CHAPTER

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Aggression and Violence as Effects of Playing Violent Video Games?

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On June 3, 2003, the United States 8th Circuit Court of Appeals decided that video games, including violent video games, must be considered free speech (Interactive Digital Software Association v. St. Louis County, 2003). Hence, like literature, violent video games are protected by the First Amendment of the U.S. Constitution. Emphasizing the "small number of ambiguous, inconclusive, or irrelevant (conducted on adults, not minors) studies" (p. 6), the court pointed out that "when the government defends restrictions on speech it must do more than simply posit the existence of the disease sought to be cured. [The court] believes that the County must demonstrate that the recited harms are real, not merely conjectural, and that the regulation will in fact alleviate these harms in a direct and material way" (p. 6). *In dubio pro reo* seems to be the conclusion of the court. Nevertheless, the violent video game *Grand Theft Auto* is currently the subject of a $246 million lawsuit after a fatal shooting by two teenagers who later told the investigators that "they got the rifles from a locked room in their home and decided to randomly shoot at tractor-trailer rigs, just like in the video game *Grand Theft Auto III*" (Mansfield, 2003, p. 1). Could this just be an excuse to avoid taking responsibility for their gruesome actions?

In fact, experts describe accused adolescents increasingly shifting their responsibility for violent behavior to the mass media (Kunczik, 2002). Correspondingly, the scientific community predominantly agrees that mass media and violent video games are only one of many factors (e.g., poverty, poor parental care) that may explain aggression and violence in a society and are surely not the most important ones (Potter, 2003; Anderson, 2003). However, the National Center for Injury Prevention and Control (2001) stated that, although youth violence has dropped in recent years, it remains unacceptably high in the United State. Besides poor parental supervision, the report names exposure to violence and beliefs supportives of violence as key risk factors. This raises the question of whether exposure to violent mass media in fact contributes to aggressive thoughts and behavior.

To shed light on this question, we will first introduce more recent violent games and, secondly, apply common theories to explain if and why playing those games may affect aggression

and violence in real life. After discussing empirical evidence, the chapter closes with a description of methodological pitfalls, challenges, and innovations in research on violent video games

VIOLENCE IN RECENT GAMES

Whereas violence in first-generation video games consisted of fighting animated, cartoonlike characters, modern games offer a much more realistic representation of violence. In *Grand Theft Auto: Vice City*, for example, the player may be rewarded for having sex with a prostitute and kicking her to death to avoid payment. In *Mortal Kombat*, a player earns extra points by ripping out the opponent's heart or decapitating him. In some versions of the game *Manhunt*, the player must simply approach an opponent from behind and press a button. The longer the player holds down the button, the more gruesome the killing appears. The homocides are shown in detailed and realistic graphics. Such M-rated games (*M*ature, which means for individuals age 17 and older only) may contain "sexual violence," "blood and gore," or "intense violence" as listed on the Internet homepage of the Entertainment Software Rating Board (http://www.esrb.org/index.asp). But even numerous T-rated games (for *T*eens, which means for individuals age 13 and older) are listed under the same content keywords.

Based on recent games research (Potter & Tomasello, 2003) as well as a number of studies on TV violence (see Gunter, Harrison, & Wykes, 2003; National Television Violence Study, 1999), the context of violence and the viewers' interpretations are particularly important in predicting negative effects. Hearold's (1986) meta-analysis reveals that the portrayal of rewarded, justified, and realistic violence (e.g., Atkin, 1983) committed by sympathetic characters shows the largest effects on aggression; unrewarded/punished, unjustified violence by unappealing characters reduces the influence of the portrayal. A comprehensive study on the amount *and* the context of violence in state-of-the-art video games was provided by Smith, Lachlan, and Tamborini (2003) and also by Thompson and Haninger (2001). Smith et al. analyzed violence in 60 of the most popular video games. The basic template for aggression in such games is "a human perpetrator engaging in repeated acts of justified violence involving weapons that results in some blood shed to the victim" (2003, p. 60). They found that the amount and context of violence presented in state-of-the-art video games rated T or M (and even E games, rated for *E*veryone) clearly pose risks for negative effects such as the development of aggressive scripts for social problem solving (see also Haninger, Ryan, & Thompson, 2004; B. Smith, chap. 4, this volume; S. Smith, chap. 5, this volume). It may be the content of those games that brought Grossman (2000) to the pointed title of his essay: "Violent video games are mass-murder simulators."

Furthermore, it is questionable whether these negative effects may be even more intense in video games than they ever were in TV or film, simply because of the interactive nature of games. Unlike TV or movies, video games involve players as virtual participants in a violent social setting (Grodal, 2000; Vorderer, 2000; see also Lee, Park, & Jin, chap. 18, this volume; Ritterfeld & Weber, chap. 26, this volume). The player may also identify with an aggressive game character more easily than TV viewers usually do (Zillmann, 1994). The expectations, preferences, fears, or desires of a player allow him or her to take on a role provided by the game. This role, however, is free of real-life sanctions for conduct and can therefore be played with apparent disregard for consequences. While there is some evidence for the assumption that interactive environments have a stronger effect on aggressive thoughts (e.g., Calvert & Tan, 1994), more traditional media seem to still pose the greater risk of negative effects (Sherry, 2001).

The amount and context of violence in state-of-the-art video games could be of minor importance if only a few mature people would play them. However, best practice surveys reveal: In 2003 more than 239 million computer and video games were sold, that is, almost two

games for every household in America (Entertainment Software Association, 2004); most U.S. children and adolescents (more than 90%) play video games for an average of 30 minutes daily (Kaiser Family Foundation, 2002); "the motion picture and electronic game industries have acted far more responsibly in improving their self-regulatory programs, yet continue to allow advertising of R-rated movies and M-rated games in venues that attract large numbers of teens" (Federal Trade Commission, 2002, p. 1); consequently, games rated M are extremely popular with preteen and teenage boys who report no trouble buying the games (National Institute on Media and the Family, 2002; Federal Trade Commission, 2000, 2002). In a nutshell, violent video games are among the most popular entertainment products for teens and adolescents, especially for boys (cf. Klimmt, 2004).

THEORETICAL FOUNDATIONS

A substantial body of theory in the fields of psychology, communication, and sociology has been developed to explain the processes by which exposure to violence could cause both short- and long-term increases in human aggressive and hostile behaviors (for an overview: cf. Anderson & Bushman, 2002a; Dill & Dill, 1998; Griffiths, 1999). Early psychological theories used the notions of aggressive instinct, catharsis, and frustration to explicate potential origins of human aggression (Bushman, 2002; Anderson & Huesmann, 2003). Recent theorizing, however, explains the long-term effects of media violence on aggression as originating from long-term observational learning of cognitions related to aggressive behavior (Bandura, 1973, 2001, 2002; Berkowitz, 1993; Huesmann, Moise-Titus, Podolski, & Eron, 2003; Krahé & Moeller, 2004), desensitization or emotional habituation (Funk, Baldacci, Pasold, & Baumgardner, 2004; Rule & Ferguson, 1986), and cultivation processes (Gerbner, Gross, Morgan, Signorielli, & Shanahan, 2002; van Mierlo & van den Bulck, 2004), whereas short-term effects may be based on processes like priming and imitation (Huesmann, Moise-Titus, Podolski, & Eron, 2003; Jo & Berkowitz, 1994) as well as arousal processes and excitation transfer (Zillmann, 2000, 2003). The general aggression model from Anderson and Bushman (2002a) can be considered as an integration of different theories (except catharsis theory) explaining effects of media violence (see also Buckley & Anderson, chap. 24, this volume). The following sections provide an outline of the aforementioned theories.

Symbolic Catharsis Hypothesis

In response to the criticisms of violent video games, some researchers have claimed creative and prosocial applications of such games. It has been argued that the aggressive content of video games could allow players to release their stress and aggression in a nondestructive way and, in fact, would have the effect of relaxing them (Bowman & Rotter, 1983; Kestenbaum & Weinstein, 1985). These arguments are based on the idea of symbolic catharsis—discharging aggression by purging aggressive emotions or emotional purification (Golden, 1992; Scheff, 1979; Scheele, 2001).

In psychoanalytic theory, sexuality and aggression serve as the two major drives (Ellis, 2002). Both drives arrogate for release that may happen in reality or in fantasy, the latter called symbolic catharsis. Therapeutic ideas on emotional catharsis "form the basis of the hydraulic model of anger. The hydraulic model suggests that frustrations lead to anger and that anger, in turn, builds up inside an individual, similar to hydraulic pressure inside a closed environment until it is released in some way. If people do not let their anger out, but try to keep it bottled up inside, it will eventually cause them to explode in an aggressive rage" (Bushman, 2002, p. 725).

The notion of catharsis was brought to the field of media violence research by Feshbach (1955), who investigated the impact of exposure to television violence on aggression. According to this line of thinking, the exposure to violence in video games would permit viewers to engage in fantasy aggression, thus discharging their hostility in a satisfactory way and reducing the need to carry out aggression in a behavioral realm (Sparks & Sparks, 2002). However, so far there is hardly any empirical support for a catharsis effect or the existence of the hydraulic anger system (Bushman, 2002). The fact that the evidence for the symbolic catharsis hypothesis is very sparse (see also Griffiths, 1997) may be due to the flaws in the conceptualization of cathartic effects (Scheele, 2001). Particularly, the restriction of the meaning of catharsis to the process of purging emotional excitement through fantasy is arbitrary as originally the term was introduced by Aristotle to refer to the processes of both emotional purgation and purification or "intellectual clarification" (Scheele, 2001; Scheff, 1979). The restricted interpretation might not fully account for the effects of violence in video games and other media. Furthermore, only inferior research designs have been applied in order to test the catharsis hypotheses with respect to violent video games. Subjects must feel aggressive and angry before they become confronted with different game genres or other media (mainly TV and movies) that they may select and use any way they like. Under these conditions, a controlled experiment (with a control group that is also in an aggressive state but has no media choices) could reveal if aggression really decreases as a result of playing a violent video game.

Contemporary Theories Explicating Long-Term Effects

Cognitive Neoassociation Theory. One helpful theory in exploring long-term effects is the cognitive neoassociation theory (Berkowitz, 1993). Contrary to the theory of catharsis, this theory suggests that discharge of aggressive emotions, for instance, through behaving aggressively against inanimate objects, should increase rather than decrease angry feelings and aggressive behaviors. Virtual aggression or violence is supposed to prime individuals' aggressive thoughts and feelings and enable real-life violence (cf. Bushman, 2002). According to this theory, aggressive thoughts form an associative network in memory. Once an aggressive thought is processed or stimulated, activation spreads along the links of the network to prime associated aggressive ideas and violent emotions, and may even provoke aggressive actions (Berkowitz, 1993). Thus, exposure to violent depictions in video games may activate the network of associated angry thoughts and emotions and potentially result in increased likelihood of aggressive behavior in real-life situations.

Observational Learning and Social Cognitive Theory. Social cognitive theory postulates long-term effects of exposure to violence through the influence of exposure on the observational learning and imitation of violent acts, and ultimately the development of aggressive problem-solving scripts, hostile attribution biases, and normative beliefs approving of aggression (Bandura, 2001, 2002). Originally, the theory was developed by Bandura (1973) within the framework of behaviorism. Later, Bandura modeled symbolic representations of human responses to stimuli. The theory explains the psychological functioning of humans in terms of triadic reciprocal causation where "personal factors in the form of cognitive, affective, and biological events; behavioral patterns; and environmental events all operate as interactive determinants that influence each other bidirectionally" (Bandura, 2002, p. 121). It is assumed that the plasticity of human nature is fashioned by direct and observational experiences. Thus, individuals can not only learn while acting but also by observing others. Consistently, observing game characters behaving aggressively is assumed to increase the likelihood for the player to imitate the displayed behavior in real life. Furthermore, a player's identification with the

game character should enhance observational learning as well. Frequent exposure to violent games may also lead to the formation of normative beliefs associated with the appropriateness of aggression and hostility in reallife social encounters (Huesmann et al., 2003)

Desensitization Theory. Another alternative to explain long-term effects of exposure to violence in mass media is provided by desensitization theory. This theory is based on the assumption that most humans show an innate negative psychological and physiological reaction to observing violence. Desensitization may be defined as the habituation or attenuation of such distress-related cognitive, emotional, and behavioral reactivity to observations and thoughts of violence as a result of exposure to violence in real life as well as in the media (Rule & Ferguson, 1986). It is believed that the unpleasant physiological arousal usually associated with violence inhibits thinking about violence, disregarding violence, or behaving violently; however, as a result of continuous exposure to violent depictions, individuals are expected to no longer have such reactions. Violence becomes perceived as mundane and pervasive, and this may result in a heightened likelihood of violent thoughts and behaviors (Anderson et al., 2003; Huesmann et al , 2003; Sparks & Sparks, 2002).

Although desensitization theory has been extensively studied with regard to violent television viewing, there is only limited empirical support (Carnagey & Anderson, 2003). Regarding video games, one of the few attempts to directly test this hypothesis was made by Funk, Baldacci, Pasold, and Baumgardner (2004) From their survey of 150 fourth and fifth graders about exposure to violence in real life and in various media, the authors concluded that both video game and movie violence exposure are associated with stronger proviolence attitudes Higher exposure to video game violence was also associated with lower empathy toward the victims

Cultivation Theory. Cultivation theory (Gerbner, Gross, Morgan, Signorielli, & Shanahan, 2002) concentrates on the enduring and common consequences of growing up and living with mass media—television in particular Theories of the cultivation process attempt to understand and explain the dynamics of mass media as the distinctive and dominant cultural force in contemporary societies—"the source of the most broadly shared images and messages in history" (Gerbner et al , 2002, p 43) The general hypothesis of the cultivation theory claims that heavy users of mass media are more likely to see the world in terms of the images, value systems, and ideologies propagated by the mass media The result could be a social legitimization of the reality depicted in the mass media, which may again influence behavior The heuristic processing model of cultivation effects offered by Shrum (2002) posits that frequent exposure to mainstream messages enhances the accessibility of mental schemata employed by individuals to process information and to evaluate them. The parallel to cognitive neoassociation theory (see above) is obvious.

In regard to applying cultivation theory to investigating negative effects of video games on aggression, several differences between comparable mass media, such as television, and video games seem to be problematic On the one hand, the level of graphical quality or realism in video games is lower than in television Therefore, we would expect weak or no cultivation effects as found in van Mierlo and van den Bulck's (2004) study, hereby reinforcing the assumption that a game is just a game. On the other hand, a video game usually requires complete attention and involvement, shows a higher frequency of violent scenes, and offers multiple opportunities to identify with violent characters (Anderson & Dill, 2000; Dill & Dill, 1998) According to this line of argument cultivation theory should predict larger cultivation effects of video games compared with other media.

Contemporary Theories Explicating Short-Term Effects

Any of the above outlined theories may also contribute to explaining short-term effects of playing violent video games on aggression. However, there are theoretical and methodological approaches, basically the notion of priming (Jo & Berkowitz, 1994) and excitation transfer (Zillmann, 2003), which are both primarily focused on rather short-term effects. At the same time, priming and excitation transfer may serve as conditions for any other negative effect including long-term effects. Furthermore, neuroscience methodology has recently been introduced into video game research (Koepp et al., 1998; Weber, Ritterfeld, & Mathiak, in press) in order to explore short-term arousal processes induced by violent video games more reliably than ever before.

Media Priming Theory. According to media priming theory, exposure to media immediately increases the accessibility of information that is presented in media messages (Anderson & Huesmann, 2003; Jo & Berkowitz, 1994). Once specific information has been processed, it influences attitudes, norms, and even behavior. It is believed that exposure to aggression and violence in violent video games fosters the availability of aggressive schemata, which, subsequently, can be more easily used for processing information in other social contexts. In the long run, frequently primed angry cognitions, affects, and aggressive behaviors may become increasingly automatic in their invocation.

Excitation Transfer Theory. Excitation transfer (Zillmann, 2003; Bryant & Miron, 2003) serves as another potential and widely discussed explanation as to why aggression may occur as an immediate effect of exposure to violence in video games. Media violence is believed to be exciting (arousing) for most people. Excitation transfer theory assumes that arousal from exposure to media messages facilitates the response of an individual to a certain stimulus of provocation (Tannenbaum & Zillmann, 1975). According to this theory, arousal from any source has the potential through misattribution processes to result "in inappropriate (disproportionate) responses to the current circumstances" (Bryant & Miron, 2003, p. 35); for instance, it can enhance the experience of anger and induce hostile or aggressive thoughts and behavior (Zillmann, 1978). Experiments testing this model with film and television stimuli (cf. Anderson et al., 2003) have demonstrated that aggressive behavior in response to provocations is more likely to occur immediately after exposure to violent media stimuli and often lasts no longer than a few minutes. Supporters of the excitation transfer model in video game research suggest that highly violent video games provide the arousal that is necessary for aggressive reactions in real life.

Psychophysiology and Neuroscience Research. Excitation transfer theory in combination with long-term learning processes seems to provide a solid background to explain possible effects of playing violent video games on aggression and real-life violence. Nevertheless, it is questionable to what extent excitation can result from nonviolent media stimuli and if violent media stimuli can be considered as a direct cause of excitation linked to aggressive activation. We do know that playing violent video games show physiological effects that are different compared to playing less violent games or no games at all (Lynch, 1994, 1999) and that those effects may be even greater for children who already show more aggressive tendencies (Gentile, Lynch, Linder, & Walsh, 2004a; Gentile, Walsh, Ellison, Fox, & Cameron, 2004b). There is also evidence that violent content leads to a higher physiological arousal and therefore to a more intense stimulus when embedded in a narrative (Schneider, Lang, Shin, & Bradley, 2004). However, does this ultimately mean that violent content results in a higher excitement which transfers itself to aggressive activation or even behavior? This crucial

question is still unanswered, but recent neuroscience research has the potential to provide new answers.

If individuals express aggressive thoughts or are exhibiting aggressive behavior, they seem to lack cognitive control of their emotions. Emotions are usually regulated in the human brain by a complex circuit consisting of the orbital frontal cortex, the amygdala, the anterior cingulate cortex, and some other interconnected regions. Through functional magnetic resonance imaging (fMRI), Davidson, Putnam, and Larson (2000) were able to show that unusual brain activity in the neural circuitry of emotion regulation appears as a result of impulsive violence and aggression. In particular, reduced activation in the cognitive and emotional subdivision of the anterior cingulate cortex and also amygdala seems to provide a reliable indicator of faulty emotion regulation and may be considered a neuronal correlate of aggression (Bush, Luu, & Posner, 2000; Sterzer, Stadler, Krebs, Kleinschmidt, & Poustka, 2003; Pietrini, Guazzelli, Basso, Jaffe, & Grafman, 2000).

Given these neurobiological correlates of aggression, neuroimaging studies can contribute significantly to identifying the direct impact of violent video games on aggressive cognitions. To our knowledge, there are only two pertinent neuroimaging studies that have focused on video game playing. By means of positron emission tomography (PET), Koepp et al. (1998) found evidence for dopamine release during video game playing that may play an additional role as a correlate of aggressive and violent cognitions (cf. Davidson et al., 2000). The distinctiveness of the correlation, however, is questionable as dopamine release indicates learning, attention, and sensorimotor coordination also. Mathews, Kronenberger, Wang, Lurito, Lowe, and Dunn (2005) explicitly studied the impact of violent media, including video games, on brain activity. The research team revealed similar brain activity patterns in children exposed to violent media within the last 12 months to children with a diagnosed aggressive behavior disorder. Unfortunately, the design of this study lacks internal validity because the findings are not only attributable to the media usage but also to many other confounded factors. Another fMRI study by Weber, Ritterfeld, and Mathiak (in press) overcomes some of the limitations of the aforementioned studies by controlling the treatment conditions while also considering the external validity of the game play. Thirteen volunteers (male, ages 18–26) played a violent first-person shooter game (*Tactical Operations*) while their brain activity within the neural circuitry of emotion regulation was measured. A high-resolution content analysis of the recorded game play provided information on the occurrence of violence in every moment. The study reveals that violent playing is highly associated with those brain activity patterns characteristic for aggression. As the authors used a within-subjects design, the findings may be interpreted as a short-term, causal effect that might be of importance in combination with long-term learning processes.

General Aggression Model

The general aggression model (GAM; Anderson & Bushman, 2002a; Carnagey & Anderson, 2003; Anderson, 2004; see also Buckley & Anderson, chap. 24, this volume) that integrates most theories of human aggression is a useful and often applied framework for understanding the effects of violent media. GAM describes a cyclical, dynamic pattern of interaction between a person and the environment or situation in which he or she lives. According to this theory, aggression is largely based on learning, activation, and application of aggression-related knowledge structures stored in memory (e.g., scripts, schemata). Two main models of violent media effects are offered: The single-episode GAM explicates the short-term effects of violence exposure whereas the multiple-episode GAM accounts for the long-term or cumulative effects of observing violence in real life and in mass media.

The single-episode model suggests that situational input variables such as recent exposure to violent media, aggressive cues, provocation or frustration, as well as personality factors such as traits, values, attitudes, or beliefs influence aggressive behavior through their impact on the person's present internal state, represented by cognitive, affective, and arousal variables Violent media, for instance, may increase aggression by teaching observers how to behave aggressively, by priming aggressive cognitions (including previously learned aggressive scripts and aggressive perceptual schemata), by increasing arousal, and by creating an aggressive affective state

Long-term effects explicated in the multiple-episode model also involve learning processes. The authors stated that humans learn from infancy how to perceive, interpret, judge, and respond to events in the physical and social environments. We all adopt various types of knowledge structures over time. These cognitive schemata are based on day-to-day observations of interactions with other people in real life and also imaginary scenarios In this respect, violent video games may have an impact on real-life aggression because "each violent-media episode is essentially one more learning trial" (Anderson & Bushman, 2001, p 355). Overall, the combination of single-episode and multiple-episode processes may result in the positive relation between exposure to media violence and aggressive or violent behavior

EMPIRICAL RESEARCH FINDINGS

The fundamental question of this chapter remains still unanswered: Do violent video games cause aggression? To date, three meta-analytic reviews (Anderson & Bushman, 2001; Sherry, 2001; Anderson, 2004) complement numerous literature reviews (e.g , Anderson & Dill, 2000; Dill & Dill, 1998; Griffiths, 1999; Gunter, 1998).

Anderson and Bushman's (2001) meta-analysis cumulates empirical findings across 33 independent tests on the relation between video game violence and aggressive behavior, involving 3,033 participants. The average effect size of $r = 0\,19$ proves to be positive and significant, however small Effect sizes are greater if aggressive cognitions ($r = 0\,27$) are investigated compared to studying aggressive affects ($r = 0\,18$). Gender, age, or methodological design does not moderate the effects Sherry (2001) considered 25 independent studies and arrived at a significant average effect size of $r = 0.15$ ($n = 2, 722$) that is slightly smaller but still comparable to Anderson and Bushman's data. Two additional findings in Sherry's review need to be highlighted, however. A regression between effect sizes and moderator variables reveals the strongest positive relation between the year the game was released and the effect sizes ($\beta = 0\,33$) as well as a notable *negative* relation between the playing time and aggression. Sherry concluded that on one side recent generation games increase the harmful effect while on the other side the time spent playing games reduces their negative impact In contrast, Anderson and Bushman (2001) stated that the magnitude of effect does not depend on the amount of time spent playing violent games

Recently, Anderson (2004) provided an update of his initial 2001 meta-analytic review while expanding the database to 32 independent samples with 5,240 participants. Data confirm a significant average effect size of $r = 0.20$ for aggressive behavior. Most interestingly, Anderson discriminates between 'best practice' and "non-best practice" studies by referring to the methodological rigor applied. Less rigorous studies show *smaller* effect sizes than more rigorous studies, suggesting that previous analyses on effect sizes may have underestimated the true magnitude of the negative consequences of playing violent video games. The average effect size of best practice studies regarding aggressive behavior is $r = 0\,26$. Anderson (2004) summarized his findings by stating that exposure to violent video games is clearly and

causally linked to increases in aggressive behavior, aggressive cognitions, aggressive affects, and cardiovascular arousal, and to decreases in helping behavior.

Overall, and according to Cohen's (1988) classification of effect sizes, there is a noticeable but small effect of playing violent video games on aggressive reactions (the effects are close to medium in size). Considering the increasingly realistic, elaborate, and involving design of recent game development and Sherry's findings of a positive and notable relation between release year of a violent game and effect one may expect considerably higher effect sizes in the future (see also Shapiro Pena-Herborn, & Hancock, chap. 19 this volume).

Furthermore, it is important to consider the dosage of a potential risk factor. Considering the amount of young people who are exposed to simulated violence, even a small effect can result in high societal costs or damage (Abelson, 1985; Prentice & Miller, 1992; Rosenthal, 1986). Anderson (2004) compared the effect sizes in the context of violent video games with effect sizes in other areas and stated that violent video game effect sizes are larger than the effects of studies that relate secondhand tobacco smoke to lung cancer, lead exposure to children's IQ, or condom use to the risk of HIV infection. However, Sherry (2001) pointed out that the effect sizes are still smaller than in the domain of violent TV and aggression. Translated into Cohen's *d*-metric, Sherry found a small effect of $d = 0.30$ for violent video games while Paik and Comstock (1994), for instance, yielded a medium effect of $d = 0.65$ for television violence and aggression. This statement is interesting, but certainly not comforting in a broader sense. Assuming that video games and TV are used complementarily and not as substitutes, and that effects may be mutually reinforcing (Slater, Henry, Swaim, & Anderson, 2003), the overall effect of media violence on aggression is clearly substantial (see also Anderson & Bushman, 2002b).

To answer the introducing question of whether violent mass media contribute to aggressive thoughts and behavior, we have critically examined the meta-analytic reviews, scrutinized the available literature reviews, and also considered studies that demonstrate negligible effects of playing violent video games on aggression (e.g., Collwell & Payne, 2000; Durkin, 1995; Durkin & Aisbett, 1999; Durkin & Barber, 2002; Kestenbaum & Weinstein, 1985; Scott, 1995). We are forced to conclude that within the bounds of the social science methodology, playing violent video games does increase aggressive reactions. However, whether the implied causality is justified will be explicated in the next section.

METHODOLOGICAL PITFALLS AND CHALLENGES

The crucial factor investigating the effect of violent video games is causality. Do violent computer games evoke aggression, or could it also be the reverse: Aggressive people use video games to cope with their problems? Roe and Muijs (1998) reported that boys who perform poorly in school tend to show higher motivation to achieve success in the world of video games—possibly to compensate for their failure. It is well-known that a single correlational study provides almost no information on causality. Even experimental studies may fail to prove causal relationships if control and experimental groups are not comparable or variables are confounded. If, for example, an experimental group plays a violent video game while the control group receives a racing or strategy game, not only the magnitude of violence but also numerous other aspects of content and game format are manipulated. Evidence of causality requires the combination of rigorous experimental studies with correlational studies using different operationalizations of both the independent (violent content of video games) and the dependent variable (aggression) but revealing consistent results. To date, the number and diversity of studies justify only careful causal interpretation of the relation between video games and aggressive reactions. Further exploration with longitudinal studies is still missing

and badly needed. Cross-lagged panel designs (Kenny, 1973; Lazarsfeld, 1940) offer the best way to find strong evidence for a causal relationship.

Besides methodological critique, the common understanding of causality is also questionable. Traditionally, causality is defined as one or multiple variables affecting one or more other variables in a single direction. Understanding media effects requires a more complex model of causality: Slater et al. (2003), for example, stated that media violence research provides evidence that aggressive youth seek out media violence (selective exposure) and that media violence predicts aggression in youth. They argued that both relationships, when modeled over time, should be mutually reinforcing and generate exclusive effects. The authors introduced these processes as "downward spiral model" or "feedback loop model". Accordingly, aggressive tendencies may influence game players to expose themselves to violent content, which reinforces their existing aggressive predispositions. Bandura (2002) named similar ideas "triadic reciprocal causation" (see above).

Within the dynamic-transactional model of media effects (Früh, 1991; Früh & Schönbach, 1982), causes and effects can no longer be distinguished, because there is no stimulus or response. Instead, there are two basic transactions and multiple variables that can be simultaneously causes as well as effects and can be mutually intensifying or attenuating. The first transaction describes how audience members "read" and interpret messages in media or video games, which can be quite different from objective content (see below and Potter & Tomasello, 2003). Messages and stimuli are always subjective. The second transaction describes cognitive processes within the recipients, such as evaluating and learning messages. In summary, which video game a person plays and how this person interprets the messages of this video game affects what he or she learns; what he or she learns has an effect on which video games are subsequently selected and played and how the messages are interpreted; and so on. The exchanges between the two transactions build a dynamic process and an exclusive effect over time.

Vorderer and Weber (2003) pointed out that understanding interdependencies as dynamic, multicausal, transactional constructs is new to entertainment research but was introduced in other fields much earlier, for example, in economic research (e.g., Smith, 1776). The authors pointed to the necessity of modeling and analyzing such processes appropriately and suggested a connectionist approach in which artificial intelligence methodology is used for simulations.

Another important question relates to how best to operationalize the constructs "violent content" and "aggressive reaction" or "real-life violence". So far, various definitions of violent content had been used with possible effects being dependent on the applied definition (e.g., Anderson & Dill, 2000; Griffiths, 1999; Sherry, 2001). The same is true for "aggression" and "real-life violence" (e.g., Potter, 2003, pp. 87f). Griffiths (1999), for example, criticized that findings in the realm of video game violence are mainly based on observations of children's free play. This means that in fact aggressive *play* was measured and not aggressive *behavior* (Silvern & Williamson, 1987). Aggressive play or imitation does not imply the intent to harm. Interestingly, effects for aggressive play are considerably higher than for aggressive behavior (Cooper & Mackie, 1986; Hellendoorn & Harinck, 1997). The diversity in definitions and operationalizations may be another reason why some people in industry, politics, and even in academia draw inconsistent conclusions about the effects of video games on aggression. Additionally, this ambiguity makes it problematic to compare video game effect sizes to those in other fields of research. The operationalizations of lung cancer or an HIV infection are simply undisputable and, thus, the measurements more reliable than those of complex psychological variables like aggression or violent behavior.

Finally, a noteworthy methodological challenge stems from comparisons between interactive and noninteractive violent stimuli. It may be assumed that effects of violent state-of-the-art video games are higher than compared with television because the player is much more actively

involved. However, this assumption is difficult to investigate, particularly in experimental designs. How can a noninteractive violent stimulus be created that is comparable to an interactive one, or vice versa? The control group could just watch a game that the experimental group played, but it may not look like the games played by the experimental groups. It is the nature of an interactive game that every player can play his or her "own" game. Klimmt, Vorderer, and Ritterfeld (2004) discussed possible solutions and proposed a design to compare interactive with noninteractive stimuli (see also Vorderer, 2000; Ritterfeld, Weber, Fernandes, & Vorderer, 2004).

CONCLUSION AND FUTURE RESEARCH

The current scientific evidence on negative consequences of playing violent video games, as well as the confirmed effect sizes, may be insufficient to ban violent video games. Nevertheless, we think that the pattern of significant, positive, rising, and notable effect sizes from diverse best practice studies ought to be sufficient to justify funding of national and international long-term studies. Such studies do not exist to date and are badly needed, both from academia as well as from the video game industry. Also, no study has ever investigated how players *understand* the video games they play. We should not expect violent video games (or other games for that matter) to affect players directly. Instead, it is more promising to expect possible effects to be moderated by the way users interpret the game; for example, they may interpret it as "just a game" and an opportunity to socialize with friends, or as a simulation of reality and a way to prepare for social life. Such interpretations of game play, and not the game itself, are the most fundamental cause of what the game can do to attitudes, affects, and behaviors of users (Potter & Tomasello, 2003).

We still know very little about players' interpretations and feelings while playing video games. We do not even know why exactly video games are so appealing, although we have learned what makes traditional entertainment so attractive (Vorderer, 2001; Zillmann & Vorderer, 2000). We certainly need to find out more about what children, adolescents, and adults do with a video game in order to understand what a video game, especially a violent game, can do to them.

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