show that children do become more aggressive after either playing or watching a violent video game. However, all of these come from the use of one particular research methodology (i.e., observation of children’s free play)” [49, p. 203].

J. L. Sherry [personal communication, October 25, 1999] conducted a meta-analysis and found that the overall effect of violent video games on aggression was small. He obtained an overall effect size of .12. By comparison, according to Cohen [50], .20 is a small effect size, .50 is a medium effect size, and .80 is a large effect size. Although the evidence to date is not definitive, Sherry’s review suggested that there is a smaller effect of violent video games on aggression than has been found with television violence on aggression. Sherry also found that more recent games, which contain human characters engaging in violence, registered greater effect sizes than games with more abstract violence.

Including our review, each of the four reviews identified major gaps in the existing research. These gaps include a lack of randomized, well-controlled research, particularly with adolescents; a lack of

research on possible long-term effects; and a lack of research on subsets of individuals, possibly with other risk factors, who may be more susceptible to negative effects of game-playing. Three of the four reviews (including our own) found that the current evidence suggests a role that is either limited in size or scope. Thus, at present, it may be concluded that the research evidence is not supportive of a major public health concern that violent video games lead to real-life violence. However, this conclusion might change as more research is conducted on more recent and increasingly realistic games.

Limitations of the Review

The most obvious explanation for the lack of published experimental studies examining the effect of violent video games on aggressive behavior in teenagers or adults is that few experimental studies have been conducted, although these types of studies are certainly possible [51]. It is also possible that studies were conducted without significant findings, and so were not published [52]. Although we attempted to include all the reports of which we were aware, we have been unable to obtain three dissertation studies [53–55] and one conference report [56] cited in other reports and that appear to be relevant to this review. According to comments about those studies in other reports, it appears that most, if not all of them, yielded nonsignificant findings, so that, if they were included, the evidence for an effect of video game play on aggression would likely be even weaker than we have described.

Our literature review was limited to examining the associations between video games with aggressive content and aggressive and antisocial thoughts, feelings, and behaviors. Negative effects other than increasing aggression, such as reinforcing racist or sexist stereotypes, have also been suggested [9,22]. However, video games may also have positive effects such as training spatial skills or divided-attention performance [57] or helping some youth deal with developmental issues [19,58].

Personality differences influencing reactions to media violence have received relatively little attention. Anderson and Dill [5] found that aggressive and irritable males showed a relatively stronger association between video game violence and aggression than did females or nonaggressive males. Similarly, Zillman and Weaver [59] reported that repeatedly viewing films that show gratuitous violence (such as *Total Recall* and *Die Hard II*) had a more negative effect of increased acceptance of violence as

a means of conflict resolution for males who were high in psychoticism (which involves high levels of hostility and low empathy) than for males low in psychoticism or for females with either level of psychoticism. Weaver and Zillman [59] argued that persons who are "already callous and harbor social discontent and hostility, should be most receptive of the supportive information contained in violent displays. . . persons without such inclinations should find it hard to accept the concept that violent actions are acceptable means of conflict resolution, if only because they respond with empathic distress to portrayals of coercion and victimization" [p. 614]. Other risk factors for violence, such as a history of child abuse, may also influence susceptibility to violence in video games and other media, although this risk factor has not been examined to date.

In conclusion, current research evidence is not supportive of a major concern that violent video games lead to real-life violence. However, well-controlled studies of adolescents are lacking. Also, this conclusion might change as more research is conducted on more recent and increasingly realistic games.

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