Correlates and Consequences of Exposure to Video Game Violence: Hostile Personality, Empathy, and Aggressive Behavior

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Research has shown that exposure to violent video games causes increases in aggression, but the mechanisms of this effect have remained elusive. Also, potential differences in short-term and long-term exposure are not well understood. An initial correlational study shows that video game violence exposure (VVE) is positively correlated with self-reports of aggressive behavior and that this relation is robust to controlling for multiple aspects of personality. A lab experiment showed that individuals low in VVE behave more aggressively after playing a violent video game than after a nonviolent game but that those high in VVE display relatively high levels of aggression regardless of game content. Mediational analyses show that trait hostility, empathy, and hostile perceptions partially account for the VVE effect on aggression. These findings suggest that repeated exposure to video game violence increases aggressive behavior in part via changes in cognitive and personality factors associated with desensitization.

Keywords: *video games; aggression; hostility; empathy; desensitization*

Consumption of media is the favorite pastime of most Americans (Bartholow, Dill, Anderson, & Lindsay, 2003). Although television viewing accounts for the majority of media exposure, video games increasingly dominate the leisure time of young people. The average 2- to 17-year-old plays video games 7 hr per week (Gentile & Walsh, 2002); adolescent boys play almost twice that amount (Gentile, Lynch, Linder, & Walsh, 2004). With annual worldwide sales of $20 billion, video game industry profits have outpaced even those of the movie industry (Markoff, 2002).

More than their prevalence, what concerns researchers and policy makers is the violent content of the most popular video games. Improved computer graphics, along with recognition by the industry of the increasing popularity of violent games (Kent, 2001), has led to a vast number of games featuring explicit violent content and marketing campaigns aimed at ensuring their wide dissemination to young consumers. Despite media industry denials (see Bushman & Anderson, 2001) and consumer skepticism (see Bartholow et al., 2003), research indicates that exposure to video game violence has numerous harmful consequences. Short-term exposure causes increases in aggressive behavior (Anderson & Bushman, 2001; Bartholow & Anderson 2002; Cooper & Mackie, 1986), aggressive thoughts (Bushman, 1998; Calvert & Tan, 1994; Kirsh, 1998), aggressive affect (Anderson & Ford, 1986; Ballard & Weist, 1996), and aggressive schemata (Bushman & Anderson, 2002), and decreases in prosocial behavior and attitudes (Carnagey, Bushman, &

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Anderson, 2005). A recent meta-analysis (Anderson, 2004) confirmed a significant effect of violent video game play on all of these outcomes (*r*s = approximately .26).

In addition to these short-term consequences, long-term violent video game use has been shown to correlate with aggressive behavior and delinquency (Anderson et al., 2004; Anderson & Dill, 2000; Colwell & Payne, 2000; Gentile et al., 2004). However, more research is needed to understand the long-term consequences of violent video game play. In particular, little currently is known about how chronic violent video game players react to salient (or ambiguous) aggressive cues. Recent theoretical (e.g., Anderson & Bushman, 2002) and empirical (e.g., Bartholow, Anderson, Carnagey, & Benjamin, 2005) work suggests important differences in aggressive outcomes as a function of personal history with aggressive cues. However, this question has not been addressed in the context of video game exposure.

Critics of the link between media violence and aggression (e.g., Freedman, 2002) have charged that long-term exposure effects are spurious, masking the effects of some unmeasured third variable, such as hostile personality (among other criticisms; Huesmann & Taylor, 2003). Recently, Anderson and Dill (2000) reported a significant correlation between scores on a video game violence exposure (VVE) measure and indices of aggressive behavior and found that this association was robust to statistical control of other predictors, such as aggressive personality and gender (see also Anderson et al., 2004). Thus, it appears that the link between chronic VVE and aggression is not merely an artifact of aggressive personality. A more conservative approach to this question would involve control of basic dimensions of temperament, including those that are specifically known to correlate with antisocial behavior. For example, scores on the Psychoticism subscale of the Eysenck Personality Questionnaire (EPQ; Eysenck, 1988) and the Novelty-Seeking subscale of the Tridimensional Personality Questionnaire (TPQ; Cloninger, 1987) are believed to represent aspects of personality that predispose individuals to disinhibited, antisocial behaviors (Sher, Trull, Bartholow, & Vieth, 1999). If such underlying temperaments lead some people to prefer violent video games, then controlling for their influence might eliminate the video game violence effect on aggression.

Media Violence and Desensitization

Theorists have long posited that repeated exposure to media violence results in desensitization to real-world violence (Anderson & Bushman, 2002; Griffiths & Shuckford, 1989). Data from a number of experiments have supported this idea. For example, viewers of filmed violence show reduced emotional and physiological arousal and rate violent films as less violent after multiple exposures (Dexter, Penrod, Linz, & Saunders, 1997; Drabman & Thomas, 1976; Linz, Donnerstein, & Penrod, 1988; Mullin & Linz, 1995). These findings suggest that one aspect of the desensitizing effects of media violence exposure is a reduction in empathy, generally defined as sensitivity to others' pain and suffering (Funk, Bechtoldt Baldacci, Pasold, & Baumgardner, 2004). Researchers have long known of a link between low levels of empathy and risk for increased aggression (for reviews, see Eisenberg, 2000; Miller & Eisenberg, 1988). Individual differences in empathy have been shown to predict aggressive behavior in a number of domains (Giancola, 2003; Loudin, Loukas, & Robinson, 2003), including responses following violent video game exposure (Funk, Buchman, Jenks, & Bechtoldt, 2003). Taken together, these findings suggest that reductions in empathy may be one pathway by which exposure to video game violence increases aggression.

Anderson and Bushman (2002) have proposed a General Aggression Model (GAM) to account for interactive effects of personalogical and situational influences on aggression. The GAM recently has been used as a theoretical framework for understanding how media violence exposure can lead to aggression (Carnagey & Anderson, 2003). According to this model, repeated exposure to violent video games is thought to produce changes in a number of cognitive and affective processes, including desensitization, that result in stable increases in aggressive personality. Hence, exposure to video game violence can serve as a proximate situational cause of aggression by influencing cognitive, affective, and/or arousal variables, but it can also serve as a distal cause by influencing the development of aggressive personality.

Theoretically, distal processes such as these not only lead to changes in person-level factors but also influence the manner in which situational factors are interpreted and experienced. If so, any single exposure to aggression-related cues, such as playing a violent video game, should have differential consequences for aggressive behavior as a function of the degree of long-term exposure to video game violence. This aspect of the GAM was tested in the current research.

The Current Research

To begin addressing these questions, we conducted two studies examining the links between violent video game exposure, personality dimensions, and aggressive behavior. In the first study, we predicted that prior exposure to video game violence would be positively correlated with self-reported aggressive tendencies and with scores on basic dimensions of personality that are associated with aggressiveness and antisociality, and that the link between VVE and aggressiveness would be robust to

statistical control of these trait dimensions. We also predicted that the significant association between VVE and aggressiveness would be at least partially accounted for by differences in trait empathy.

The second study was a laboratory experiment in which participants with varying levels of prior exposure to video game violence played either a violent or a nonviolent video game and then engaged in a task designed to assess aggressive behavior. We predicted a significant interaction between prior exposure to video game violence and video game condition on aggression in one of two ways. According to Hypothesis 1, individuals with high prior VVE should behave more aggressively than those with low prior exposure in the violent game condition only. This prediction is based on the notion that repeated violent video game play leads to the development and rehearsal of aggression-related knowledge structures (Anderson & Bushman, 2002) but that these knowledge structures will be implemented only in the presence of a strong situational cue to aggression. According to Hypothesis 2, high prior VVE should be associated with more aggression regardless of video game condition. This prediction assumes that distal processes associated with exposure to video game violence can have a direct influence on aggression irrespective of the presence of aggressive cues in the situation.

STUDY 1

Method

PARTICIPANTS

Two hundred male undergraduates (ages 18 to 22) recruited from introductory psychology courses at a large public university participated in exchange for partial course credit.[1] Participants registered online for a study of video game playing and personality. Sessions consisted of groups of up to 20 participants each.

MEASURES

VVE. We used Anderson and Dill's (2000) measure of exposure to video game violence. Participants listed their five favorite video games and then rated each game on scales anchored at 1 (*rarely* and *little or no violence*, respectively) and 7 (*often* and *extremely violent*, respectively) in terms of how often they play the game and the violence of its content and graphics.[2] For every participant, we computed a VVE score for each of his five favorite games by summing the violent content and violent graphics ratings and multiplying by the how-often rating. These five scores were averaged to form an overall index of VVE. One participant failed to list five games; his VVE score was computed on the basis of four games. Anderson and Dill reported $\alpha = .86$ for this measure. In the current study, $\alpha = .83$.

Aggressive behavior. In Study 1, scores on two of the four subscales of the Buss-Perry Aggression Questionnaire (BPAQ; Buss & Perry, 1992), a 29-item self-report measure of aggressiveness, served as measures of aggressive behavior. The Physical Aggression subscale consists of items such as "If somebody hits me, I hit back" (9 items; $\alpha = .76$). The Verbal Aggression subscale consists of items such as "I can't help getting into arguments when people disagree with me" (5 items; $\alpha = .77$). Responses were made using scales anchored at 1 (*extremely uncharacteristic of me*) and 6 (*extremely characteristic of me*). The BPAQ is widely accepted as a valid measure of trait aggressiveness (Anderson & Dill, 2000; Harris, 1996) and has been shown to predict numerous laboratory (Bushman, 1995) and real-world (Bushman & Wells, 1998) indices of aggression.

Trait hostility. The Anger and Hostility subscales of the BPAQ provided an indication of hostile feelings and attitudes. Items such as "some of my friends think I'm a hothead" and "at times I feel I have gotten a raw deal out of life" measure anger (7 items; $\alpha = .83$) and hostility (8 items; $\alpha = .78$), respectively. Participants also completed the Caprara Irritability Scale (CIS; Caprara et al., 1985), a 30-item self-report questionnaire measuring the propensity toward quick and impulsive reactions to perceived provocation. Agreement with statements such as "I easily fly off the handle with those who don't listen or understand" indicates irritability. Responses were made using 5-point Likert-type scales, ranging from 1 (*this doesn't characterize me at all*) to 5 (*this characterizes me very well*). In creating CIS scores for the current study, 4 items inquiring directly about aggressive behavior (e.g., "I seldom strike back even if someone hits me first") were excluded to ensure that CIS scores reflected hostility per se rather than aggression. Caprara et al. (1985) found that irritability predicted aggressive behavior following provocation and reported a coefficient alpha of .81. In the current sample, $\alpha = .86$ for the 26-item version.

Basic personality. Numerous general factor models (Watson, Clark, & Harkness, 1994) have been proposed as comprehensive accounts of the major dimensions underlying adult personality. In the current study, we assumed a three-factor model and used two widely known measures of associated traits.

The EPQ-revised (Eysenck, 1988) is a 90-item self-report measure assessing extraversion (e.g., activity and surgency), neuroticism (EPQ-N; e.g., anxiety and depression), and psychoticism (EPQ-P). The Psychoticism subscale is of particular relevance here because of its association with hostile and antisocial behavior (Eysenck, 1990). In the present sample, alphas ranged from .88 for EPQ-N to .55 for EPQ-P. Although the alpha level for EPQ-P was rather low, it was largely consistent

with that reported in previous research (e.g., Sher, Bartholow, & Wood, 2000).

The TPQ (Cloninger, 1987) assesses personality dimensions labeled *harm avoidance* (TPQ-HA; e.g., negative emotionality), novelty seeking (TPQ-NS; e.g., impulsivity and quickly angered), and reward dependence (e.g., sociability). These dimensions are conceptually similar to the EPQ dimensions of neuroticism, psychoticism, and extraversion, respectively (Sher et al., 1999). Therefore, scores on the TPQ-NS subscale are of particular relevance here, again because of their links to impulsivity and antisociality. Coefficient alphas for the TPQ subscales ranged from .85 for TPQ-HA to .80 for TPQ-NS.

Empathy. The Interpersonal Reactivity Index (IRI; Davis, 1980) is a 28-item measure assessing trait empathy in four subscales: Perspective Taking (PT) measures the tendency to adopt the point of view of other people; Fantasy (FS) measures the tendency to transpose oneself into the feelings and actions of fictional characters; Empathic Concern (EC) measures the tendency to experience feelings of warmth, compassion, and concern for others; and Personal Distress (PD) taps feelings of personal discomfort in reaction to the negative emotions of others. Responses were made using 5-point Likert-type scales, ranging from 1 (*does not describe me well*) to 5 (*describes me very well*). Davis (1980) reported alpha levels for the subscales ranging from .71 to .77. In the current sample, coefficient alphas were .81 for the PT, FS, and EC subscales and .71 for the PD subscale.

PROCEDURE

On arrival, participants read and signed informed consent forms, after which they were given a packet containing all of the measures in a randomized order. After completing the questionnaire packet, they read a debriefing statement explaining the purposes of the study. After answering any questions, the experimenter thanked and dismissed the participants.

Results and Discussion

BIVARIATE ASSOCIATIONS

Zero-order correlations among all measured variables are presented in Table 1. As expected, VVE was positively correlated with both physical and verbal aggression and with trait hostility. VVE also correlated positively with dimensions of basic personality associated with impulsivity and antisociality (EPQ-P and TPQ-NS) and negatively with three of the four domains of empathy. All of these associations were as predicted. Other correlations in Table 1 are also of interest, including that hostile personality was associated with traits linked to negative emotionality (EPQ-N and TPQ-HA) in addition to those associated with antisociality.

VIDEO GAME VIOLENCE—AGGRESSION LINK AND PERSONALITY

We took two approaches to understanding the links between VVE, aggressive behavior, and personality. First, we computed a series of hierarchical regression equations intended to test the durability of the link between VVE and aggression in the face of a number of competing variables. This destructive testing approach (Anderson & Anderson, 1996; Anderson & Dill, 2000) examines whether the significant association between VVE and aggression is caused primarily (or entirely) by spurious associations between VVE and personality variables (e.g., if people with hostile or antisocial personality traits simply prefer violent video games). According to Anderson and colleagues (e.g., Anderson & Anderson, 1996), what is of interest is not whether the initial significant link can be eliminated but rather the durability of the link in the presence of other theoretically and empirically related variables. We next conducted a series of mediational analyses to examine which personality variables (if any) carry the effect of VVE on aggression.

Destructive testing approach. The results of the destructive testing regression analyses are given in Table 2. The first column presents the simple bivariate associations between VVE and physical and verbal aggression. Each subsequent column presents the standardized regression coefficients associated with the slope of VVE on aggression when additional variables are added to the model. As shown in Table 2, the link between VVE and physical aggression survived inclusion of all personality variables, including basic personality dimensions and traits theoretically most associated with aggression (i.e., hostility and empathy). However, the link between VVE and verbal aggression was less durable, being reduced to nonsignificance after inclusion of the first set of additional predictors (hostile personality). Incidentally, including any of the competitor variable groups reduced this relationship to nonsignificance.

Mediation approach. According to the desensitization hypothesis, (reduced) levels of empathy are important in determining aggressiveness following violent media exposure. We tested this proposal using a series of regression equations (Baron & Kenny, 1986) followed by Sobel tests (e.g., MacKinnon, Warsi, & Dwyer, 1995; Sobel, 1982) to determine whether the indirect effects of VVE on aggression via empathy were significant. Given that empathy was significantly correlated with physical aggression but not with verbal aggression, it was appropriate to test empathy as a potential mediator of physical aggression only (Baron & Kenny, 1986). As shown in the upper panel of Figure 1, the magnitude of the VVE–physical aggression relation was reduced when

TABLE 1: Zero-Order Correlations Between All Measured Variables: Study 1

	VVE	*BPAQ Subscales*				*CIS*	*IRI Subscales*				*EPQ Subscales*			*TPQ Subscales*	
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
1. VVE															
2. BPAQ-P	.33****														
3. BPAQ-V	.19***	.38****													
4. BPAQ-A	.18***	.51****	.31****												
5. BPAQ-H	.03	.25****	.24****	.38****											
6. CIS	.20***	.63****	.46****	.63****	.43****										
7. IRI-EC	–.33****	–.37****	–.13*	–.14**	–.04	–.37****									
8. IRI-FS	.01	–.14**	.11	–.01	.13*	–.24****	.48****								
9. IRI-PD	–.15**	–.31****	–.02	.06	.27****	–.18***	.46****	.41****							
10. IRI-PT	–.21***	–.23***	–.06	–.20***	–.07	–.47****	.57****	.50****	.34****						
11. EPQ-E	.03	.08	.04	–.00	–.33****	–.03	.07	–.04	–.22***	.10					
12. EPQ-P	.22***	.30****	.17**	.14**	.09	.16**	–.18***	.09	–.14**	–.08	.09				
13. EPQ-N	.07	.19***	.22***	.36****	.56****	.39****	.08	.18***	.32****	–.08	–.30****	–.06			
14. TPQ-NS	.13*	.25****	.16**	.21***	.05	.19***	–.06	.03	–.05	–.10	.25****	.35****	–.04		
15. TPQ-RD	–.05	–.11	–.14**	–.01	–.14**	–.12	.22***	.19***	–.01	.21***	.45****	–.10	–.07	.03	
16. TPQ-HA	.01	.01	.08	.22***	.53****	.23****	–.01	.15**	.39****	–.09	–.61****	–.12*	.61****	–.10	–.16**

NOTE: VVE = video game violence exposure; BPAQ = Buss-Perry Aggression Questionnaire; BPAQ-P = Buss-Perry Aggression Questionnaire–Physical Aggression; BPAQ-V = Buss-Perry Aggression Questionnaire–Verbal Aggression; BPAQ-A = Buss-Perry Aggression Questionnaire–Anger; BPAQ-H = Buss-Perry Aggression Questionnaire–Hostility; CIS = Caprara Irritibility Scale; IRI = Interpersonal Reactivity Index; IRI-EC = Interpersonal Reactivity Index–Empathic Concern; IRI-FS = Interpersonal Reactivity Index–Fantasy; IRI-PD = Interpersonal Reactivity Index–Personal Distress; IRI-PT = Interpersonal Reactivity Index–Perspective Taking; EPQ = Eysenck Personality Questionnaire; EPQ-E = Eysenck Personality Questionnaire–Extraversion; EPQ-P = Eysenck Personality Questionnaire–Psychoticism; EPQ-N = Eysenck Personality Questionnaire–Neuroticism; TPQ = Tridimensional Personality Questionnaire; TPQ-NS = Tridimensional Personality Questionnaire–Novelty Seeking; TPQ-RD = Tridimensional Personality Questionnaire–Reward Dependence; TPQ-HA = Tridimensional Personality Questionnaire–Harm Avoidance.
*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$.

TABLE 2: Destructive Testing Approach Examining the Durability of the Link Between Video Game Violence Exposure and Aggressive Behavior: Study 1

	Predictor Variable			
Aggression Measure	*VVE*	*+ Hostility*	*+ Basic Personality*	*+ Empathy*
Physical aggression	.33***	.20**	.16**	.13*
Verbal aggression	.19**	.09	.06	.09

NOTE: Numbers in the table are standardized regression coefficients (βs). VVE = video game violence exposure score. Hostility included Buss-Perry Aggression Questionnaire subscales for hostility and anger in addition to the Caprara Irritibility Scale score. Basic personality included all subscales of the Eysenck Personality Questionnaire and the Tridimensional Personality Questionnaire. Empathy included the subscales of the Interpersonal Reactivity Index.
*$p < .05$. **$p < .01$. ***$p < .001$.

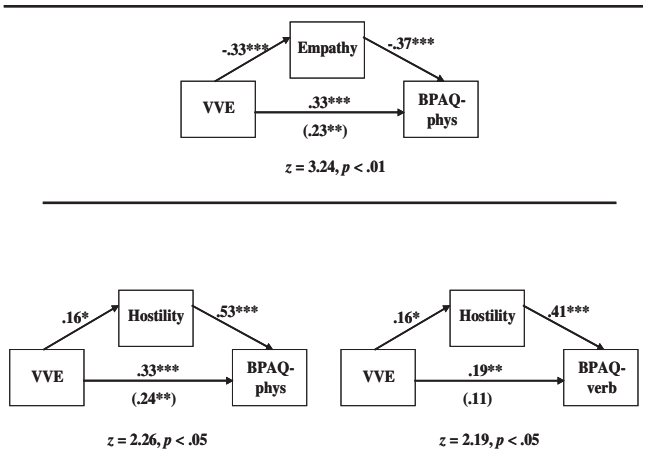

Figure 1 Regression models examining whether empathy (upper panel) and hostility levels (lower panel) account for significant variance in the association between VVE, physical aggression, and verbal aggression: Study 1.

NOTE: The numbers along each path are standardized regression coefficients. The numbers in parentheses represent the size of the relationship between VVE and aggression after controlling for the other variable. VVE = video game violence exposure; BPAQ = Buss-Perry Aggression Questionnaire; phys = physical; verb = verbal.
*$p < .05$. **$p < .01$. ***$p < .001$.

controlling for empathy levels. Moreover, the indirect effect linking VVE to physical aggression via empathy was highly significant ($z = 3.24$, $p < .01$).

We next conducted a similar set of analyses examining hostile personality as a mediator. We first computed a composite hostile personality score for each participant by standardizing and averaging scores on the BPAQ-Anger and BPAQ-Hostility subscales, CIS, and EPQ-N and TPQ-HA subscales ($\alpha = .79$). The lower panel of Figure 1 shows path models depicting regression coefficients associated with the equations including hostility. For both aggression criterion variables, the direct effect of VVE was reduced when controlling for hostility. Furthermore, the indirect effects were significant for both physical aggression ($z = 2.26$, $p < .05$) and verbal aggression ($z = 2.19$, $p < .05$).

These findings suggest that as predicted, increased hostility provides one pathway through which exposure to video game violence influences aggression. Evidence for a third variable process involving empathy was weaker but still suggestive; caution should be used in inferring a mediational role for empathy based on these data. These findings extend earlier work (Anderson et al., 2004) that showed evidence for the role of persistent aggressive cognitions in mediating the link between VVE and aggression using similar measures of these constructs and are consistent with those of Gentile et al. (2004), who found that hostility partially mediated the link between VVE and self-reports of physical fights. Nevertheless, it is important to stress that these correlational data do not indicate the causal precedence of any of the variables.

STUDY 2

Study 1 provided preliminary support for the hypothesis that repeated exposure to video game violence increases aggressiveness in part because of differences in hostility and to some extent empathy. However, it has yet to be determined whether prior exposure to video game violence is associated with increased aggression using standard laboratory behavioral measures and whether such prior exposure leads to differential aggressive responding in the presence of situational cues to aggression (e.g., a single exposure to video game violence; Anderson & Bushman, 2002). Study 2 was designed to address these issues and to further explore potential mediation of the relationship between VVE and aggression via empathy and hostility.

In Study 2, we examined the interactive effects of VVE and video game content on aggression. We also were interested in controlling for aspects of the game-playing experience that might influence aggression. For example, participants who play the violent video game could become frustrated, which could increase their aggressiveness. Additionally, those who play video games more often might perform better than those who play less frequently, and this difference also could influence aggressive outcomes. Thus, we measured postgame frustration and performance levels to control for such potential differences.

Method

PARTICIPANTS

Participants in Study 2 consisted of a subset of 92 of the participants from Study 1 who received additional course credit for the time they spent participating in the

second study, which was described as one of video games and reaction time abilities.

MATERIALS AND MEASURES

Violent video game. The violent video game was *Unreal Tournament*, a first-person shooter game in which the primary objective is to kill numerous characters using a variety of weapons. Players must navigate through a realistic three-dimensional labyrinth while avoiding elimination by other characters. Advancing in the game is determined entirely by the number of other characters the player kills, making continual acts of graphic violence necessary for success.

Nonviolent video game. The nonviolent video game was *Myst*, a colorful puzzle-solving game specifically designed to be nonviolent. This game mirrors the three-dimensional, first-person format of *Unreal Tournament* but contains no weapons or aggressive acts, instead requiring complicated logical interactions with a detailed, realistic environment to advance in the game. Pilot research conducted at other institutions has indicated that undergraduates find *Myst* to be just as interesting, difficult, enjoyable, frustrating, and fast paced as a number of violent games and that it produces similar levels of physiological arousal (Anderson & Dill, 2000). Both games were played on a Macintosh computer.

Aggressive behavior. A modified version of the Taylor (1967) Competitive Reaction-Time Task (CRT) was used to assess aggressive behavior. The CRT is a widely used (e.g., Anderson, Anderson, Dorr, DeNeve, & Flanagan, 2000; Bartholow & Anderson, 2002; Bushman, Baumeister, & Phillips, 2001; Lindsay & Anderson, 2000) and externally valid (e.g., Anderson & Bushman, 1997; Carlson, Marcus-Newhall, & Miller, 1989; Giancola & Zeichner, 1995) measure of aggression. Participants were told that they were competing against another participant to see who could respond most quickly to a series of auditory tones. Following each trial, the loser received an aversive blast of noise through headphones, the intensity and duration of which supposedly were determined by his opponent. Depending on trial outcome, the computer monitor displayed either "YOU WON!" or "YOU LOST!" Prior to each trial, the participant set the level of noise punishment that supposedly would be delivered to the opponent if the participant won that trial. Noise intensities ranged from 1 (65 decibels) to 10 (105 decibels). A nonaggressive no-noise option (Setting 0) also was included. Noise duration ranged from 0.25 (Level 1) to 2.5 s (Level 10). In this study, average noise intensity and duration settings were multiplied to form a composite aggressive behavior score.

Actually, there was no opponent; the computer controlled wins and losses and levels of noise punishment. The participant lost the first trial and half of the remaining 24 trials in a random pattern, with intensity and duration settings varying randomly from 2 to 10. As a suspicion safeguard, the participant also lost any trial in which he responded slower than 750 ms, even if the computer had predetermined that trial to be a win. Following each trial (regardless of a win or loss), the level of noise set by the alleged opponent was displayed via a bar graph on the computer screen.

Questionnaires. Following video game play, participants responded to three items assessing frustration (e.g., "To what extent do you currently feel frustrated?"), perceived video game performance (e.g., "How would you rate your performance on the video game you just played?"), and perceived ability to successfully play the video game (e.g., "To what extent did you feel able to play the video game successfully?") using scales anchored at 1 (*not at all*, *very poor*, and *totally unable to play*, respectively) and 7 (*extremely*, *very good*, and *very able to play*, respectively). Responses to the video game performance and ability items were averaged to create a single perceived game performance score ($\alpha = .91$).

A final questionnaire assessed participants' effort during the CRT task (e.g., "To what extent did you try your best during the reaction time task?") and perceptions of their opponent (e.g., "To what extent were the noise levels you set influenced by the punishment you received from your opponent?" "To what degree were your noise settings made in response to your opponent's actions?") using 7-point Likert-type scales (1 = *did not try at all* and *did not influence at all*, respectively, and 7 = *tried very much* and *influenced very much*, respectively). This measure also included several open-ended items aimed at probing for suspicion (e.g., "Was there anything about the reaction time task that seemed strange?"). Responses to these open-ended items, in addition to comments made during debriefing, were used by the experimenter to classify each participant as *not suspicious* (0), *slightly suspicious* (1), or *suspicious* (2) for purposes of excluding suspicious participants' data from later analyses.

PROCEDURE

A male experimenter informed the participant and a confederate that the study was intended to examine the effects of video game play on reaction time and decision making. They were further told that to reduce potential performance anxiety, they would participate in separate rooms but would compete against one another during the second part of the experiment. After informed consent was obtained, the experimenter flipped a coin to determine the rooms to which they would be assigned. Actually, the participant always stayed in the lab, and the confederate was taken out of the room and to the lab room next door. The participant was then asked to play either the violent or nonviolent video game, depending

on random assignment. Forty-six participants were assigned to each condition. The participant was given basic game-playing instructions and an unlimited amount of observed practice time (generally less than 3 min). Once the participant felt comfortable with the game, the experimenter left the room for 20 min, during which the participant played the game freely.

After the free play period and prior to the CRT, the participant completed the post-video-game questionnaire (frustration and game performance items). Before starting the CRT, the experimenter explained that it was necessary to set up the task on the other participant's computer; he then left the room for 4 min. On returning, the experimenter explained the CRT to the participant and demonstrated Noise Levels 2, 6, 8, and 10. After making sure the participant understood the instructions, the experimenter left the room again, obstensibly to tell the other participant that it was time to begin. On the experimenter's return, the participant was told to begin, and the experimenter exited the room for the remainder of the task (approximately 6 min). At the conclusion of the CRT, the experimenter returned and administered the postexperimental questionnaire (opponent perception and suspicion check items), after which the participant was debriefed, given experimental credit, and dismissed.

Results and Discussion

Prior to analyses, ratings of participants' suspicion levels were examined. Of the 92 participants in the sample, 11 were rated as suspicious (9 of whom said they knew they were not really competing against anyone), and 5 were rated as somewhat suspicious. Examination of these participants' responses during the CRT showed patterns indicative of response sets (e.g., Setting 1 or 10 on every trial). Therefore, CRT data for these participants (7 in the violent game condition and 9 in the nonviolent game condition) were excluded from all analyses. A Fisher's exact probability test showed that these participants were equally distributed across conditions ($p = .30$, $\phi = .15$). The remaining participants' aggression scores from the CRT were analyzed using hierarchical regression equations in which video game condition (nonviolent or violent, coded as 0 and 1, respectively) and VVE scores were entered on the first step, followed by the Condition × VVE cross-product term on the second step. Both predictor variables were centered at 0 prior to creation of the cross-product term to reduce multicolinearity (Aiken & West, 1991).

Main analyses. Results of the main regression analyses are presented in the left columns of Table 3. The significant main effect of video game condition indicates that participants who played the violent video game delivered louder and longer noise blasts than did participants who played the nonviolent game. In addition, the significant main effect of VVE indicates that participants with higher VVE scores behaved more aggressively during the CRT. These main effects were qualified by a significant Condition × VVE interaction. Figure 2 depicts the essence of this interaction, showing the video game effect as a function of high, moderate, and low levels of VVE (1 *SD*, *M*, and –1 *SD* on VVE, respectively). Note that VVE was treated as a continuous variable in all analyses; these three levels were chosen for illustrative purposes only (Aiken & West, 1991). Simple effect tests indicated significant slopes associated with video game for low VVE ($t = 3.88$, $p < .001$, $d = .91$) and moderate VVE ($t = 2.49$, $p < .02$, $d = .57$) but not for high VVE ($t = -.24$, $p = .81$, $d = .05$) participants. In other words, in the nonviolent game condition, aggression increased as VVE increased, $F(1, 72) = 12.31$, $p = .001$, $\eta = .38$, whereas levels of VVE had little effect on levels of aggression for those in the violent game condition, $F(1, 72) = 0.71$, $p = .40$, $\eta = .09$.

Controlling for frustration and game performance. Separate hierarchical regression analyses in which postgame ratings of frustration and perceived performance were regressed on video game condition and VVE main effects (Step 1) and their interaction (Step 2) showed that participants who played the nonviolent game were more frustrated ($M = 3.78$) than those who played the violent game ($M = 2.90$; $\beta = -.25$, $p < .05$). VVE scores had no effect on reported frustration level ($\beta = .01$, $p > .90$), and the interaction also was not significant ($\beta = -.16$, $p > .10$). Self-ratings of performance were higher in the violent game condition ($M = 4.64$) than in the nonviolent game condition ($M = 3.27$; $\beta = .36$, $p < .01$) and also were higher among those with higher VVE scores ($\beta = .30$, $p < .01$). The interaction again was not significant ($\beta = .15$, $p > .10$). Given that these differences could influence aggressive behavioral responses, we conducted ancillary regression analyses controlling for postgame frustration and performance ratings. As shown in Table 3, controlling for frustration levels (middle columns) and perceived performance (right-hand columns) did not change the nature of the effects produced by our main analyses.[3]

Mediational analyses. To determine whether trait empathy and/or hostility might account for the link between VVE and aggressive behavior in the lab, we computed a series of regression analyses similar to those used in Study 1 to test mediation. Separate models were constructed for both hypothesized mediators and are shown in Figure 3. For the models including hostility, we created a composite trait hostility variable by standardizing and averaging scores on the four BPAQ subscales and the CIS ($\alpha = .79$). The empathy variable used in these

TABLE 3: Regression Equations Predicting Aggressive Behavior as a Function of Video Game Condition and Video Game Violence Exposure Scores: Study 2

	Main Analysis		*Controlling for Frustration*		*Controlling for Performance*	
	Adjusted R^2	β	*Adjusted* R^2	β	*Adjusted* R^2	β
Step 1: Main effects	.16**		.15**		.16**	
Condition		.26*		.27*		.30**
VVE		.32**		.32**		.35**
Frustration		—		.04		—
Performance		—		—		–.11
Step 2: Interactions	.06*		.07*		.06*	
Condition × VVE		–.26*		–.26*		–.28*
Condition × Frustration		—		–.13		—
VVE × Frustration		—		–.10		—
VVE × Performance		—		—		–.06
Condition × Performance						.15

NOTE: VVE = video game violence exposure. Condition refers to video game condition (1 = *violent*, 0 = *nonviolent*). Adjusted R^2 in Step 1 is for the main effects model; Adjusted R^2 in Step 2 represents the change in R^2 by adding the interaction terms. Analyses controlling for frustration and performance self-ratings included all terms from the main analysis plus those associated with frustration and performance, respectively.
*$p < .05$. **$p < .01$.

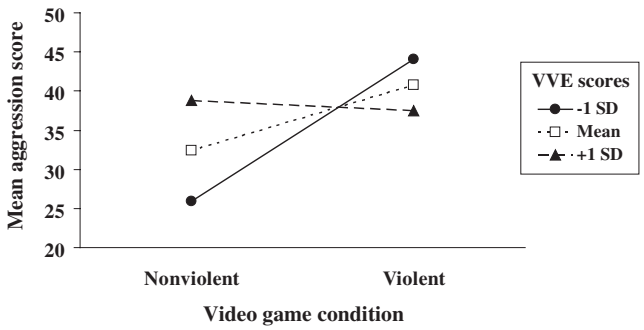

Figure 2 Aggressive behavior as a function of video game condition and scores on the VVE measure: Study 2.
NOTE: VVE = video game violence exposure. Aggression scores were determined for each participant by multiplying his mean noise intensity and noise duration levels.

models was the EC subscale of the IRI. *z* scores associated with the magnitude of the indirect effects of VVE on aggression via the hypothesized mediator (i.e., Sobel tests) are given beneath each model. As shown in Figure 3, modeling trait hostility reduced the magnitude of the direct effect of VVE on aggression and produced a significant indirect effect. Modeling empathy, however, did not.

Although these mediation models indicate that VVE effects can be partially accounted for by relevant person-level factors, the direct effect of VVE remained significant in each case. We therefore attempted to find aspects of the situation that also might help explain the VVE effect. As noted previously, exposure to video game violence is thought to increase hostile perceptions (Bushman & Anderson, 2002). Although we did not directly assess hostile perception bias in this experiment, two items on the post-CRT questionnaire provide indirect indices of perceptual bias. Specifically, participants rated the extent to which the noise levels they set were influenced by the punishment they received from their opponent and the degree to which their settings were made in response to their opponent's actions. To the extent that individuals high in VVE perceived their opponent's actions to be hostile and responded in kind, responses on these items might partially explain the link between VVE and aggression. To test this possibility, we combined each participant's response on these two items into a perceptual-bias composite ($\alpha = .72$) and constructed an additional mediation model including this composite. This model is presented at the bottom of Figure 3, which shows that controlling for this perceptual bias reduced the direct effect of VVE and produced a significant indirect effect.

Another way to test the influence of perceptual bias on levels of aggression is to examine the levels of noise set on the first trial of the CRT, which represents aggression that cannot be influenced by any bias that might develop throughout the course of the task because the participant has yet to interact with his opponent. A hierarchical regression analysis examining the composite first trial aggression (Intensity × Duration) showed a main effect of video game condition ($\beta = .26$, $p < .05$), indicating that those in the violent game condition showed more unprovoked aggression ($M = 24.89$) than those in the nonviolent condition ($M = 13.47$). The main effect of VVE and the Condition × VVE interaction were both nonsignificant (βs = .04 and .01, respectively, *p*s > .20). This result is consistent with the idea that the effect of VVE on aggression during the CRT depends on perceptions of the opponents' hostility.

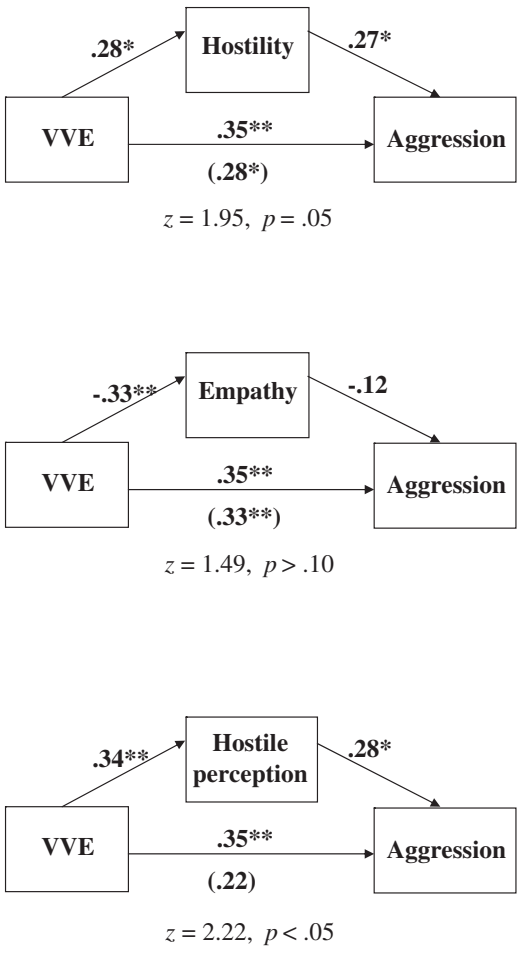

Figure 3 Regression models testing hostility, empathy, and hostile perceptions as mediators of the effect of VVE on aggression: Study 2.

NOTE: VVE = video game violence exposure. *z* scores beneath each model indicate whether the indirect effect of VVE on aggression via the mediator is significant. Numbers along each path are standardized regression coefficients. The numbers in parentheses represent the size of the VVE–aggression relation after controlling for the other variable. $^{*}p < .05$. $^{**}p < .01$.

It is also possible that this same perceptual bias might account for significant variance in the effects of the manipulated video game condition variable on aggression. However, although participants who played the violent game tended to show more of this bias ($M = 4.9$) than those who played the nonviolent game ($M = 4.0$), this difference was not significant, $F(1, 74) = 2.64$, $p = .10$, $d = .38$. Therefore, testing opponent perceptions as a mediator of the effects of video game condition was not warranted.

The pattern of aggressive behavioral results from this study generally supports the second main hypothesis, which predicted that high VVE would be associated with more aggressive responses during the CRT regardless of video game condition. This finding suggests that the changes in cognitive and affective processes posited in the GAM to result from repeated exposure to violent video games produce chronically elevated levels of aggressive responding even when situational cues, represented here by video game content, do not expressly prime aggressive cognitions and affect. These data are the first to show that the size of the violent video game effect on aggression differs according to one's prior exposure to video game violence.

GENERAL DISCUSSION

Overview of Main Findings

This research clearly indicates that both acute and chronic exposure to video game violence is associated with increased aggression. The findings from Study 1 show that VVE is associated with self-reports of physical aggression even when multiple aspects of personality are controlled (see also Anderson et al., 2004), including temperament domains with theoretical and empirical links to hostile and antisocial behavior. This finding suggests that playing violent video games has implications for aggression beyond that attributable to individual differences that might predispose aggressive individuals to seek out violent entertainment. These correlational data also suggest that effects may be larger for physical than for verbal aggression, which is consistent with previous research and theory indicating that playing violent video games calls for rehearsal of violent behavioral scripts but seldom involves verbal aggression (Anderson et al., 2004).

In the second study, the typical violent video game effect (see Anderson, 2004; Anderson & Bushman, 2001) was replicated, but participants who were chronically exposed to a lot of video game violence behaved aggressively regardless of the type of video game they played. The mediational models shown in Figure 3 indicate that hostility levels partially account for this effect. Although empathy was not a significant mediator of laboratory aggression using the composite measure, ancillary analyses showed that empathy significantly mediated the link between VVE and noise duration levels ($z = 1.98$, $p < .05$). Nevertheless, the pattern of findings appears to be weaker for empathy than for hostility.

Hostile perceptions accounted for slightly more variance in the VVE effect on aggression such that the direct effect was reduced to nonsignificance. This finding is generally consistent with the results of previous studies indicating that exposure to a violent video game increases hostile perception biases (e.g., Bushman & Anderson, 2002; Kirsh, 1998) and extends these prior findings by showing that these biases are associated with increased aggression. More generally, this finding indicates that the participants high in VVE interpreted the

ambiguously hostile situation embodied by the CRT as quite hostile and suggests that their (more aggressive) responses were made as a result of perceptions of their opponent's provocation. That VVE did not predict aggression on Trial 1 of the CRT, prior to any opportunity to interact with the opponent, also supports this view. In a similar vein, Zillman and Weaver (1999) reported that participants who experienced prolonged exposure to media violence were more hostile toward a confederate regardless of whether the confederate had actually provoked them. Thus, although the nonviolent video game arguably did not represent a situational cue to aggression, the CRT may have served as an aggressive cue for high VVE participants. Playing the violent video game also increased hostile perceptions, consistent with the findings of others (e.g., Bushman & Anderson, 2002). Although this effect was not significant, the effect size (d = .38) was similar to that reported by Bushman and Anderson (d = .33), suggesting that this effect would have been significant with a larger sample.

Implications for Theories of Media Violence and Aggression

Researchers have long posited that repeated exposure to media violence may alter cognitive, affective and motivational, and behavioral processes in a manner consistent with desensitization (Cline, Croft, & Courrier, 1973; Griffiths & Shuckford, 1989; Lazarus, Speisman, Mordkoff, & Davison, 1962; Linz, Donnerstein, & Adams, 1989; Osofsky, 1995; Smith & Donnerstein, 1998; Thomas, 1982). Some researchers have specifically posited that such exposure leads to reduced empathy (e.g., Funk et al., 2004) and/or increased hostility (e.g., Anderson & Bushman, 2002), which in turn might be associated with increased aggression. The current results are some of the first to directly support this prediction. Analyses of both self-reported and behavioral aggression indicated that empathy and hostility levels accounted for significant variance in explaining the link between VVE and aggression, although the effects were clearly weaker for empathy. Our finding that biased perceptions account for significant variance in this link generally supports the cognitive aspect of desensitization, although more research is needed to better understand this process.

These results are consistent with the GAM-based prediction that repeated exposure to violent video games leads to increases in aggressive, antisocial personality traits. Nevertheless, controlling for these aspects of personality did not eliminate the relationship between VVE and aggressive behavior. In addition to changes in personality, the GAM predicts that media violence exposure changes the way in which situational cues related to aggression are interpreted. The findings from Study 2 also support that contention and suggest that distal processes associated with repeated violent gaming provide a unique prediction of aggressive outcomes.

Limitations and Future Directions

Several limitations of the current work should be noted. Primary among these is that the presumed temporal relations between VVE and the personality-related mediators in Figures 1 and 3, although theoretically sound (Anderson et al., 2004; Funk et al., 2004), were not optimally structured. Ideally, researchers should assess changes in empathy and hostility throughout time as a function of increasing exposure to video game violence and then measure their association to aggressive behavior. Another option would be to measure state (rather than trait) levels of presumed mediators following an episode of game play and prior to the assessment of aggressive behavior (Anderson et al., 2004). Moreover, statistically controlling for the effects of empathy and hostility did not fully account for VVE effects on aggression. In future work, researchers should examine other presumed third variables and mediators. Also, although the questionnaire items assessing perceptions of the opponent provided significant prediction and mediation of aggressive responses, these items did not directly measure perceived hostility. In the future, researchers should consider other methods or measures to assess hostile perceptions and expectations. In addition, more work using younger populations is needed to better characterize the effects of video game violence on children younger than 18, who may be a particularly vulnerable group. Also, the fact that only male participants were used in the current study places limits on the generalizability of the results. In future work, researchers should endeavor to recruit sufficient numbers of both male and female participants with varying levels of VVE.

Much work still is needed to more fully understand the short- and long-term effects of exposure to video game violence. For example, the proposed desensitization hypothesis for long-term VVE effects includes cognitive, motivational, and affective elements (Anderson & Bushman, 2002; Funk et al., 2004). Most research to date has focused on factors such as cardiovascular arousal (e.g., Carnagey et al., 2003) and changes in trait dimensions, such as empathy (e.g., Funk et al., 2004), assumed to represent the affective route to desensitization. However, little work to date has examined the cognitive and motivational routes. Ongoing research in our laboratory linking VVE with measures of brain activity associated with processing violent images (Bartholow, Bushman, & Sestir, 2005) is showing some promise in understanding these other routes.

In addition, researchers should devote more attention to understanding potential behavioral changes

associated with playing nonviolent video games. In some cases, it could be that part of the violent video game effect (e.g., Anderson, 2004) results from nonviolent games briefly reducing aggressive inclinations. This issue recently was investigated by Sestir and Bartholow (2004), who found that participants who had played a nonviolent game were significantly more aggressive when measurement of aggression (using the CRT) was delayed by 15 min than when aggression was measured immediately following game play. However, those who played a violent game were significantly more aggressive than those who played the nonviolent game even after the delay. It remains to be determined whether nonviolent games reduce aggression compared to baseline (e.g., established by participants who do not play any video game prior to the CRT).

Conclusion

It should go without saying that human aggression is multiply caused and can be moderated by a host of factors, including (but not limited to) genetic predispositions (Hudziak et al., 2003), childhood conduct problems (Broidy et al., 2003), prefrontal cortex impairment (Giancola, 1995), temperament and personality processes (Netter, Hennig, Rohrmann, Wyhlidal, & Hain-Herman, 1998; Schmeck & Poustka, 2001), arousal levels (Raine & Jones, 1987), prenatal (Dosh, 1998) and parenting practices (Patterson, 1995), cultural influences (Staub, 1996), poverty (Ewart & Suchday, 2002) and other urban stressors (Guerra, Huesmann, Tolan, Van Acker, & Eron, 1995), and peer group affiliation (Prinstein & La Greca, 2004). We do not claim that exposure to violent video games is a more important cause than any of these others but rather that media violence exposure is another important cause of aggressive behavior (see Bushman & Anderson, 2001). No one causal factor alone explains more than a small proportion of the variance of individual differences in aggressive behavior (Huesmann, 1998). Nevertheless, the current results indicate that empathy and hostility levels provide important mechanisms through which media violence exposure exerts its effects on aggression.

NOTES

1. Only male participants were used here because pilot work indicated an insufficient number of female undergraduates who could be considered relatively high in exposure to video game violence. Thus, using females would effectively confound the sex variable and the measure of video game violence. However, the question of how exposure to violent video games influences the behavior of women is an important one that should be addressed in future work (see also Bartholow & Anderson, 2002).

2. The experimenters verified the ratings of the violent content of the games according to known game parameters and based on ratings provided by others. Theoretically, individuals who play a lot of violent video games can become desensitized to their violent content, which could lead them to rate the games as less violent than they truly are. Therefore, ratings of violent content were changed slightly for 14 participants who had rated games known to have extremely violent content as only slightly or moderately violent. This change did not markedly alter any of our reported effects.

3. Ancillary analyses in which Eysenck Personality Questionnaire–Psychoticism and Tridimensional Personality Questionnaire–Novelty Seeking were covaried from the model showed no significant effects of the covariates and did not change the pattern of findings reported in Table 3.

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