



VIDEO GAME VIOLENCE: A REVIEW OF THE EMPIRICAL LITERATURE

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ABSTRACT. *The popularity of video games, especially violent video games, has reached phenomenal proportions. The theoretical line of reasoning that hypothesizes a causal relationship between violent video-game play and aggression draws on the very large literature on media violence effects. Additionally, there are theoretical reasons to believe that video game effects should be stronger than movie or television violence effects. This paper outlines what is known about the relationship between violent video-game playing and aggression. The available literature on virtual reality effects on aggression is discussed as well. The preponderance of the evidence from the existing literature suggests that exposure to video-game violence increases aggressive behavior and other aggression-related phenomena. 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. © 1998 Elsevier Science Ltd*

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All the time people say to me, “Vlad, how do you do it? How come you’re so good at killing people? What’s your secret?” I tell them, “There is no secret. It’s like anything else. Some guys plaster walls, some guys make shoes, I kill people. You just gotta learn the trade and practice until you’re good at it.”

THIS FICTITIOUS DIALOGUE (Victar, 1994) was written by a video-game fan to describe the skills and motivations of a favorite violent video-game character. It epitomizes the realism with which players view their favorite characters, the genuine admiration they feel toward them, and the lessons they learn about violence from them. The purpose of this article is to outline what is known about the relationship between violent video-game playing and aggression. A narrative review was chosen in lieu of a meta-analytic review because of the dearth of experimental findings. We begin by noting the popularity of video games, particularly violent video games, and discuss insights about video-game violence

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that can be gleaned from the existing media violence literature. Next, we discuss why violent video games may actually facilitate aggression even more so than other forms of media violence. We then review the published experimental work that has been done in this area, in an attempt to answer the question—"Is there evidence that short-term exposure to violent video games increases aggressive behavior, thoughts, and feelings?" Next, we review the descriptive data that attempt to link long-term exposure to video games with aggressive behavior and other negative outcomes, particularly decrements in self-esteem. Finally, we discuss conclusions that can be drawn from the present literature, the limitations of the present literature, and implications for future work.

POPULARITY OF VIDEO GAMES

The popularity of video games has reached phenomenal proportions. The video-game industry's leader, Nintendo, sold an average of three games every second of the 12 years from 1983 to 1995 for a total of *one billion* games sold. To put that number in some perspective, that is one game for every teenager on earth, or one game for every person in North America, Europe, and Japan, or enough games that, if laid end to end, would reach around the equator two and a half times. More than 40% of American families own a Nintendo system, for which over 2000 separate games have been created ("Nintendo sells one billionth video game," 1995). Furthermore, Americans spend more money annually on video games than they do on movie tickets. In fact, skyrocketing sales figures have recently tempted some of Hollywood's finest to abandon their filmmaking careers to try to tap this growing gold mine (Elmer-Dewitt, 1993). An industry war is brewing over who can build a bigger, better mousetrap and attract the biggest sales. This war has resulted in increases in technological capabilities that outclass early video games as much as computer word-processing programs outclass stone tablets and chisels as writing tools.

In 1987, Chambers and Ascione reported that 100% of the elementary and junior high students they surveyed indicated that they had played a video game at least once. More recently, Funk (1993) surveyed 357 middle-class seventh and eighth graders, and found that 75% of them played video games at home at least 1 hour a week. Buchman and Funk (1996) found that fourth- through eighth-grade boys played video games an average of 5 to 10 hours a week, and that fourth- through eighth-grade girls played an average of 3 to 6 hours a week.

How Popular Are Violent Video Games?

Of special relevance to this review is the relative popularity of violent video games. Recently, America's top selling video game was *Killer Instinct*, a game that pits two macabre characters (or, more to the point, its two young players) against one another in harsh, bloody combat to the death. The most popular game of 1993 was *Mortal Kombat*[™], which, as the name implies, involves a "to the death" struggle, this time between two humanoid martial arts experts. The popularity of *Mortal Kombat's* violence resulted in the release of increasingly more bloody and gory versions of the game in 1994 and 1995 (Elmer-Dewitt, 1993). In these "improved" versions, characters can enact special "finishing moves," which involve, among other actions, burning opponents down to their skeletons or removing an opponent's head and connected spine. We should also reference the recent most popular arcade game, Sega's *Primal Rage*, which involves giant, prehistoric creatures executing "fatality moves," such as the face ripper and the jugular bite.

Provenzo (1991) recently studied the most popular video games and noted that 40 out of 47 were violent in nature. Braun and Giroux (1989) studied the video games present

in 18 of Montreal's largest arcades. Content analysis of the 21 most popular games indicated that 71% were violent in nature. Of the adolescents surveyed by Funk (1993), 50% reported at least one violent video game among their favorites.

Buchman and Funk (1996) had raters classify the favorite games of 900 fourth through eighth graders into six categories: general entertainment, education, fantasy violence, human violence, nonviolent sports, and sports violence. They found that fantasy and human violence games accounted for about 50% of students' favorite games, with girls more likely to report preferring fantasy violence and boys to report preferring human violence games. This preference for violent games remained constant across grade level. The sports violence category, which was part of the survey for only fourth through sixth graders, accounted for approximately 16% to 20% of favorites for boys and 6% to 15% of the favorites for girls.

Video Game Addiction

One clinician (Klein, 1984) noted that many of the children he counseled were seemingly addicted to video games. Several had skipped classes and spent their lunch money or, alternately, stole or begged money to get their "video game fix" (p. 396). Zimbardo (as cited in Klein, 1984, p. 397) likened video-game players to junkies, saying, "Video game fanatics essentially are cocaine addicts who get an instant rush from an electronic fix." Egli and Meyers (1984) found that 13% of the adolescents they surveyed showed what could be described as compulsive behavior toward video games and sacrificed other attractive activities so that money and time could be devoted to video-game play. Braun and Giroux (1989) called video games, ". . . the perfect paradigm for induction of 'addictive' behavior," and noted that this, ". . . should be of some concern especially with regard to children as consumers" (p. 101).

Given the knowledge that video games in general are very popular and potentially addictive, and that violent video games constitute the lion's share of popular games, it is important to explore the effects of these games on the consumer. How does the existing literature on media violence help us to form theories about the effects of violent video-game play?

LESSONS FROM THE TELEVISION VIOLENCE LITERATURE

The theoretical line of reasoning that hypothesizes a causal relationship between violent video-game play and aggression draws upon the very large literature on media violence effects. The media violence literature has used a variety of designs, including experimental, static observational, and longitudinal designs to support, via triangulation, the hypothesis that exposure to media violence increases aggressive behavior, cognitions, and affect (Huesmann & Miller, 1994). Why should violent video games produce similar effects? A similar relationship should exist because the same conceptual variables are involved. Specifically, video-game violence effects should operate through elaboration and priming of aggressive thought networks, weakening of inhibitions against antisocial behavior, modeling, reinforcement, decreased empathy for others, and the creation of a more violent world view. Each of these mechanisms is discussed below. A competing hypothesis, catharsis, is also discussed.

Priming and Elaboration of Aggressive Thought Networks

One way that exposure to violent video games may lead to greater aggression is through the construction, elaboration, and priming of aggressive thought networks. Leonard Berkowitz' Cognitive Neoassociation Model of Aggression (Berkowitz, 1984, 1990, 1993) proposes that when people are repeatedly exposed to aggression, they create in their minds more

detailed and interconnected aggressive thought networks. Exposure to aggression can trigger related feelings and can bring to mind knowledge of aggression-related skills, memories, and beliefs. It can also color what behaviors are seen as appropriate in a given situation. For example, when a person is exposed to a violent video game, aggressive cognitions and associated affect are activated. Repeated exposure to such aggressive video games could make aggressive cognitions and affect chronically available, thus increasing the likelihood of aggressive responses. In the long term, this would mean that chronic exposure to violent video games would lead to increases in the tendency of an individual to act aggressively and that this effect would be pervasive.

Weakening Inhibitions and "Justified" Aggression

One theory about why exposure to television and movie violence increases aggressive behavior is that increased exposure to media violence weakens inhibitions against engaging in aggressive behavior (e.g., Berkowitz & Geen, 1966). Weakening inhibitions may work through changing an individual's perception of what is normal or acceptable behavior. Increased exposure to violence on the video-game screen should theoretically produce similar increases in aggressive behavior because the same conceptual variables are involved.

Additionally, video-game violence is often portrayed as "justified" (Dominick, 1984). This is particularly true of one of Nintendo's most popular games: *Mortal Kombat*. In *Mortal Kombat*, humans compete in a tournament against evil beings from another dimension so that those beings cannot enter into Earth's dimension and destroy the human race. The literature on media violence clearly shows that violence that takes place in the context of a justifiable motive arouses more aggression than violence that takes place in the context of an unjustifiable motive (Berkowitz, & Geen, 1966; Berkowitz & Rawlings, 1963; Geen & Stonner, 1973, 1974). This increase in aggressive behavior subsequent to viewing "justified aggression" may occur because inhibitions against engaging in aggressive behavior are weakened when the aggression is seen as justified (Geen, 1990).

Modeling and Reinforcement

Albert Bandura's social learning theory (e.g., Bandura, 1971, 1973; Bandura, Ross, & Ross, 1961, 1963) states that children learn what behaviors are appropriate and rewarding in a given situation through observation and reinforcement. For example, once children learn that aggressive behavior is appropriate and that it can be rewarding, they are more likely to choose aggressive responses to conflict situations in their own lives. In the present context, this means that a child playing an aggressive video game may learn that hitting or even shooting another person is the appropriate response in a conflict situation, and that this type of aggression is likely to be reinforced.

Decreased Empathy

Another concern is that violent video-game play may reduce empathy for victims (Buchman & Funk, 1996). Empathy has been found to be lower among known aggressors than among nonaggressors. For example, Rice, Chaplin, Harris, and Coutts (1994) found that rapists were less empathetic than nonrapists. Empathy training has been used with success recently in prison settings to rehabilitate violent criminals (Serin & Kuriychuk, 1994). If violent video-game play indeed depicts victims as deserving attacks (Dominick, 1984), and if these video games tend to portray other humans as "targets," then reduced empathy is likely to be a consequence of violent video-game play, thus putting the player at risk for becoming a more violent individual.

World View

As noted by Buchman and Funk (1996), violent video-game play may also heighten perceptions of the world as a dangerous place. Gerbner and his colleagues (e.g., Gerbner, Gross, Morgan, & Signiorelli, 1980) have proposed that exposure to media violence causes an increase in fear, which leads to the formation of a distorted world view in which violence is considered to be more prevalent than it actually is. Bryant, Carveth, and Brown (1981) examined this phenomenon experimentally and found that short-term exposure to media violence in the lab produced an increase in anxiety and a concern about personal safety. Theoretically, one can expect parallel findings for video games.

Catharsis

Contrary to the theories discussed above, the theory of aggression catharsis would predict that violent video-game play leads to decreases in aggression. Aggression catharsis is the idea that engaging in aggressive behavior can actually lead to a reduction in subsequent aggressive behavior due to a “venting off” of aggressive energy or desires. Research on aggression catharsis (e.g., Geen, Stonner, & Shope, 1975; Geen & Quanty, 1977) has generally shown that behaving aggressively engenders more, and not less, aggressive behavior, although it does tend to lead to a temporary reduction in physiological arousal (see Geen, 1990 for a review of this topic).

WHY VIOLENT VIDEO GAMES MAY BE MORE IMPACTFUL THAN OTHER FORMS OF MEDIA VIOLENCE

The television and movie violence literatures suggest that exposure to video-game violence should increase aggression. There are also theoretical reasons to believe that video-game effects should be stronger than movie and television violence effects. These are discussed below.

Rewards and Punishments

Although the violence observed on television and in the movies is reinforced vicariously (i.e., the violent behavior of the *actor* is rewarded), video-game violence is directly rewarded. That is, the person playing the game behaves aggressively and is rewarded (with points, sound effects, access to new levels of the game, etc.) for doing so. This direct participation in the violence may serve to increase aggressive behavior (Koop, 1982). Video games are created using schedules of reinforcement and punishment that offer goals that are very challenging, yet possible to attain, thus maximizing the player’s energy mobilization for game-directed play (Braun & Giroux, 1989; Brehm, Wright, Solomon, Silka, & Greenberg, 1983).

Braun and Giroux (1989) analyzed the 21 most popular video games in 18 of Montreal’s largest arcades. They found that the great majority of games included a fixed-ratio schedule of reinforcement, which promotes habit maintenance. They also noted that, although variable ratio reinforcement is more powerful than fixed ratio, the fixedness of the reinforcement schedule may not be apparent to video-game players, who experience a great deal of variability and unpredictability in play. To players, the reinforcement schedule may well appear variable. Braun and Giroux also commented that most of the popular arcade games used an appetitive or positive reinforcement paradigm, which has been shown to be more effective than an aversive or negative reinforcement paradigm.

Furthermore, the antisocial behavior present in violent video games generally does not generate realistic consequences for the aggressor (Funk & Buchman, 1996). In fact, it

usually reaps only positive consequences, thus reinforcing antisocial behavior. In violent video games, aggression is often the main goal, and killing adversaries means winning the game and reaping the benefits. While in real life, murder is a crime, in a violent video game, murder is the most reinforced behavior. Additionally, violent video games tend to reinforce negative stereotypes, especially the stereotype of women as helpless victims (Provenzo, 1991). This is particularly distressing when one considers (a) that males comprise the majority of video-game players (Braun, Goupil, Giroux, & Chagnon, 1986; Funk & Buchman, 1996; Loftus & Loftus, 1983); (b) that the overwhelming majority of video-game players are adolescents, a group in the process of developing attitudes and beliefs (Buchman & Funk, 1996; Funk, 1993); and (c) that research on media violence demonstrates a variety of negative consequences from depictions of violence towards women (e.g., Donnerstein, 1984; Donnerstein & Berkowitz, 1981).

Video-Game Play as Symbolic Aggression

The violent video-game player is an active aggressor, making aggressive behavioral choices and carrying them out; thus the player's behavioral repertoire is expanded to include new and varied aggressive alternatives. When playing a video game, the player acts as a game character, not as an observer, as is true with other types of media violence (Calvert & Tan, 1994). In essence, violent video-game play is active, covert role-taking aggression, whereas witnessing television or movie violence is a more passive and vicarious experience.

Simultaneous Exposure

Video games potentially influence the consumer to a greater degree than television or movies because video games *simultaneously* expose the player to modeling, reinforcement, and rehearsal of behaviors (Chambers & Ascione, 1987; Loftus & Loftus, 1983), which is not true of television violence. This is important because the combination of these methods of learning has been shown to affect behavior significantly more than any of the methods used singly (Barton, 1981).

The Trend Toward Realism and Extremity in Video-Game Violence

Until very recently, video-game violence was largely abstract. More than a decade ago, Cooper and Mackie (1986, p. 729) observed that, "The protagonist in many video games is a computer-generated blip on the screen under the control of the player." In 1984, Dominick commented that, "Video game violence is abstract and generally consists of blasting spaceships of stylized aliens into smithereens. Rarely does it involve one human being doing violence to another . . ." (p. 138). In describing *Super Mario Brothers*, Anderson and Morrow (1995, p. 1025) said the goal was to "maneuver [the main characters] through various scenes while simultaneously avoiding cute but deadly creatures."

Five years ago, Nintendo's popular *Mario Brothers* games may have been considered violent because the cartoon-like heroes pelted the equally cartoon-like villains with fireballs or jumped on them to make them disappear. But, today's most popular games, such as *Mortal Kombat*, *Killer Instinct*, *Street Fighter*, *Fatal Fury*, and *Maximum Carnage*, make the Mario Brothers seem as harmless as the Marx Brothers. In these recent games, the characters are humanoid and the violence is realistic and highly graphic. For example, Ballard and Weist (1996, p. 717) described the action depicted in *Mortal Kombat* as follows: "The game includes characters that can kill or be killed by electrocution, ripping out the heart, or decapitation with a quivering spinal cord attached." Surely removing the spinal cord of your opponent cannot accurately be described as cute, nor could the opponents in this game be described as blip-like. In many of the latest violent games there is a wide

array of lethal weapons available to the protagonist (and therefore to the game player) from knives and handguns to automatic weapons, flame throwers, and chain saws, not to mention graphically violent hand-to-hand combat moves. When a character is attacked with this arsenal, blood flows, and realistic groans and screams can be heard (e.g., Scott, 1995 for a description of *Fatal Fury*).

Realism in media violence has been shown to increase the amount of aggressive behavior it engenders. This may be due, in part, to the similarity of aggressive cues available when an aggressive response is encoded and when it is retrieved (see Geen, 1990 for a review of this topic). Thus, the more realistic human targets in today's violent video games should engender more aggressive responding than the symbolic blips and nonhuman characters of earlier games. Additionally, this realism may move video games into the position of being even more dangerous to consumers than other types of media violence.

Furthermore, although video games have a rating system, it is not, at present, enforced. Although youngsters would be denied admittance to the latest Steven Segal movie without parental supervision, they are able to enter any department or toy store in America and purchase graphically violent games like *Mortal Kombat* or *Killer Instinct* without censure. Also, many parents are not in the habit of playing video games with their children, and therefore are not cognizant of the violent content in their children's games, or of the possible deleterious effects. Funk (1992) notes that parents do not typically monitor their child's arcade game play. Bonnafont (as cited in Goldstein, 1992), in a study of French school children, found video-game play to be associated with disrupted parent-child communication. Bonnafont explained that this schism may be fueled by lack of parental understanding of and skill at video games and by parents' excluding themselves from the video-game culture.

Identification with the Aggressor

Identification with video-game characters may be stronger than identification with television or movie characters, in part because players choose a character and play that character's role in the video-game scenario. Many of the games mentioned thus far, including the top-selling *Killer Instinct* and *Mortal Kombat*, allow players to choose their own character from a pool of several available characters. These characters are very individualized, each bearing a particular sex, race, personality type, and possessing particular fighting strengths and weaknesses. This allows players to choose a particular "hero" with whom they identify strongly. In doing so, players may actually imagine being their chosen character and may react emotionally to the aggressive actions of the character and the character's opponent, thus activating in the individual a broad range of aggressive action tendencies. The literature on media violence supports the contention that identification with an aggressor increases the amount of aggression directed toward a victim (e.g., Leyens & Picus, 1973; Perry & Perry, 1976; Turner & Berkowitz, 1972). Leyens and Picus (1973) found that when participants were asked to identify with a prize fighter who would later prove to be victorious in a film scene they were themselves more punitive against an individual who had previously provoked them than were participants who were not asked to identify with the prize fighter.

In addition to the ability to choose one's favorite character and to act as that character in a video game, there is also a trend for players to enter the playing field as themselves, which does not happen in television or movies. A number of recent video games feature a three-dimensional "walk-through" format. This means that the perspective portrayed on the video-game screen is the same perspective through which human beings view real-life activities. In our everyday lives, we do not have a full view of our bodies walking through life, interacting with people and the environment. Rather, we see the world through the window of our own eyes: we see our arms and legs, but not our faces and backs. This

realistic view of the world is being mimicked in many popular games. For example, in the game *Wolfenstein 3D*, players walk through a three-dimensional environment, seeing their hands holding weapons and shooting and stabbing Nazi guards in an attempt to escape from Castle Wolfenstein. Thus, not only do video games offer a chance to choose and identify with the players in a scene, they also allow us essentially to be those players and to experience life in the player's realistically rendered world.

VIRTUAL REALITY

Virtual reality games are the most immersive video games created to date. Virtual reality is a computer-simulated world designed to mimic perceptually the experience of interacting with a three-dimensional environment. Virtual reality allows people to feel that they have visited new worlds and experienced exciting scenarios without ever having left their chairs. It did not take virtual reality game creators long to mimic the violence common in other media genres: creators quickly created violent virtual reality games in which players are visually surrounded by a three-dimensional violent world where they see and feel themselves drawing a virtual gun to shoot and kill their virtual enemies. If the latest three-dimensional video games have more potential to build the aggressive behavioral repertoires of consumers than television shows and movies, then violent virtual reality games constitute another step forward into the danger zone.

EXPERIMENTS

A small amount of experimental research has been conducted in an attempt to determine whether short-term exposure to violent video games increases aggressive behavior and other aggression-related outcomes. Some work has also been done that assesses whether short-term exposure to violent video games produces decrements in prosocial behavior. The data from true experiments, reviewed below, are crucial first steps toward understanding the effects of violent video-game play.

Effects of Violent Video-Game Play on Aggression and Aggression-Related Outcomes

Studies showing aggressive behavior effects. Cooper and Mackie (1986) randomly assigned fourth- and fifth-grade boys and girls to play an aggressive video game (VG—*Missile Command*), a low aggressive VG (*Pac Man*) or a maze-solving game (non-VG control condition) in same-sex pairs. One member of each pair played the assigned game and the other observed game play. The children's free play was then observed and coded for aggressive behavior. Finally, the children were asked to indicate how much punishment they would give to a hypothetical "bad child" and how much reward they would give to a hypothetical "good child" by pressing a buzzer. The duration of the buzzer press indicated how much reward or punishment participants chose to administer to the hypothetical child.

Results indicated that VG type affected only girls' aggressive free play, with the aggressive VG producing higher levels of aggressive free play. Interestingly, the VG did not effect boys' aggressive free play, and the increased aggression among the girls in the aggressive VG condition resulted in bringing these girls' level of aggression up to that of the boys. There was no effect of VG on rewards or punishments given to the hypothetical "good child" or "bad child," respectively. Boys tended to give both more rewards and more

punishments. Players, rather than observers, also gave more rewards and punishments; this was the only effect of the player/observer distinction. It should be noted that, although a pretest indicated significant differences in the aggressive content of *Missile Command* and *Pac Man*, ratings of the participants indicated that *Pac Man* was not significantly different in aggression from *Missile Command* or the control game. Indeed, *Pac Man* has been viewed elsewhere in the literature as an aggressive game (e.g., Dominick, 1984).

Silvern and Williamson (1987) used a pre-post design to study the effects of aggressive video game play and violent television viewing on aggressive, fantasy, and prosocial behavior in 4- to 6-year-old boys and girls. A baseline freeplay session was videotaped prior to television or VG exposure. Next, children came into the lab in two separate experimental sessions. In one session they watched a violent cartoon (*Roadrunner*) with a same-sex partner. In the other session, one partner played an aggressive VG (*Space Invaders*) while the other observed. After each session, the children's free play was videotaped and coded for aggressive, fantasy, and prosocial behavior. Instances of aggressive behavior were approximately twice as numerous as they had been at baseline both after exposure to TV and VG violence, with no differences in aggressive behavior between the TV and VG manipulations. Thus, both TV and VG violence produced relatively equal and significant increases in aggressive behavior. Similarly, prosocial behavior decreased both after exposure to TV and VG violence, with no differences in prosocial behavior between the TV and VG manipulations. There were no main effects of TV or VG play on children's fantasy behavior.

Schutte, Malouff, Post-Gorden, and Rodasta (1988) randomly assigned boys and girls, ranging in age from 5 to 7 years, to play either a violent or a nonviolent video game. The violent VG was a Karate game called *Karateka*, in which the protagonist's goal is to kill villains by physical assault in order to rescue a damsel in distress. In *Jungle Hunt*, the nonaggressive game, the protagonist must swing from vine to vine in order to avoid plummeting to his death. Participants played the VG in matched-sex pairs, after which raters, who were blind to VG condition, observed the free play of the pairs in a room equipped with a bobo doll, dressed in a Karate robe, and a jungle swing toy. Schutte et al. (1988) hypothesized that post-game behavior would be related to video-game theme and that aggressive VG players would display more postgame aggression. In keeping with both hypotheses, children in the *Jungle Hunt* condition played more with the jungle swing than did children in the *Karateka* condition and children in the *Karateka* condition displayed more postgame aggression toward the other child and toward the bobo doll than did children in the *Jungle Hunt* condition. Results were discussed in terms of reward conditioning, modeling, participant modeling, and schema activation.

Irwin and Gross (1995) hypothesized that impulsivity, a variable shown in the past to be related to aggressive behavior (Lahey, Schaughency, Hynd, & Carlson, 1987) would interact with aggressive video-game content to produce heightened levels of postgame aggression. Impulsivity was proposed to affect selection of an aggressive behavioral response because it involves inadequate social information processing coupled with the tendency to select the first available response from the behavioral repertoire. In this case, the first available behavioral response should be aggressive due to priming from the VG.

The authors measured impulsivity in sixty 7- to 8-year-old boys and then randomly assigned them to play an aggressive or nonaggressive VG. The aggressive VG was Nintendo's *Double Dragon*, a street-fighting game in which gang members attempt to kill their enemies with blows from the hands and feet, as well as with weapons such as chain whips. The nonaggressive game was Nintendo's *Excitebike*, in which a lone player races against the clock on an obstacle-packed track. An analysis of covariance (ANCOVA) indicated that heart rate change from baseline was equated for the two games. After game

play, the children's aggressive behaviors in both a free-play and a frustrating/competitive situation were observed and coded by raters. Aggressive toy selection was also measured. Results indicated that violent VG play increased physical and verbal aggression towards objects, increased verbal aggression toward a confederate in a free-play situation, and increased physical aggression toward a confederate in a frustrating/competitive situation.

Others have examined how the content of different VGs affects aggression. Anderson and Morrow (1995) examined instead how differing interpretations of the same game could produce differences in aggressive behavior. Specifically, they were interested in how viewing a game as competitive or cooperative generates differences in aggressive game play. Study 1 indicated that people characterize competitive situations as calling for aggression, more so than cooperative situations. In study 2, male and female undergraduates played Nintendo's *Mario Brothers* video game in pairs with either cooperative or competitive instructions. Results indicated that those in the competitive condition showed a more aggressive play style than those in the cooperative condition, even in the absence of rewards for this behavior. That is, participants in the competitive condition had a significantly higher "kill ratio" in the video game than those in the cooperative condition, even though this difference was not instrumental in attaining their goal of maximizing their forward progress in the game.

Studies showing mixed results or no differences in aggressive behavior or ideation. Two studies by Graybill and colleagues (Graybill, Kirsch, & Esselman, 1985; Graybill, Strawniak, Hunter, & O'Leary, 1987) do not show increases in aggression as a function of violent VG play. In one study (Graybill, Kirsch, & Esselman, 1985), elementary school boys and girls played either Atari Boxing (aggressive) or Basketball (nonaggressive). After playing the VG, participants completed a projective test designed to measure reactions to frustrating situations. Results indicated that participants in the nonviolent VG condition were less likely to show ego-defensiveness in frustrating situations, but that participants in the violent VG condition were more likely to show need-persistent fantasies, meaning that they were more likely to emphasize finding solutions to frustrations. Also, for nonaggressive girls, the cause of the frustration was seen as more salient after aggressive video-game play.

It should be noted that no pretest was conducted to choose a nonviolent or violent video game, or to equate the two games on aggression-irrelevant factors. In fact, post-hoc analyses revealed that the aggressive game was viewed by participants as more difficult. The authors noted that video-game content (aggressive vs. nonaggressive) may be confounded with game difficulty, and that these results should be viewed with caution.

Using ratings of psychology graduate students, Graybill, Stawniak, Hunter, and O'Leary (1987) pretested six Atari video games and equated them on difficulty, excitement, and enjoyment. Three video games (*Berzerk*, *Gangster Alley*, and *Boxing*) were significantly higher than the other three on aggressive content, but did not differ from each other on this variable. Similarly, the three low-aggressive games (*Fast Food*, *Basketball*, and *Frogs and Flies*) did not differ from each other on aggressive content. Second- through sixth-grade boys and girls were paired by sex and grade with partners, and randomly assigned to play or watch two violent or two nonviolent video games. In addition to the projective test used by Graybill et al. (1985), a measure of aggressive behavior was included in this study as a dependent measure; also a personality measure of aggression was included as an independent variable. The children were shown a panel with a "help button" and a "hurt button," and told that it was connected to a game that another child would be playing in an adjoining room. Supposedly, the button was attached to a crank, which was part of the other child's game. Touching the help button was supposed to make the crank easier to turn, while touching the hurt button was supposed to make the crank hot and painful to touch, thus physically hurting and impairing the other child's progress. This constituted

the measure of aggressive behavior. The authors found no differences in any of their dependant measures, including the projective measure, which had yielded differences in the earlier study (Graybill et al., 1985).

Winkel, Novak, and Hopson (1987), using video-game construction software called the *Arcade Machine* by Bruderbund, created games that differed from each other only on aggressive content. These games were then rated by 100 undergraduates and rank ordered according to aggressive content. Three games, one highly aggressive, one moderately aggressive, and one nonaggressive were chosen for use in this study. Eighth-grade boys and girls were randomly assigned to one of the three game conditions, or to a no-game control condition. The dependent measures included heart rate and aggressive behavior. For the aggressive behavior measure, a teacher–learner paradigm was used and aggression was defined as the amount the “teacher” decided to deduct for errors from the “learner’s” pay for experimental participation. Mean heart rate did not differ across control and VG conditions either during video-game play or during the “teacher–learner” task. Level of aggressive content of the video game had no effect on aggressive behavior in terms of monetary reductions.

Studies showing affect or arousal differences. Anderson and Ford (1987) examined the effects of aggressive video-game play on affect. Male and female undergraduates played either a high-aggressive arcade game (*Zaxxon*), a mild-aggressive arcade game (*Centipede*) or no video game. The highly and mildly aggressive games were shown in a pretest to be equated on action speed, lack of pauses, difficulty, enjoyment, and frustration, but to be significantly different on violent content and graphics, with *Zaxxon* receiving higher scores. Results indicated that players in both VG conditions reported more hostility that did no-game controls. Players of the high-aggressive game reported more hostility than mild-aggressive game players, but this difference did not reach significance. Interestingly, the high-aggressive VG produced levels of anxiety that were significantly higher than those in the mild-aggressive VG and the control conditions, whereas control participants did not differ from mild-aggressive game players in anxiety.

Ballard and Weist (1996) examined differences in cardiovascular reactivity and hostility engendered by three types of VGs in 30 male undergraduates. Because the authors were specifically interested in examining how adding violent content to a game while holding other game features constant affects cardiovascular reactivity and hostility, they used two different versions of the game *Mortal Kombat*—both versions being aggressive, but one containing more explicitly violent graphics (e.g., increased appearance of blood)—and compared the effects of these aggressive games to a nonaggressive control game (the billiards game *Corner Pocket*). They found that the most violent version of *Mortal Kombat* elicited increased systolic blood pressure above and beyond that engendered by the other two conditions, but that the milder level of *Mortal Kombat* did not differ significantly from the control on systolic blood pressure. Heart rate was significantly higher for both *Mortal Kombat* conditions than for the control condition. Two self-report measures of hostility indicated that postgame hostility increased linearly with VG violence.

Studies showing mixed results or lack of affect or arousal differences. Nelson and Carlson (1985) pretested male undergraduates for trait and state mood. All participants then played two violent driving games (*Death Race* and *Demolition Derby*) and two nonviolent driving games (*Night Driver* and *Le Mans*). Next, these same participants were randomly assigned to play just one of the four driving games. Mood reported after game play was more hostile, aggressive, depressive, and marginally more anxious. Concentration decreased and fatigue increased after game play. None of these effects varied as a function of video-game condition. Although prior exposure in the study to all four games should not have

effected postgame mood differentially by condition, it may be that there were carryover effects that make interpreting these results more difficult than if the study had solely employed a between-subjects design.

Scott (1995) exposed male and female Scottish university students to one of three levels of VG violence: (a) a nonaggressive game (the shareware version of the block-building game *Tetris*); (b) an arcade-type aggressive game (a space “shoot ‘em up” type game, with no human figures, called *Overkill*); or (c) a highly aggressive modern game containing realistic graphics and human characters (*Fatal Fury*). This study employed a between-subjects pre-post design in which measures of aggressive personality and hostility were administered before and after 10 minutes of VG play. Although a linear trend of increasing hostility from *Tetris* to *Overkill* to *Fatal Fury* was predicted, results indicated an irregularity of changes in aggressiveness inconsistent with this prediction. The author interpreted failure to support the original prediction as evidence for a general lack of support for the idea that playing aggressive video games causes increases in aggressive feelings and further speculated that some individuals may be able to spend a great deal of time playing video games with no consequent increase in aggressive behavior. A variety of problems preclude confident interpretation of these results.¹

Decrements in prosocial behavior. Chambers and Ascione (1987) examined the effects of both aggressive and prosocial VG play on prosocial behavior, hypothesizing that aggressive game play would decrease subsequent prosocial behavior and that prosocial game play would increase subsequent prosocial behavior. Elementary- and junior-high-aged boys and girls played either Atari *Boxing* (aggressive) or Coleco *Smurfs* (prosocial) either alone or with a partner. Pair playing was designed to be competitive in the aggressive VG condition and cooperative in the prosocial VG condition. Both aggressive VG conditions (alone and pairs) appeared to suppress children’s donating behavior as compared to that of the lone prosocial game players. The prosocial pairs condition did not differ from the control condition in amount of prosocial behavior. This finding was contrary to predictions, possibly because the primary behavior necessary to play the game was escaping harm, rather than helping, and because it was difficult for two players to operate the game controls simultaneously, or “cooperatively.” Future research in this area would benefit by using a VG that more clearly teaches helping behaviors through modeling and reinforcement. However, for our purposes, it is interesting to note that this research suggests a relationship between violent VG play and decreases in prosocial behavior. This is consistent with other findings (e.g., Silvern & Williamson, 1987) discussed earlier.

Effects of Violent Virtual Reality Game Play on Aggression-Related Outcomes

One empirical article has been published to date on the effects of aggressive virtual reality game play (Calvert & Tan, 1994). After completing a hostility inventory and providing pulse rate data, 36 male and female undergraduates were assigned either to a violent virtual reality game playing condition, a violent virtual reality game observation condition, or a no-game control condition. Analyses revealed no pretest differences in personality or gender across conditions.

¹For example, the study involved a pre-post design with each participant providing one score before and one score after video-game play, yielding one, and only one, change score per participant. However, a table of change scores provides two change scores, one “before” change score and one “after” change score. Additionally, this table indicates substantial between-condition differences in pregame aggressiveness scores (i.e., nonequivalent baselines), which were not controlled for statistically. These preexisting differences seem to account for the counter-theoretical findings reported by the authors.

The violent virtual reality game was *Dactyl Nightmare*. In this game, players enter a three-dimensional acropolis in which they try to kill an opponent and an attacking pterodactyl before they are killed by these characters. Players are equipped with a virtual gun to help them accomplish this task. The “play” group played *Dactyl Nightmare* for 4 minutes, the observation group watched game action on a three foot by three foot video screen, and the control group mimicked the movements of the game-playing group, without awareness of any of the game’s aggressive themes. Next, participants completed measures of current mood and of thoughts they experienced while task engaged, and provided pulse rate data. ANCOVAs revealed greater posttreatment arousal in the virtual reality play group than in the observation or control groups. Participants in the virtual reality game playing group also reported feeling more dizzy or nauseous during game play than the other groups. Although neither game playing nor observation increased self-reported hostility, game playing did increase aggressive thoughts endorsed in a free thought-listing task. Men reported more hostility than women on both the pretest and the posttest. However, men and women did not differ in amount of postgame aggressive thought.

SUMMARY AND DISCUSSION OF THE EXPERIMENTAL LITERATURE

Precious few true experiments have been done to assess the effects of playing violent video games on aggression-related outcomes; there is no real “programmatic” line of research yet in this area. Much of what has been done has focused on very young children and has examined aggressive free play as the main behavioral dependent measure. Four studies (Cooper & Mackie, 1986; Irwin & Gross, 1995; Schutte et al., 1988; Silvern & Williamson, 1987) used very young children (ages ranging from approximately 4 to 11 years), measured aggressive free play, and found increases in aggression as a function of playing an aggressive video game.

All experiments that measured aggressive affect, in contrast, have used undergraduate participants. Two of these studies showed increases in aggressive affect after violent video-game play (Anderson & Ford, 1987; Ballard & Weist, 1996). A study by Nelson and Carlson (1985) showed an increase in hostility across all video-game conditions, but not differentially for aggressive video games. Calvert and Tan (1994) found no hostility differences after violent virtual reality game play. Finally, results of a study by Scott (1995) revealed mixed effects of aggressive video game play on hostility.

The majority of studies used both male and female participants; three employed only male participants (Ballard & Weist, 1996; Irwin & Gross, 1995; Nelson & Carlson, 1985). Cooper and Mackie (1986) found that violent video-game play had a greater effect on girls than on boys. However, this investigation was the only one to reveal differential effects of video games on aggression as a function of participant gender. Other gender effects did emerge. For example, Calvert and Tan’s (1994) males reported higher levels of hostility both before and after treatment, and Cooper and Mackie’s boys gave both more rewards and more punishments than did the girls.

Two studies showed increases in physiological arousal after violent video game or violent virtual reality game play (Ballard & Weist, 1996; Calvert & Tan, 1994). One study (Winkel et al., 1987) found no differences in heart rate after violent video-game play.

Regarding the player/observer distinction, two studies found no differences in aggressive behavior between players and observers of video games (Cooper & Mackie, 1986; Silvern & Williamson, 1987). However, playing a violent virtual reality game was shown to affect aggressive thoughts more than observing the same game (Calvert & Tan, 1994).

Only four experiments to date have examined the effects of state-of-the-art video games

(Ballard & Weist, 1996; Irwin & Gross, 1995; Scott, 1995) or virtual reality games (Calvert & Tan, 1994) featuring realistic graphics that portray violence between humanoid characters. The four games examined were *Mortal Kombat*, *Double Dragon*, *Fatal Fury*, and *Dactyl Nightmare*, respectively. Three of these studies (Ballard & Weist, 1996; Calvert & Tan, 1994; Irwin & Gross, 1995) did show increases in aggressive behavior, hostility, or aggressive thoughts as a function of violent video-game or virtual reality game play. The fourth study (Scott, 1995) had methodological problems that rendered interpretations tenuous at best.

Overall, the majority of investigations have supported the predicted relationship between violent video-game or violent virtual reality play and increases in aggression or aggression-related outcomes (Anderson & Ford, 1987; Anderson & Morrow, 1995; Ballard & Weist, 1996; Calvert & Tan, 1994; Cooper & Mackie, 1986; Irwin & Gross, 1995; Schutte et al., 1988; Silvern & Williamson, 1987). Additionally, two studies showed decrements in prosocial behavior as a function of violent video-game play (Chambers & Ascione, 1987; Silvern & Williamson, 1987). There are a number of notable methodological problems in this literature, the majority of which were in efforts that found no differences or that failed to support their own hypotheses.

DESCRIPTIVE STUDIES

A small amount of questionnaire data has also been collected in an attempt to further examine the relationship between video-game play and aggression and other negative outcomes. Given that causal statements cannot be made from correlational data, studies that show the predicted relationship between video-game play and aggression are open to a variety of interpretations. For example, possible explanations for significant, positive correlations between video-game play and aggression might include: (a) video-game play causes aggression; (b) violent people seek violent or arousing pasttimes, including video-game play; or (c) another variable, like low self-esteem, causes both aggression and increased video-game play. However, this research is important both because a variety of research strategies are needed in order to triangulate on an answer to a research question and because this literature is pertinent to the question of the effects of long-term exposure to video games.

Preferences for Violent Video Games

Funk (1993) examined the video-game preferences of 357 seventh- and eighth-grade boys and girls and showed that half of their most preferred games were violent in nature. Both boys and girls played video games more often at home than in arcades. Ninety percent of boys and 75% of girls played video games at home on a regular basis, averaging about 4 and 2 hours of play per week, respectively.

Braun and Giroux (1989) observed boys and girls playing video games in Canadian arcades. They noted that more boys than girls attend arcades, that most games encourage solitary play, and that boys and girls did not differ in their greater preferences for violent video games. They observed that the majority of the most popular arcade games were violent in nature; this violence took the form of war, sport, ingestion, and criminality.

The earliest video-game research tended to focus on arcade play. With the increased popularity of dedicated systems (e.g., Nintendo, Sega), as well as the recent trend toward simultaneous release of game versions for dedicated systems and for home computers, play in the home has become more popular than in the arcade (Buchman & Funk, 1996; Funk, 1993; Kubey & Larson, 1990). The most recent literature reflects this change.

Nelson and Carlson (1985) found that male undergraduates preferred nonviolent driving

games (*Night Driver* and *Le Mans*) over violent driving games (*Death Race* and *Demolition Derby*) and that these preferences were not a function of trait mood or of prior state mood. However, there are indications that a simple preference for the game *Night Driver*, and not for nonviolent games in general, might have been responsible for this effect.

Aggression

Lin and Lepper (1987) obtained teacher ratings of the impulsivity and aggressiveness of fourth- through sixth-grade boys and girls. They found that reported frequency of arcade video-game play was positively correlated with teacher reports of both aggressiveness and impulsivity for boys. For girls, the positive correlations between these variables were marginally significant. Dominick (1984) reported that playing video games correlated with aggressive delinquency for high-school-aged boys and with manifest aggressive behavior and aggressive delinquency for high-school-aged girls. However, Dominick noted that partialling out the effects of other “control variables,” such as television violence viewing and grades reduced the video-game correlations to nonsignificance. Fling, Smith, Rodriguez, Thornton, Atkins, and Nixon (1992) surveyed sixth- through twelfth-grade boys and girls on their video-game playing habits. These authors found a significant positive relationship between self-reports of frequency and duration of video-game play and both teacher and peer ratings of aggressiveness.

Emotional Reactions

Mehrabian and Wixen (1986) asked 58 undergraduates to rate their emotional reactions to 22 then-common arcade video games. The students did not play the games during the study, but were asked to rate games they had played in the past on pleasure, arousal, and dominance. In the description of this emotional impact data, the authors noted that most games were rated as highly unpleasant, moderately arousing, and moderately dominance-inducing. The authors interpreted this data as suggestive that the predominant emotional response to video games is aggression, anger, or hostility. The authors also suggested that more pleasure-inducing video games should be designed. In a second study, the authors recruited college-aged participants, who were present at a local video arcade, to play two different video games, and to rate their emotional reactions to and preferences for these games. Results indicated that higher pleasure and arousal was correlated with greater game preference. Additionally, higher dominance feelings were correlated with greater game preference for males only.

These two studies have some problems that limit their interpretability. In the first study, participants were only asked to rate games that they had played a few times; thus participants self-selected into particular video-game rating groups. Additionally, asking participants to think about games they had played in the past constitutes a less tenable design than simply having them play each game before rating it. The second study tested a nonrandom sample of participants who happened to be at a video-game arcade when the researchers arrived. This self-selection also limits the generalizability of these results. Furthermore, one cannot reasonably surmise that the predominant response to video-game play is aggression simply because a group of video games has been rated as unpleasant, arousing, and dominance-inducing.

Kestenbaum and Weinstein (1985) hypothesized that heavy video-game play helps male adolescents manage their conflicts and discharge their aggressive urges, and does not result in neuroticism, social withdrawal, or escape into fantasy. Boys who played video games for 5 or more hours a week, or who spent \$5.00 or more a week on video games were classified as high video-game players; the rest of the boys were classified as low video-game players. The high video-game group reported that playing well was more important to them, that they felt more relaxed after playing a game, and that they liked to play

games when they were tense or wound up. The high video-game group showed lower frustration tolerance, more difficulty with delay of gratification, and reported getting into trouble with the police more often than did the low video-game group. The authors interpret these findings as indicating that for heavy video-game players, video-game play has a cathartic effect on aggressive urges and that concern about video games is a parental overreaction. However, this interpretation is inconsistent with the authors' data on police records, frustration tolerance, and delay of gratification. Although there were no differences in neuroticism, social withdrawal, or fantasy between the two groups, results supporting a null hypothesis are open to a variety of explanations. Additionally, although the authors proposed that violent video-game play has a cathartic effect, the aggression catharsis hypothesis was not supported in this dataset. The self-report data on postgame relaxation is consistent with the idea of temporary catharsis of physiological arousal.

Decrements in Self-Concept and Self-Esteem

Klein (1984) argues that video games offer adolescents a forum in which to simultaneously escape from their own lives and to practice, in some primitive fashion, life skills that they have not already developed. They also give the player a sense of mastery which, theoretically, may provide a forum in which the player attempts to build self-esteem. One teenager described this phenomenon as follows: "When you start to think you're a loser, you come in here [to the arcade] and get 4,000 at Space Invaders and you ain't a loser anymore" ("Invasion of the Video Creatures," 1981, p. 91).

Two studies examined the relationship between video-game play, aggression, and self-esteem. Another study examined the relationship between preference for violent games and self-concept. Note that these three studies, described in the following paragraphs, are discussed in the context of a full exploration of published work investigating video games and aggression and do not constitute a full review of all studies that consider video games and self-esteem.

Funk and Buchman (1996), hypothesized a relationship between violent VG play and decrements in adolescent self-concept. Adolescent boys and girls were asked where, how often, and what types of video games they played. They also completed a measure of self-concept. Video-game play was not related to self-concept for boys. However, time spent playing video games was negatively correlated with scholastic competence, social acceptance, athletic competence, behavioral conduct, and global self-worth for girls. No relationship was found between preference for violent games and overall level of self-esteem.

Fling et al. (1992) administered a questionnaire to assess the relationship between video-game playing and self-esteem in sixth- through twelfth-grade boys and girls. In this study, no relationship was found between frequency and duration of video-game play and self-esteem as measured by the Coopersmith (1967) inventory. Dominick (1984) found no relationship between amount of time spent playing video games at an arcade and self-esteem for high-school girls. However, a significant relationship emerged for high-school boys, such that self-esteem was negatively correlated with time spent playing video games at an arcade. Further analysis revealed that boys who went to arcades alone (21% of the sample) reported the lowest self-esteem, followed by boys who went with friends, and boys who did not go at all.

SUMMARY AND DISCUSSION OF THE DESCRIPTIVE DATA

The survey data indicate that adolescents generally prefer aggressive video games. Boys play video games more frequently than girls, in general, but the majority of both male and female adolescents play video games on a regular basis. Finally, home play on computers

or dedicated systems has become more popular than arcade play. The questionnaire data on the relationship between video-game playing and aggression can be interpreted as less equivocal than the experimental data. One strength of this set of studies is that it uses a variety of operationalizations of aggression, including delinquency and teacher and peer ratings of aggressiveness, which all generally provide support for the existence of a relationship between video-game playing and aggression. However, this is still a very small literature, and much work needs to be done to expand our knowledge of the relationship between long-term exposure to video games and aggression. The data on the emotional impact of video games is still in a fledgling state at present. Methodological problems as well as inconsistencies in data interpretation make drawing conclusions from these studies untenable.

Interestingly, of the studies concerned with video-game play and self-esteem or self-concept, one showed no relationship (Fling et al., 1992), one indicated a negative correlation for boys only (Dominick, 1984) and one obtained a negative correlation for girls only (Funk & Buchman, 1996). These studies did employ different measures of self-esteem and self-concept. Also, Fling et al. (1992) aptly pointed out that the relationship between self-esteem and video-game playing may be a complex one. For example, it may be that low self-esteem would motivate video-game playing in order to gain a sense of mastery. However, frequent video-game playing might increase self-esteem due to an increased sense of accomplishment. Therefore, the relationship between self-esteem and video-game playing would differ depending on length of exposure to video games or game-playing success. Fling et al. (1992) suggest that an experiment might shed light on these relationships. However, a true experiment on video-game playing and self-esteem would carry with it obvious ethical issues, especially with an adolescent population.

Some sex effects emerged in the questionnaire data. Certain effects, like the finding that males tend to play video games more than females, and that males tend to prefer violent games more than females, seem reasonably well established. Other sex effects are either preliminary at this point, or contradict the findings of other researchers. Clearly, this literature is so small that much work needs to be done before strong conclusions may be made, either about sex differences, or about a whole host of other interesting variables.

One element that is clearly lacking from the nonexperimental data is the use of *violent* video-game play as the main predictor of aggression and other negative outcomes. The norm in this literature is to simply measure video-game play in terms of frequency or duration, and to correlate this variable with aggression, or self-esteem decrements. This is akin to lumping the films *The Little Mermaid* with *Pulp Fiction*, and expecting this combined "movie viewing" variable to predict increases in aggressive behavior. Nonviolent video games are being thrown into the mix with violent video games, and this is unnecessarily clouding the results.

GENERAL DISCUSSION

The literature on the relationship between video game and virtual reality violence and aggression is still in a fledgling state. One should be cautious when attempting to draw firm conclusions from this specific literature because it is so small and because there are many methodological problems and inconsistencies. In 1989, Braun and Giroux stated that, "Most of the research on induction of violent behavior by video games is inconclusive" (Braun & Giroux, 1989, p. 103). Similarly, Scott (1995), noted that, to date, the research on the role of video-game playing and aggressiveness suggests no clear conclusions. Scott also pointed out that there are inconsistencies in the selection of independent and dependent variables and that there are methodological problems with prior studies. Griffiths (1991)

echoed these sentiments saying, “. . . there is much speculation as to whether the procedures used to measure aggression levels are valid and reliable,” (p. 62) adding that, “. . . much of what has been written could best be described as ‘armchair theorizing’ or anecdotal” (p. 66).

However, the majority of the problems and inconsistencies reside in studies that showed either no differences or failed to support their own predictions. The preponderance of the evidence from the higher quality experimental studies suggests that short-term exposure to video-game and virtual reality violence engenders increases in aggressive behavior, affect, and cognitions and decreases in prosocial behavior. Nonexperimental evidence also suggests that video-game play is linked to heightened aggressive behavior and decrements in self-esteem or self-concept. Further exploration of the relationship between violent video-game play and aggression is clearly warranted. Additionally, of the limited amount of clean experimental research that examined the effects of playing modern, realistic, graphically violent video games, all studies indicated increases in aggression associated with violent game play. Finally, there are compelling empirical and theoretical reasons from the movie and television violence literatures to expect significant deleterious effects of playing violent video games.

Clearly, additional research needs to focus on careful methodology. One form this should take is departing from “experimenter-defined” aggressive versus nonaggressive video games. The video-game violence literature should emulate the media violence literature in which pretesting is commonly conducted to determine empirically what constitutes an aggressive versus a nonaggressive film, and to equate aggressive and nonaggressive films on other variables of interest, such as excitement and action before using them in a study.

All Video Games Are Not Created Equal

As noted earlier, most of the questionnaire research has focused on the relationship between playing video games in general and aggression. It would be most profitable to explore time spent playing violent games as the variable of interest, rather than just time spent playing video games. Nonviolent games may not promote aggression in the consumer, and thus may be adding variance to these questionnaire studies. All video games are not created equal. Some video games can promote learning of new information and skills in positive ways. These games have the potential to engender a new excitement about learning. Video games can be engaging, challenging, and can offer an excellent forum for self-guided learning. For example, the video game *Myst* was designed specifically to be nonviolent. This game hones problem-solving skills and promotes self-efficacy for exploration and discovery. A discussion of research into the more positive side of video games follows.

Video games as therapy. A number of investigations have examined video games as therapy for both psychological and physical illness. McGuire (1984) demonstrated that video games can help improve the quality of life for patients in long-term health-care facilities. Gardner (1991) used video games with success in psychotherapy with children. Several researchers (Kolko, Rickard, & Jorge, 1985; Noeker, & Petermann, 1990; Redd, Jacobsen, Die-Trill, & Dermatis, 1987; Vasterling, Jenkins, Tope, & Burish, 1993) have shown video games to ameliorate both the stress associated with the anticipation of chemotherapy and the aversive side effects of the treatment (e.g., nausea). Mickel (1982) and Kreutzer and Morrison (1986) have also found evidence that video games can help rehabilitate patients who have suffered severe physical injury. For example, Kreutzer and Morrison (1986) found that playing video games can improve cognitive functioning after a brain injury.

Eye–hand coordination. Better eye–hand coordination and visual-spatial ability have been associated with increased video-game play. For example, Griffith, Voloschin, Gibb, and Bailey (1983) found that video-game users had better eye–hand coordination as measured by a pursuit rotor task. Drew and Waters (1986) also showed a relationship between increased video-game playing and improvements of eye–hand coordination, as well as manual dexterity, and reaction time. Of course, data from true experiments would add significantly to this literature, as the direction of causality cannot, as yet, be determined.

Using video games to test other phenomena. Other researchers have used video games as a new and improved method of testing various phenomena of interest. Kennedy, Bittner, Harbeson, and Jones (1982) proposed replacing paper and pencil performance tests in the United States Navy with video games. Video games have been used by Weisman (1983) as an effective tool for diagnosing mental and physical illnesses, and by Rebert, Low, and Larsen (1984) as a test of visual-spatial abilities.

Youth Violence

Violent crime, especially among youth, is on the rise in America. Teenagers are responsible for the largest portion of all violent crime committed in the United States (McNulty, 1996). Today, more murders are committed by 18-year-old males than by any other group, and although the teenage population in the U.S. has declined over the past 10 years, violent crime committed by juveniles has risen sharply over the same period. The number of 13- to 15-year-old murderers nearly doubled between 1982 and 1992 (McNulty, 1996). McNulty (1996) aptly expressed the fears of our nation when he said, “No population poses a larger threat to public safety than juvenile and young adult criminals” (p. 171).

Clearly, violence prevention is a national priority (Buchman & Funk, 1996), and the prevention of youth violence in particular is of paramount concern. Buchman and Funk (1996) warn that video games teach, through a powerful combination of modeling, practice, and reinforcement, that violence is fun, necessary, and basically lacks negative consequences. Given the significant amount of time young people in the U.S. spend playing video games, and given the prevalence of violent themes in video games, more attention needs to be directed toward examining their effects.

Battling Ignorance

Steps to make the buyer (and the buyer’s parents) simply aware of the content of a particular video game, as in the implementation of a rating system, have been resisted. For example, Steve Dasbach, chairman of the Libertarian Party, is on record in the U.S. Senate as opposing such a system. “The marketplace can deal with violent or bawdy video games more efficiently, cheaper, and with less danger to the First Amendment than a bunch of busybody Senators can. . . . It’s clear that American parents—and the dollars they spend—have more power to positively influence video games than the U.S. Senate,” claimed Dasbach (“Libertarian Party Critiques,” 1994). However, warning labels may be ineffective for other reasons. Bushman (1996) showed that warning labels about violent content increased the attractiveness of and desire for violent games. Furthermore, when Nintendo released a warning regarding the violent content of the game *Mortal Kombat*, sales for the game took a sharp increase (Elmer-Dewitt, 1993).

Chairman Dasbach further claimed, “The industry leader, Nintendo, purged gratuitous sex and violence from its games years ago because they realized they could make more money that way” (“Libertarian Party Critiques,” 1994). This statement was made in Febru-

ary, 1994—the same year that Nintendo released the first of its more violent/gory versions of *Mortal Kombat* and was soon to release *Killer Instinct*.

The argument about whether video game violence is a corrupting influence or a harmless pastime was recently discussed in an interesting skirmish between the organization “Chiropractic OnLine Today” and Nintendo (“Chiropractic OnLine Today Received Information,” 1994). In the game *Killer Instinct*, a character can “finish-off” a defeated opponent by twisting the opponent’s head until the neck is broken; a move referred to in the game’s manual as the “Chiropractor.” In a statement given by the International Chiropractic Pediatric Association (ICPA), concern is expressed that children may be inspired by the video game to emulate this dangerous action, a notion strongly supported by the literature on social learning (Bandura et al., 1961, 1963, 1971, 1973), as well as the video-game research discussed here (e.g., Schutte et al., 1988). Nintendo conceded to eliminate the term *Chiropractor* from subsequent printings of the game’s instruction manual. However, Nintendo’s response to the ICPA was that their concern for the violent content of video games was unfounded and, further, that it is based on ignorance and fear. It is unsettling to read that a company’s official position so blatantly ignores relevant theory and data, especially when considering the popularity of Nintendo games and the extent to which the company has the ear of so many impressionable youths.

REFERENCES

- Anderson, C. A., & Ford, C. M. (1987). Affect of the game player: Short term effects of highly and mildly aggressive video games. *Personality and Social Psychology Bulletin*, *12*, 390–402.
- Anderson, C. A., & Morrow, M. (1995). Competitive aggression without interaction: Effects of competitive versus cooperative instructions on aggressive behavior in video games. *Personality and Social Psychology Bulletin*, *21*, 1020–1030.
- Ballard, M. E., & Weist, J. R. (1996). *Mortal Kombat™*: The effects of violent videogame play on males’ hostility and cardiovascular responding. *Journal of Applied Social Psychology*, *26*, 717–730.
- Bandura, A. (1971). Social learning theory of aggression. In J. G. Knutson (Ed.), *Control of aggression: Implications from basic research* (pp. 201–50). Chicago: Aldine-Atherton.
- Bandura, A. (1973). *Aggression: A social learning analysis*. Englewood Cliffs, NJ: Prentice-Hall.
- Bandura, A., Ross, D., & Ross, S. A. (1961). Transmission of aggression through imitation of aggressive models. *Journal of Abnormal and Social Psychology*, *66*, 575–582.
- Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology*, *66*, 3–11.
- Barton, E. J. (1981). Developing sharing: An analysis of modeling and other behavioral techniques. *Behavior Modification*, *5*, 396–398.
- Berkowitz, L., & Geen, R. G. (1966). Film violence and the cue properties of available targets. *Journal of Personality and Social Psychology*, *3*, 525–530.
- Berkowitz, L. (1984). Some effects of thoughts on anti- and prosocial influence of media events: A cognitive neoassociation analysis. *Psychological Bulletin*, *95*, 410–427.
- Berkowitz, L. (1990). On the formation and regulation of anger and aggression. *American Psychologist*, *45*, 494–503.
- Berkowitz, L. (1993). *Aggression: Its causes, consequences, and control*. New York: McGraw-Hill.
- Berkowitz, L., & Rawlings, E. (1963). Effects of film violence on inhibitions against subsequent aggression. *Journal of Abnormal and Social Psychology*, *66*, 405–412.
- Braun, C., & Giroux, J. (1989). Arcade video games: Proxemic, cognitive and content analyses. *Journal of Leisure Research*, *21*, 92–105.
- Braun, C., Goupil, G., Giroux, J., & Chagnon, Y. (1986). Adolescents and microcomputers: Sex differences, proxemics, task and stimulus variables. *Journal of Psychology*, *120*, 529–542.
- Brehm, J. W., Wright, R. A., Solomon, S., Silka, L., & Greenberg, J. (1983). Perceived difficulty, energization, and the magnitude of goal valence. *Journal of Experimental Social Psychology*, *19*, 21–48.
- Bryant, J., Carveth, R. A., & Brown, D. (1981). Television viewing anxiety: An experimental examination. *Journal of Communication*, *31*, 106–119.

- Buchman, D. D., & Funk, J. B. (1996). Video and computer games in the '90s: Children's time commitment and game preference. *Children Today*, 24, 12–16.
- Bushman, B. J. (1996). *Forbidden fruit versus tainted fruit: Effects of warning labels on attraction to television violence*. Manuscript submitted for publication.
- Calvert, S. L., & Tan, S. (1994). Impact of virtual reality on young adults' physiological arousal and aggressive thoughts: Interaction versus observation. *Journal of Applied Developmental Psychology*, 15, 125–139.
- Chambers, J. H., & Ascione, F. R. (1987). The effects of prosocial and aggressive videogames on children's donating and helping. *Journal of Genetic Psychology*, 148, 499–505.
- Chiropractic OnLine Today received information. (1994, September 7). *Chiropractic OnLine Today*, <http://www.panix.com//tonto1/dc.html>.
- Cooper, J., & Mackie, D. (1986). Video games and aggression in children. *Journal of Applied Social Psychology*, 16, 726–744.
- Coopersmith, S. (1967). *The antecedents of self-esteem*. San Francisco, CA: W. H. Freeman.
- Dominick, J. R. (1984). Videogames, television violence and aggression in teenagers. *Journal of Communication*, 34, 136–147.
- Donnerstein, E., & Berkowitz, L. (1981). Victim reactions in aggressive erotic films as a factor in violence against women. *Journal of Personality and Social Psychology*, 41, 710–724.
- Donnerstein, E. (1984). Pornography: Its effects on violence against women. In N. Malamuth & E. Donnerstein (Eds.), *Pornography and sexual aggression* (pp. 53–81). New York: Academic Press.
- Drew, B., & Waters, J. (1986). Video games: Utilization of a novel strategy to improve perceptual motor skills and cognitive functioning in the non-institutionalized elderly. *Cognitive Rehabilitation*, 4, 26–31.
- Egli, E. A., & Meyers, L. S. (1984). The role of video-game playing in adolescent life: Is there a reason to be concerned? *Bulletin of the Psychonomic Society*, 22, 309–312.
- Elmer-Dewitt, P. (1993, September 27). The amazing video game boom. *Time*, 66–73.
- Fling, S., Smith, L., Rodriguez, T., Thornton, D., Atkins, E., & Nixon, K. (1992). Videogames, aggression, and self-esteem: A survey. *Social Behavior and Personality*, 20, 39–46.
- Funk, J. B., & Buchman, D. D. (1996). Playing violent and computer games and adolescent self-concept. *Journal of Communication*, 46, 19–32.
- Funk, J. B. (1992). Video games: Benign or malignant? *Developmental and Behavioral Pediatrics*, 13, 53–54.
- Funk, J. (1993). Reevaluation of the impact of video games. *Clinical Pediatrics*, 32, 86–90.
- Gardner, J. E. (1991). Can the Mario Brothers Help? Nintendo games as an adjunct in psychotherapy with children. *Psychotherapy*, 28, 667–670.
- Geen, R. G., & Quanty, M. B. (1977). The catharsis of aggression: An evaluation of a hypothesis. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10, pp. 1–37). New York: Academic Press.
- Geen, R. G., & Stonner, D. (1973). Context effects in observed violence. *Journal of Personality and Social Psychology*, 25, 145–150.
- Geen, R. G., & Stonner, D. (1974). The meaning of observed violence: Effects on arousal and aggressive behavior. *Journal of Research in Personality*, 8, 55–63.
- Geen, R. G. (1990). *Human aggression*. Pacific Grove, CA: McGraw-Hill.
- Geen, R. G., Stonner, D., & Shope, G. L. (1975). The facilitation of aggression by aggression: Evidence against the catharsis hypothesis. *Journal of Personality and Social Psychology*, 31, 721–726.
- Gerbner, G., Gross, L., Morgan, M., & Signiorelli, N. (1980). The “mainstreaming” of America: Violence profile no. II. *Journal of Communication*, 30, 10–29.
- Goldstein, J. H. (1992). Sex differences in toy play and use of video games. In J. H. Golstein (Ed.), *Toys, play and child development* (pp. 110–129). New York: Cambridge University Press.
- Graybill, D., Kirsch, J. R., & Esselman, E. D. (1985). Effects of playing violent versus nonviolent video games on the aggressive ideation of aggressive and nonaggressive children. *Child Study Journal*, 15, 199–205.
- Graybill, D., Strawniak, M., Hunter, T., & O'Leary, M. (1987). Effects of playing versus observing violent versus non-violent video games on children's aggression. *Psychology A Quarterly Journal of Human Behavior*, 24, 1–8.
- Griffith, J. L., Voloschin, P., Gibb, G. D., & Bailey, J. R. (1983). Differences in eye-hand motor coordination of video-game users and non-users. *Perceptual and Motor Skills*, 57, 155–158.
- Griffiths, M. D. (1991). Amusement machine playing in childhood and adolescence: A comparative analysis of video games and fruit machines. *Journal of Adolescence*, 14, 53–73.
- Huesmann, L. R., & Miller, L. S. (1994). Long-term effects of repeated exposure to media violence in childhood. In L. R. Huesmann (Ed.), *Aggressive Behavior: Current Perspectives* (pp. 153–186). New York: Plenum Press.
- Invasion of the video creatures. (1981, November 16). *Newsweek*, 90–94.
- Irwin, A. R., & Gross, A. M. (1995). Cognitive tempo, violent video games, and aggressive behavior in young boys. *Journal of Family Violence*, 10, 337–350.
- Kennedy, R. S., Bittner, A. C., Harbeson, M. M., & Jones, M. B. (1982). Television computer games: A “new look” in performance testing. *Aviation, Space and Environmental Medicine*, 53, 49–53.

- Kestenbaum, G. I., & Weinstein, L. (1985). Personality, psychopathology and developmental issues in male adolescent video game use. *Journal of the American Academy of Child Psychiatry*, 24, 329–333.
- Klein, M. H. (1984). The bite of Pac-Man. *The Journal of Psychohistory*, 11, 395–401.
- Kolko, D. J., Rickard, F., & Jorge, L. (1985). Effects of video games on the adverse corollaries of chemotherapy in pediatric oncology patients: A single-case analysis. *Journal of Consulting and Clinical Psychology*, 53, 223–228.
- Koop, C. E. (1982, November 10). Surgeon general sees danger in video games. *New York Times*, p. A16.
- Kreutzer, J. S., & Morrison, C. N. (1986). A guide to cognitive rehabilitation software for the Apple IIe/IIc computer. *Cognitive Rehabilitation*, 4, 6–17.
- Kubey, R., & Larson, R. (1990). The use and experience of the new video media among children and adolescents. *Communication Research*, 17, 107–130.
- Lahey, E. B., Schaughency, E. A., Hynd, G. W., & Carlson, C. L. (1987). Attention deficit disorder with and without hyperactivity: Comparison of behavioral characteristics of clinic-referred children. *Journal of the American Academy of Child and Adolescent Psychiatry*, 26, 718–723.
- Leyens, J. P., & Picus, S. (1973). Identification with the winner of a fight and name mediation: Their differential effects upon subsequent aggressive behavior. *British Journal of Social and Clinical Psychology*, 12, 374–377.
- Libertarian party critiques proposed video game regulation. (1994, February 4). *News from the Libertarian Party*, <http://www.lp.org/lp/lp.html>.
- Lin, S., & Lepper, M. R. (1987). Correlates of children's usage of videogames and computers. *Journal of Applied Social Psychology*, 17, 72–93.
- Loftus, G. A., & Loftus, E. F. (1983). *Mind at play: The psychology of video games*. New York: Basic Books.
- McGuire, F. A. (1984). Improving the quality of life for residents of long term care facilities through video games. *Activities, Adaptation and Aging*, 6, 1–7.
- McNulty, P. J. (1996). The juvenile justice system should punish violent youths. In D. L. Bender (Ed.), *How should youth violence be addressed?* (pp. 170–176). San Diego, CA: Greenhaven Press.
- Mehrabian, A., & Wixen, W. (1986). Preferences for individual video games as a function of their emotional effects on players. *Journal of Applied Social Psychology*, 16, 3–15.
- Mickel, C. (1982). Innovative projects earning psychologists spots on hospital health care teams. *American Psychologist*, 37, 1350–1354.
- Nelson, T. M., & Carlson, D. R. (1985). Determining factors in choice of arcade games and their consequences upon young male players. *Journal of Applied Social Psychology*, 15, 124–139.
- Nintendo sells one billionth video game. (1995, October 30). *Nintendo of America Inc. Home Page*, <http://www.nintendo.com>.
- Noeker, M., & Petermann, F. (1990). Treatment-related anxieties in children and adolescents with cancer. *Anxiety Research*, 3, 101–111.
- Perry, D. G., & Perry, L. C. (1976). Identification with film characters, covert aggressive verbalization, and reactions to film violence. *Journal of Research in Personality*, 10, 399–409.
- Provenzo, E. F. (1991). *Video kids: Making sense of Nintendo*. Cambridge, MA: Harvard University Press.
- Rebert, C. S., Low, D. W., & Larsen, F. (1984). Differential hemispheric activation during complex visuomotor performance: Alpha trends and theta. *Biological Psychology*, 19, 159–168.
- Redd, W. H., Jacobsen, P. B., Die-Trill, M., & Dermatis, H. (1987). Cognitive/attentional distraction in the control of conditioned nausea in pediatric cancer patients receiving chemotherapy. *Journal of Consulting and Clinical Psychology*, 55, 391–395.
- Rice, M. E., Chaplin, T. C., Harris, G. T., & Coutts, J. (1994). Empathy for the victim and sexual arousal among rapists and nonrapists. *Journal of Interpersonal Violence*, 9, 435–449.
- Schutte, N. S., Malouff, J. M., Post-Gorden, J. C., & Rodasta, A. L. (1988). Effects of playing videogames on children's aggressive and other behaviors. *Journal of Applied Social Psychology*, 18, 454–460.
- Scott, D. (1995). The effect of video games on feelings of aggression. *The Journal of Psychology*, 129, 121–132.
- Serin, R. C., & Kuriyuchuk, M. (1994). Social and cognitive processing deficits in violent offenders: Implications for treatment. *International Journal of Law and Psychiatry*, 17, 431–441.
- Silvern, S. B., & Williamson, P. A. (1987). The effects of video-game play on young children's aggression, fantasy and prosocial behavior. *Journal of Applied Developmental Psychology*, 8, 453–462.
- Turner, C. W., & Berkowitz, L. (1972). Identification with film aggressor (covert role taking) and reactions to film violence. *Journal of Personality and Social Psychology*, 21, 256–264.
- Vasterling, J., Jenkins, R. A., Tope, D. M., & Burish, T.G. (1993). Cognitive distraction and relaxation training for the control of side effects due to cancer chemotherapy. *Journal of Behavioral Medicine*, 16, 65–80.
- Victar (Writer). (1994). *The blood on my hands* [On line]. Available at <http://www.mit.edu:8001/people/jevans/FF/bloodh01.txt>.
- Weisman, S. (1983). Computer games for the frail elderly. *Gerontologist*, 23, 361–363.
- Winkel, M., Novak, D. M., & Hopson, M. (1987). Personality factors, subject gender and the effects of aggressive video games on aggression in adolescents. *Journal of Research in Personality*, 21, 211–223.