

Violent Virtual Video Games and Hostile Thoughts

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A violent virtual-reality (VR) video game's short-term impact on telepresence and hostility was studied. Five weeks before a lab experiment, participants completed a questionnaire measuring prior violent video game use and trait aggression. Participants were randomly assigned to play a VR violent video game, play a standard violent video game, observe a violent video game, or observe a non-violent video game. Following exposure, measures of telepresence experienced, hostile thoughts, and aggressive acts were obtained. Findings are consistent with predictions that personal variables (prior video game use) and situational variables (violent media exposure) influence telepresence experienced in media environments and promote hostile thoughts. No findings substantiate predictions that telepresence mediates personal or situational variables' influence on aggression.

The enormous controversy surrounding violent video games has been fueled by conflicting claims about the nature of their content and the relationship between game use and hostility. Spurred by tragedies like those at Columbine High School, concern has led scholars, social critics, game manufacturers, and media profession-

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als to look at the content of video games, and to question their impact on aggressive behavior.

If violent video games can affect our children, many are at risk today. Anderson (2000) tells us that nearly all children spend time playing video games. A recent study conducted by Sherry, de Souza, Greenberg, and Lachlan (2003) found that 8th graders spent an average of 17 hours per week playing video games, while 5th graders reported an average of 12 hours per week. For males, half of their favorite games are violent. Most adolescents play bloodthirsty versions like *Doom*, *Quake*, and *Duke Nukem* (Pooley, 1999). Approximately 68% of the most popular video games contain acts of violence, 78% of which would result in moderate to extreme harm to the average-sized human (Smith, Lachlan, & Tamborini, 2003). By the time they reach college many young men report playing these games more than 8 hours a week (Sherry et al., 2003). With the promise of even more alluring video games coming in the form of virtual reality (VR) technology, misgivings about the violent future ahead compels us to scrutinize this closely.

While estimates of effect size from meta-analytic research have led some scholars to argue that the impact of violent video games on aggression is comparatively small (Sherry, 2001), others maintain that qualitative differences in today's games and those popular 20 years ago make research on early games immaterial (Walsh, 1999). Experimental evidence with modern game technology provides support for the claim that some violent video games can facilitate aggressive thoughts and behaviors. Calvert and Tan (1994) found that playing a violent virtual-reality game led experimental participants to list more aggressive thoughts. In the only study known to look at both thought and behaviors, Anderson and Dill (2000) demonstrated not only that aggressive thoughts were made more accessible by playing violent video games, but also that playing these games was followed by increased aggressive behavior. They claim that characteristics inherent in violent video game technology make the impact of these games on aggressive behavior potentially more powerful than violent television or film.

The present investigation was designed to extend work in this area to include new video game technology by comparing the use of standard violent video games with media experiences that are both more passive (observation of a violent video game) and more active (playing a VR violent video game). We propose that features inherent in VR technology will make a VR violent video game's short-term impact on hostility stronger than the impact of a traditional violent video game. Moreover, we offer that this impact will be facilitated by prior experience with violent media. These expectations are based on the belief that VR technology and relevant past user experience will lead to an increase in the sense of *telepresence*—the feeling that one is involved and immersed in the media (Steuer, 1992), and that telepresence increases identification with aggressive media characters (Tamborini, 2000). Our study tests the premise that differences in a violent virtual media exposure (observation of a violent video game, playing a standard violent game, or playing a VR

violent game) combine with differences in an individual's prior violent video game use to increase the experience of telepresence and subsequent short-term hostility.

Research on Violent Video Games

The emergence of each new communication medium has been greeted with concern about its possible effect on children and others (Wartella & Reeves, 1985). The most familiar of these controversies deals with violent television, where years of debate have impeded interpretation of evidence relating exposure to aggressive behavior. Recent interpretations of existing research, however, now provide convincing evidence that this effect is indeed substantial (Anderson & Bushman, 2002a; Bushman & Anderson, 2001; Paik & Comstock, 1994). This finding is particularly important in light of the fact that research on television violence is often considered relevant to understanding the impact of violent video games.

Two recent meta-analyses provide compelling evidence for a relationship between violent video game exposure and aggression. Sherry (2001) cumulated the findings of 25 studies on video game violence and found that violent video game play had a small but noteworthy effect on aggression ($r = .15$; $d = .30$). Interestingly, this effect correlated moderately with the year the study was performed ($r = .39$), suggesting that the effect size has *increased* over time, an increase most likely associated with the evolution of video game technology. With expectations that video games will continue to increase in graphic richness and realism, this finding suggests that the effects of violent video games will become more pronounced in the future, due to advancements such as VR technology. In the second meta-analysis, Anderson and Bushman (2001) cumulated the findings from 35 video game studies and found a positive, significant relationship between exposure to game violence and aggressive behavior ($r = .19$), aggressive cognition ($r = .27$), aggressive affect ($r = .18$), and physiological arousal ($r = .22$). Exposure also related negatively to prosocial behavior ($r = -.16$), and these relationships held across all moderator variables.

Anderson and Bushman's (2002b) General Aggression Model (GAM) provides a framework that explains the impact of video game violence on aggressive behavior through processes related to video games' first-person point of view, the user's active role in decisions to aggress, and the reward structure found in many games. Based in part on Berkowitz's (1993) application of cognitive neoassociationism research, their model offers that an active role and first-person point of view are central to priming and spreading activation processes that facilitate hostile response. According to this rationale, an active role in decisions to aggress should lead to greater involvement in the game environment than the passive role assumed by watching. At the same time, first-person point of view increases identification with the aggressor, a factor known to increase post-viewing aggression with television (Leyens & Picus, 1973). As such, both the active role and first-person point of view found in violent video games should activate aggressive behavioral scripts.

If the logic behind these claims is correct, it can help us understand the importance

of telepresence and VR technology in determining a violent video game's impact on aggression. In particular, VR technology's ability to facilitate a first-person point of view and an active role in decision-making are central to the experience of telepresence. As such, we expect technology and the experience of telepresence to play critical roles in explaining how attributes of violent video games influence aggressive behavior. Though some have discussed its impact, research to date has not investigated the interactive features of video games that increase user identification, or its relation to aggressive outcomes. The current research takes the position that telepresence will increase identification with aggressive characters and facilitate the priming of those scripts that increase short-term aggressive thoughts and behaviors.

Experiencing Telepresence in Media Environments

With technology's promise to increasingly blur the distinction between reality and virtual reality, researchers have been forced to focus their attention on subtle differences in the complex processes of media experience. Steuer (1992) uses the term telepresence to describe the extent to which we perceive that we are actually present in a mediated environment rather than being present in our natural physical surrounding. This is a "complex, multidimensional perception" determined by two general categories of variables: user characteristics and media characteristics (Ijsselstein & Riva, 2003, p. 3). Thus, the extent to which we experience telepresence can vary from high to low as a function of personal differences in one's susceptibility to these experiences, as well as situational differences in particular attributes of the environments created by different media. Yet telepresence itself is a subjective concept experienced in the receiver, and its study helps new media scholars move beyond "technological determinism" into more user-centered approaches addressing questions essential to technologies' success (Ijsselstein & Riva, 2003).

Witmer and Singer (1998) identify involvement and immersion as psychological states that embody the essence of experiencing telepresence. Reid's (2002) concept of person-centeredness, or "personalization" of a virtual environment, is a similar response stemming from involvement and attentional focus. Immersion results when the user of an environment feels perceptually surrounded (Blascovich et al., 2002). According to Tamborini (2000), the vivid and interactive natures found in different media technologies evoke feelings of involvement and immersion. While the technology of today's video games is inherently high on these attributes, the vividness and interactivity of VR technology is higher still. Consistent with the logic of GAM, this is expected to dramatically increase a user's identification with aggressive characters in violent video games and heighten the games' impact on hostile thoughts and acts. As such, identifying these media properties should allow us to predict the outcomes anticipated from experiences in different media systems.

Although most efforts to identify determinants of telepresence deal with characteristics of specific media, some attempts have been made to uncover the charac-

teristics of individuals that affect this experience. Witmer and Singer (1998) considered a person's tendency to identify with characters in stories, sports, or video games as predictors of experienced telepresence. Howe and Sharkey (1998) looked at individual differences in terms of competence (mental ability to function effectively in virtual environments) and temperament (individual make-up permanently affecting our manner of acting, feeling, and thinking). They posit that competence and temperament are likely to enhance a user's experience in mediated environments. For example, we might expect that an individual's mental ability to function effectively in virtual environments would be influenced by his or her prior experience and familiarity with similar environments.

If we can uncover the determinants of telepresence, we can look into the characteristics of individuals that create variations in their experience. This also could help answer Anderson's (2000) call for research that pinpoints attributes that increase a user's identification with the aggressive characters found in violent video games. According to Steuer (1992), the ability to become immersed in a mediated environment results from a complex interaction between the attributes of the individual user and the characteristics of the medium in question.

Telepresence in VR Violent Video Games

Many of the factors that are considered central to experiencing telepresence are evident in violent video games. The vividness and interactivity of these games can be expected to influence the involvement and immersion experienced by users. For example, if engaging multiple perceptual systems creates heightened telepresence even when signal depth to some channels is low (Steuer, 1992), the breadth provided by the simultaneous audible, visual, and haptic signals in today's video games should contribute to this experience. But we can expect VR video games to far surpass the vividness of standard games by adding depth to most of these areas and by further engaging orienting systems. As Sutcliffe (2003) points out, VR extends the representation of information traditionally provided by computers through its capacity to immerse users in a "3D interactive graphical world" (p. 23).

The interactive features of video games also should contribute to feelings of telepresence. Compared to traditional media, today's popular video games offer a high degree of functional interactivity, defined as the "capacity for conducting a dialogue or information exchange between users and the interface" (Sundar, Kalyanaraman, & Brown, 2003, p. 33). In video games, functional interactivity manifests itself in the considerable and near-instantaneous control that players have over the form and content of the gaming environment. Newer games also provide great range in terms of the number of environmental features that can be manipulated. Further, though many games use unnatural actions associated with joystick switches and buttons, some shooter games with guns provide a natural map of the motor skills associated with the behavior in real life. Once again, however, VR surpasses

standard video games by enhancing the range of control, and, in particular, by closely mapping natural actions used to manipulate the environment.

If vividness and interactivity lead to involvement and immersion (Steuer, 1992), both of these subsequent psychological experiences should be substantially higher with video games than they are with television and many other media environments. However, even beyond characteristics directly associated with vividness and interactivity, critical differences between video games and other media should affect these psychological states. In order to control video game play, users are required to pay careful attention, make mental maps of the game environment, note objects and landmarks for future reference, and coordinate visual attention with motor behavior (Grodal, 2000). The game proceeds only through the player's motivation to continue. Though both film and video games provide the coherent stimulus sets necessary for involvement (Fontaine, 1992), the video game's stimulus set is made more meaningful by requiring users to attend closely in order to satisfy immediate goals. In contrast to passive media, the need to attend closely and the meaningfulness of the stimulus set in video games work toward a strong sense of involvement.

The qualities of a standard video game that make it more involving than other media are easy to observe; however, its superiority in qualities leading to immersion are more questionable. Most games are unlikely to insulate users from their physical surroundings, thus limiting the opportunity for and magnitude of immersion. Intrusive sights and sounds in a room or video arcade can easily distract the attention of users not strongly involved in game play. Compared to the dark, quiet setting of a movie theater, the isolation provided by video games seems to suffer. The intrusiveness of one's surroundings will be radically reduced, however, when using VR technology. The isolation provided by head-mounted displays, gloves, and earphones in VR game environments should promote levels of immersion that go far beyond those found in today's standard video games, and create a profound leap forward in experiencing telepresence.

H1: Media environment predicts telepresence experienced during exposure to video games. Telepresence is highest when playing a VR video game, followed in order by playing a standard video game, and observing a video game.

Prior Violent Media Use and Experiencing Telepresence in VR Violent Video Games

Although little is known about individual differences associated with determinants of telepresence, one important determinant can be identified. When Howe and Sharkey (1998) suggest that differences in competence and temperament do not predict preferences for that which occurs within a mediated world, they compel us to consider how personal preferences for an environment's content and form will affect the experience of telepresence. If the user's motivation and the meaningfulness of the environment increase the involvement and the experience of telepresence

(Witmer & Singer, 1998), individuals with cognitive scripts best suited to processing violent video game content will experience heightened levels of telepresence. Since it is apparent that individuals who play violent video games have accessible knowledge structures for processing information associated with this type of violence (Anderson, 1997), we can posit that violent video games will be more meaningful to these individuals. To the extent that habitual use of violent video games influences this meaningfulness, heightened telepresence should be experienced in these game environments.

H2: Level of prior violent video game use is a positive predictor of telepresence experienced during exposure to a violent video game.

VR Violent Video Games, Telepresence, and Hostility

Considerable research on media violence supports Berkowitz's (1984) claim that violent media content can prime semantically related thought and increase the likelihood of subsequent hostile response. For example, exposure to violent media has been associated with beliefs about others' hostility (Carver, Ganellen, Froming, & Chambers, 1983) a willingness to use violence to solve problems (Dominick & Greenberg, 1972), increased verbal aggression in young boys (Wotring & Greenberg, 1973), and immediate (Berkowitz, 1965) as well as delayed (Zillmann & Weaver, 1999) acts of hostility.

The priming logic underlying these claims is based on a cognitive neoassociationistic perspective that portrays human memory as a network of information nodes representing elements of thought, feelings, and behavior (Anderson & Bower, 1973; Landman & Manis, 1983). These networks link nodes through associative pathways that vary in strength as a function of proximity and semantic relatedness (Jo & Berkowitz, 1994). When we experience an event, the event primes semantically related thoughts and makes them more likely to come to mind for a short time afterwards (Berkowitz, 1984; Jo & Berkowitz, 1994). Energy from primed thoughts is said to radiate out along previously established pathways (Collins & Loftus, 1975), stimulating connected nodes passively and involuntarily (Berkowitz, 1984). While a single prime increases a construct's accessibility for a little while, frequent or repeated activation makes the construct more permanently available, or "chronically accessible" (Bushman, 1998). Chronically accessible constructs have a lower activation threshold, resulting in the constructs' frequent use to guide cognitive and behavioral responses in an "essentially automatic fashion" (Zillmann & Weaver, 1999, p. 148).

We suggest that the immersive attributes of video-game experiences strengthen the effect of violent media primes. Many of today's violent video games provide the type of first-person perspective and active role that result in users identifying specifically with an aggressor. Anderson and Dill (2000) suggest that every time people play these immersive violent games they prime aggressive scripts associated with hostile

perception biases, aggressive actions against others, expectations that others will behave aggressively, and beliefs that violent solutions are effective and appropriate. As such, playing violent video games in more immersive environments should produce stronger primes and enhance hostile thoughts.

H3: Media environment predicts short-term hostility. Hostility is highest when playing a VR violent video game, followed in order by playing a standard violent video game, observing a violent video, and observing a nonviolent video.

In spite of their first-person perspective, most video game simulations not only fail to map the natural actions of aggressive behaviors but also fail to insulate users from intrusive sights and sounds in their physical surroundings. The head-mounted displays and gloves of VR games promise a different experience; one in which the heightened vividness from increased depth and the isolation from environmental distractions will surpass the ability of today's video games to immerse the player in a world of virtual violence. Further, we expect the heightened telepresence resulting from this immersion in violence to strengthen hostile outcomes resulting from game use.

H4: Level of telepresence experienced during exposure to a violent video game is a positive predictor of hostility resulting from exposure.

Methods

Male and female college students participated in this study as part of a class research requirement. At the beginning of the semester, participants completed a self-report questionnaire designed to measure prior video game use and aggressive personality (included as a control). Three weeks later, participants were recruited to take part in a lab experiment. Participants were randomly assigned to one of four conditions designed to represent ordered levels of immersive game violence. The conditions, in order from highest to lowest immersive violence, were (4) playing a VR violent video game, (3) playing a standard violent video game, (2) observing a violent video game, and (1) observing a nonviolent video game.

In each condition, participants were exposed to the assigned game condition for 5 minutes, three separate times in a one hour session. The three sessions were used to separate measurement of three different outcomes (hostile thought, telepresence, and aggressive behavior) and reduce the potential for measurement of one outcome to act as a prime and influence responses to other outcome measures. Prior to gaming, each player participated in a brief 5-10 minute training session. In this training session, a researcher described how the game controls worked, and respondents were required to demonstrate their playing ability (e.g., shooting, moving, etc.). In order to ensure that all respondents were familiar with the game and gaming environment, participants trained at their own pace (i.e., training continued until

they indicated that they were ready to start). While active players trained, participants assigned to the observer conditions were taken to a separate room where their participation was explained. They then waited for their playing counterpart to start gaming.

Subsequent to each exposure, individuals completed a thought-listing task (after the first exposure), a self-report measure of telepresence experienced (after the second exposure), and a game recommendation task (after the third exposure). Following the game recommendation task, participants completed a research assistant evaluation form used to help determine the experimenter's future financial support. Participants' verbal responses to the thought-listing task were coded for the types and frequency of hostile thoughts. The responses from the research assistant evaluation task were scored to assess participants' aggressive behavior. These measures served as the dependent variables for analyses investigating the effect of violent virtual media exposure on aggressive thoughts.

Participants

One hundred and eighty-two students (99 males, 83 females) from a large Midwestern university were recruited from an undergraduate communication course. Ages ranged from 18 to 30 ($M = 20.57$, $SD = 1.52$). Participants were informed that the investigation was designed to study the way people experience different types of media.

Procedures

Participants came to the research lab in pairs and were greeted by one of three male researchers and one of two male research assistants. Assignments to conditions were made after both participants arrived in the waiting area. One participant was randomly selected to be a player and then assigned randomly to one of the two game conditions (VR or standard). The second participant then was assigned randomly to one of the two observation conditions (violent or nonviolent). After administering a written consent form to the participants, the researcher played the instructions, all of which had been audio taped in order to minimize researcher effects and to ensure consistency across conditions. Following the first set of taped instructions, the assistant took the second participant into an adjacent room. Meanwhile, the first participant continued to receive taped instructions on playing the game.

Following these instructions and the brief practice session, the researcher left the first participant alone to play the game for 5 minutes while the second participant watched either an actual feed of the game being played (violent observation) or a previously recorded game (nonviolent observation). In both cases, participants in the observation condition were told that they were watching the game being played by the other participant. After 5 minutes, the assistant returned, administered the thought-listing task, and left the participants alone for 4 minutes. At the conclusion

of the 4 minutes, the assistant returned, played another set of taped instructions, and then left the participants to play or observe for another 5 minutes.

Following this 5-minute interval, the assistant returned and administered the telepresence experienced survey. When both of the participants had completed the survey (typically about 8 minutes), the assistant collected the surveys, played yet another set of instructions, and then left again, signaling the commencement of the third and final period of playing and observing.

At the conclusion of another 5 minutes, the assistant entered each of the two rooms and administered a game recommendation questionnaire on which the participants indicated both their enjoyment of the game experience and the price that they believed retailers could reasonably charge for the game. After collecting the questionnaire, the researcher returned and played a prerecorded statement of debriefing followed by probes designed to identify demand effects during the procedure. Finally, participants were thanked for their participation and dismissed.

Manipulation of Violent Media Environment

Participants in the violent conditions were exposed to the video game *Duke Nukem 3D* in one of three media forms. In the VR game condition, participants played *Duke Nukem 3D* on a Forte Technologies Vfx1 virtual reality system. The system consists of an immersive head mount unit that isolates users from their physical environment and delivers information through the audio and visual channels. A toy handgun modified to look realistic controlled movement in the environment and the firing of the weapon in the game. In the standard game condition, participants played *Duke Nukem 3D* on a standard IBM-compatible personal computer using a rectangular joystick device to manipulate all aspects of the game environment. In the violent observation condition, participants observed the output from the participant playing *Duke Nukem 3D* (either in the VR or standard game condition) in the neighboring room. Participants in the nonviolent observation condition watched output from the game *CoolBoarders 3* that had been previously recorded on a CD-ROM. Participants in the standard game condition and in both observation conditions viewed the output on a 14-inch color computer monitor adapted with stereo sound speakers.

The video game *Duke Nukem 3D* is a popular game available for both personal computers and home gaming systems. Players control the main character (Duke) as he wanders through urban landscapes and indoor labyrinths while being attacked by heavily-armed enemies. In order to advance, Duke must kill the enemies and recover items. He can acquire weapons such as handguns, rocket launchers, chain-fed machine guns, and pipe bombs. For the purposes of this study, the game was preset such that Duke was in possession of all necessary weapons and tools at the onset. Additionally, to avoid the problem of having to restart the game, a "God Mode" was set so Duke could not be killed. We should note that the use of God Mode eliminates the threat of death/failure in a manner that could result in users becoming less

involved. However, as our users were never aware that they were operating in this mode, perceptions of death and/or failure should have remained unaffected.

The on-screen graphics are shown from Duke's perspective—i.e., the player is literally looking through the eyes of the character that he or she is controlling, and he or she sees no more of himself or herself than a weapon extended outward. The portrayals of gore and carnage are extremely graphic. When characters are shot, they scream in pain. Blood and entrails are clearly visible, and wounded characters sometimes writhe in pain for several seconds before expiring. Further, although *Duke Nukem 3D* does contain female characters that may be offensive to some players, the role of females in the levels of the game used for this study was essentially devoid of sexual content. As such, it seems unlikely that the hostile thoughts of female participants were affected by the sexual portrayals.

CoolBoarders 3 is another popular home video game. Players control a character as they snowboard down different slalom and half-pipe courses, and they score points by executing maneuvers. This game was selected because it is fast-paced and arousing, but does not contain any overt acts of intentional violence. The visual perspective is one in which game players actually see their character on the screen, a direct contrast to the first-person perspective employed by *Duke Nukem 3D*.

Pretest Measures

A self-report questionnaire was created to collect the data on prior video game use, and the Buss-Perry Aggression Questionnaire (Buss & Perry, 1992) was used as a measure of trait aggression.

Prior video game use. Prior video game use was measured using a questionnaire adapted from Anderson and Dill (2000). It was constructed to enable the creation of two composite indexes, one focusing on exposure to video game violence, and the other focusing on the amount of time spent playing video games in general, regardless of type of content. Participants were asked to list their five favorite video games and were provided with an inventory of popular video games to aid in their recall. For each game listed, participants responded, on a scale from 1 to 7, to two items indicating how often they played the game and their perception of the game's level of violence. Responses of 1 were labeled "rarely" and "little or no violent content," respectively, and responses of 7 were labeled "often" and "extremely violent content," respectively. Reports in this study are based on the summed responses of all video games listed. Ratings of how often the participants played each game were summed to create a measure of prior game use ($M = 1.80$, $SD = 2.29$). Ratings of how often participants played each game were multiplied by measures of game violence for each game, and the products for each game listed were summed to form a prior violent-game use score ($M = 21.34$, $SD = 36.09$).

Trait aggression. The 29-item Buss-Perry Aggression Questionnaire (BPAQ) measures trait aggressiveness through four distinct subscales (Buss & Perry, 1992). The

scales used in this study include anger (7 items, $M = 2.58$, $SD = .71$, $\alpha = .71$), hostility (8 items, $M = 2.71$, $SD = .73$, $\alpha = .74$), physical aggression (9 items, $M = 2.23$, $SD = .79$, $\alpha = .74$), and verbal aggression (4 items). One item ("I tell my friends openly when I disagree with them") from the original five items in the verbal aggression scale was dropped, and in doing so, reliability improved from $\alpha = .32$ to $\alpha = .70$ ($M = 2.85$, $SD = .86$). Items such as "Some of my friends think I'm a hothead" represent the construct anger, and items such as "At times I feel I have gotten a raw deal out of life" represent hostility. Likewise, items such as "If somebody hits me I hit back" and "I can't help getting into arguments when people disagree with me" measure the constructs physical aggressiveness and verbal aggressiveness, respectively.

Outcome Measures

Two measures, a self-reported measure of telepresence experienced and a thought listing task responses coded for state hostility, served as outcome variables in this study.

Telepresence experienced. Participants' experience of telepresence was measured using the Presence Questionnaire (PQ) developed by Witmer and Singer (1998). The PQ is designed to measure a person's subjective experience in a simulated environment. It contains 32 items that assess the amount of control a person has over an environment, the number or sensory modalities and quality of sensory input received from an environment, the realism (in terms of connectedness and meaningfulness) of an environment, and the level of isolation created by the environment. The PQ uses a 7-point response scale that in format is based on the semantic differential principle (Dyer, Matthews, Stulac, Wright, & Yudowitch, 1976). Each item is end-anchored by opposing descriptors, but unlike the semantic differential, the scale includes an anchor at the midpoint. For this study, 22 items identified by Witmer and Singer (1998) as loading on Control and Sensory factors were averaged to create a measure labeled Telepresence Experienced ($M = 2.58$, $SD = .71$, $\alpha = .87$). The 10 items identified as loading on the Distraction and Realism factors were not included in this measure. The Distraction and Realism items were dropped because of their conceptual inconsistency with our study's definition of telepresence as the experience of immersion and involvement. While Sensory factors involve the extent to which participants felt engaged and involved; and the Control factors involve the extent to which the environment felt responsive and interaction felt natural (two central features of experienced telepresence as we define it); the Distraction factor focused on the salience of control devices; and the Realism factor focused on the disconnected feeling of sensory information sources. They were removed because these features were not characteristics of telepresence as we define it.

State hostility. Hostile thoughts that were listed by the participant immediately after exposure to the media environment were recorded and coded in accordance with the thought-listing procedure described by Cacioppo and Petty (1981). Partic-

ipants were told that the researchers were interested in their thoughts. "You might have had ideas about the game, about the study, about your day, about things irrelevant to any of this, or a mixture of these." They were given exactly 4 minutes and asked to "state your thoughts and ideas as briefly as possible" and to "ignore spelling, grammar, and punctuation." Two independent coders, blind to both the experimental conditions and the study hypotheses, and trained in the recognition of hostile words, counted the number of hostile thoughts listed by each participant. A hostile thought was defined operationally as any word having a hostile connotation, and more specifically subcategorized as expressions of negative affect, verbally abusive terms, profanity, and references to destruction or physical harm. The inter-coder reliability coefficient was $r = .91$. The summed frequency of words coded in these categories was used as a measure labeled Hostile Thoughts ($M = 2.79$, $SD = 2.59$).

Aggressive behavior. Aggressive behavior was measured using a procedure adapted from earlier research (Zillmann & Weaver, 1997) in which participants were asked to evaluate a research assistant. An individual identified by the researcher as a student research assistant in the department conducted the experimental sessions. Participants were informed that the research assistant was a volunteer applying for a paid position at the Mind Lab (a new media research center at the university), asked to complete a Mind Lab Research Assistant Evaluation form (made to look official), and seal it in an envelope. The form identified the experimenter by name and contained four questions. The first three items asked participants to respond on an 11-point integer scale to the following questions: How courteous is this person? How competent is this person? Is he/she deserving of financial support? Responses ranged from "not at all" to "extremely" courteous, competent, and deserving. The fourth question asked, "If you had to make a Yes or No decision, what would it be?" All but one participant answered yes to the question, so the item was deleted from further analysis. The remaining three items were averaged to create a measure labeled researcher evaluation ($\alpha = .83$). Low scores on researcher evaluation were taken as an indicator of aggressive behavior. Most participants evaluated the assistant favorably ($M = 9.58$, $SD = 1.43$).

Results

ANOVA and multiple regression analyses were used to test hypotheses proposed in the current study. ANOVA was used to test hypotheses 1 and 3 concerning the impact of media environment on telepresence, aggressive thoughts, and behaviors. Subsequent tests of mean differences were conducted using Least Significant Difference analysis with α set at $p < .05$. Regression analysis was used to test hypothesis 2 and 4 concerning the manner in which traits combine with media environment and telepresence to influence aggressive thoughts and behaviors.

Media Environment and Telepresence

Hypothesis 1 predicted that media environment affects telepresence. Highest telepresence is predicted in the VR violent video game condition, followed in order by the standard violent video game, observe violent video, and observe nonviolent video conditions. Univariate analysis of variance performed on telepresence experienced as a function of media environment condition was significant, $F(3,178) = 15.90$, $p < .01$, $\eta^2 = .21$. Subsequent analyses demonstrated two things: Expected differences between the VR violent video game and standard violent video game conditions were not observed. In fact, though not significant, telepresence in the standard game ($M = 4.14$, $SD = .79$) tended to be higher than the VR game condition ($M = 3.84$, $SD = .89$). However, consistent with predictions, telepresence in both the VR game and standard game conditions was significantly greater than telepresence in the violent observation ($M = 3.13$, $SD = 1.01$) and nonviolent observation ($M = 2.95$, $SD = 1.05$) conditions.

Video Game Use and Telepresence

Hypothesis 2 predicted that prior violent video game use heightens the Telepresence Experienced when one is exposed to a violent video game. For tests of this hypothesis, hierarchical techniques were used to regress prior game use and prior violent game use on telepresence experienced. In the first step, scores on the four subscales of trait aggression (BPAQ), media environment condition (coded sequentially as nonviolent observation = 1, violent observation = 2, standard game = 3, VR game = 4), and gender (coded male = 1, female = 2) were entered. This block accounted for a significant portion of the variance in telepresence, $R^2 = .17$, $F(6, 169) = 5.59$, $p < .01$. The individual regression coefficients for both media condition ($\beta = .38$, $t(169) = 5.34$, $p < .01$) and gender ($\beta = -.20$, $t(169) = 2.47$, $p < .05$) achieved significance. No other coefficient was significant (see Table 1).

In the second step, prior game use and prior violent-game use were added to the model. This block significantly increased variance accounted for, $R^2\Delta = .05$, $F(2, 167) = 5.23$, $p < .01$. Significant regression coefficients were found for media condition ($\beta = .40$, $t(167) = 5.72$, $p < .01$) and prior violent game use ($\beta = .32$, $t(167) = 2.90$, $p < .01$). Consistent with the test of hypothesis 1, the results show that the positive impact of game condition on telepresence is robust, and, more notably, that increased prior violent video game experience predicted higher levels of telepresence.

Media Environment and Short-Term Hostility

Hypothesis 3 predicted that violent video games increase hostility, with the highest hostility resulting from playing VR violent video games, followed by standard violent

Table 1
Hierarchical Multiple Regression on Telepresence Experienced
and Hostile Thoughts

Predictor Variables	Telepresence Experienced	Hostile Thoughts
	β	β
Block 1		
Gender	-.20*	.32**
Media Environment	.38**	.22**
Buss-Perry hostility	.02	.13
Buss-Perry anger	.08	.04
Buss-Perry verbal aggression	.02	-.08
Buss-Perry physical aggression	-.08	-.01
Prior Game Use	entered in Block 2	.05
Prior Violent Game Use	entered in Block 2	-.06
(Block 1 $R^2 \Delta$)	(.17**)	(.20**)
Block 2		
Prior Game Use	-.12	entered in Block 1
Prior Violent Game Use	.32**	entered in Block 1
Telepresence Experienced	not included in analysis	-.12
(Block 2 $R^2 \Delta$)	(.05**)	(.01)

Note: * $p < .05$. ** $p < .01$.

video game play, violent video observation, and nonviolent video observation. To test this hypothesis, separate univariate analyses of variance were performed on hostile thoughts and on researcher evaluation as a function of media environment. Analysis on hostile thoughts was significant, $F(3,177) = 10.83$, $p < .01$, $\eta^2 = .16$. Results of subsequent Least Significant Difference analysis demonstrate that fewer hostile thoughts were observed after non-violent observation ($M = 0.61$, $SD = .88$) than the other three conditions. There were no significant differences among the number of hostile thoughts found in the violent observation ($M = 3.50$, $SD = 2.90$), standard game ($M = 2.89$, $SD = 2.68$), or VR game conditions ($M = 3.28$, $SD = 2.08$). Univariate analysis performed on scores of researcher evaluation as a function of media environment demonstrated no differences among the different game conditions, $F(3,166) = .46$, *ns*.

Telepresence and Hostility

Hypothesis 4 predicted that telepresence experienced during exposure to a violent video game would increase state hostility. Hierarchical techniques were used to regress telepresence experienced on both hostile thoughts and on researcher eval-

uation. For regression on hostile thoughts, scores on prior game use, prior violent-game use, the four subscales of trait aggression (BPAQ), media environment condition, and gender were entered to account for their influence. This block explained a significant portion of the variance in telepresence, $R^2 = .20$, $F(8, 166) = 5.24$, $p < .01$. Significant regression coefficients were found for media condition ($\beta = .22$, $t(166) = 3.15$, $p < .01$) and gender ($\beta = .32$, $t(166) = 3.19$, $p < .01$), while the effect for the hostility subscale of the BPAQ approached significance ($\beta = .13$, $t(16) = 1.69$, $p < .10$). No other coefficient was significant. In the second step, telepresence experienced was added to the regression model. This block failed to account for significant increased variance, $R^2 \Delta = .01$, $F(1, 165) = 2.27$, *ns*. Though analyses failed to support H4, results show that hostile thoughts were more common in females and, to some extent, those high on trait hostility.

Regression analysis was also performed on the researcher evaluation using the same predictors as the analysis on hostile thoughts. The model failed to account for significant variance, $F(9, 154) = 1.41$, *ns*, and none of the individual variables were significant predictors of researcher evaluation.

Discussion

We began this investigation expecting to find that exposure to elevated levels of virtual violent media would increase hostility. While some predictions were unconfirmed, perhaps the most important results of our study were those supporting hypotheses that replicate the effect of violent media on hostile thoughts in a VR video game environment, and those demonstrating that prior experience can increase the sensation of telepresence in violent VR environments. Notably, the evidence concerning violent VR extends research on media violence in general and violent video games in particular to include the violent VR video game exposure. With regard to prior experience, our observation that prior violent video game exposure led to an increased experience of telepresence signals the importance of individual differences in understanding the creation of telepresence in violent VR environments. In addition, while the evidence at hand fails to show this as a significant predictor of hostile outcome, it forces us to consider this potential further. Finally, it is important to note that while our data replicate the effect of violent media on hostile thoughts, they show no effect on hostile behavior.

Violent Video Games and Hostility

Replicating earlier studies showing that violent media content increases forms of hostility (Anderson & Bushman, 2001; Sherry, 2001), more hostile thoughts were found in the standard violent video game and violent observation conditions than were found in the nonviolent media observation control. More importantly, however, the same elevated levels of hostile thoughts were found in the VR violent video

game condition. While replicating the effect of violent media in a VR game environment is important in itself, it can be understood more broadly in relation to other research on media violence. One line of research that seems applicable here is GAM (Anderson & Bushman, 2002b). Our study's finding that exposure to violent media content increases hostile thought, and that individual differences are important determinants of experiencing violent media, are consistent with notions of GAM.

The multi-stage process represented by GAM suggests the potential for both short-term and long-term effects on aggressive behavior. The short-term process begins with personal variables (e.g., personal experience with media environments) and situational variables (e.g., violent media exposure). The model predicts that media violence primes aggressive scripts. These scripts activate affect and arousal, influence appraisal processes, and lead to aggressive behavior. The long-term model shows how these short-term experiences promote chronic personal and situational attributes facilitating aggression. While not designed as a test of GAM, our study has implications for this line of research. The findings provide evidence that violent video games prime hostile thoughts in respondents. Such an outcome from one short gaming experience suggests the potential for repeated short-term experiences with VR violence to affect habitual long-term states. At the same time, the logic behind GAM suggests that primed thoughts should lead to lower research evaluations—something not observed in our study. Clearly, the resolution for some of these issues requires considerably more study.

Violent Media Environments and Telepresence

Consistent with our predictions, the findings indicate that telepresence is more readily experienced in the two active game environments (i.e., VR game and standard game) than in either of the observational conditions. In contrast to predictions, however, the virtual reality condition did not produce the highest levels of telepresence; rather, the standard game environment tended to produce higher levels of telepresence. This seems surprising at first, but consideration of other outcomes may help explain this unexpected occurrence.

We began with the assumption that the three violent conditions represented a continuum of immersion, with the VR condition the most immersive and the observation condition the least. However, because the standard game environment produced higher levels of telepresence than expected, characteristics of the game, the technology, or the participants in this study failed to create the predicted immersion patterns. We suspect that all may have been contributors. For example, the familiarity with and increased visibility of the joystick control device in the standard condition may have made the condition seem higher in what Sundar et al. (2003) defined as functional interactivity (since while familiarizing themselves with the game, users in the standard condition could see, in its full color, the directional pad and several buttons. Conversely, users in the immersive condition could see only the virtual environment, and their only sensory exposure to the toy handgun control

device was through touch). The greater perceived functional interactivity in the standard condition could have led to an increased sense of telepresence. Moreover, the lab context could have been a contributor. Most normal gaming situations and settings contain distractions not present in our lab. As such, our participants were able to focus only on the game. Potentially, this absence of distractions may have allowed for an increase in immersion and, therefore, telepresence.

The finding that telepresence was predicted by prior violent video game experience suggests that characteristics of participants were important predictors of telepresence. Familiarity should increase a player's ability to control the game environment. We suspect that the heightened experience of telepresence in the standard game condition resulted from this feeling of control. By contrast, the struggle associated with the initial learning curve for VR video game play is likely to impede feelings of telepresence. The fact that many participants had considerable experience with video game play while none had experience with the type of VR technology used here suggests that certain features of the participants and the game combined to make telepresence highest in the standard game condition. If this account is correct, we should expect the predicted patterns of telepresence to occur once player populations become more familiar with and skilled at VR game environments.

In line with this reasoning, we also recognize that the three, 5-minute playing sessions employed in our study might not have allowed for enough time to evoke heightened levels of telepresence. The time required to experience telepresence is likely to vary as a function of task difficulty and familiarity with the environment. Prolonged exposure within a virtual environment is generally thought to allow users the time to gain necessary skills and familiarity, as well as to adapt to the heightened sensory experience offered. Thus, given the novice VR participants and the difficulty of the game used in the current study, longer exposure might have increased familiarity and resulting levels of telepresence in the VR condition. In a similar respect, the long breaks between sessions could have influenced telepresence negatively. If playing time was a hindrance, then repeated breaks could have caused users in the VR condition to reorient several times, thereby inhibiting telepresence. Additional work is needed to determine the extent to which lengthy and/or repeated exposure to these environments influences the ability of users. Findings in this area would improve our capacity for identifying not only VR technology's impact on telepresence but also the role of telepresence in determining the effect of violent virtual environments. If familiarity is an important determinant here, then knowledge of this would be essential to any functional understanding of these environments or the outcomes expected from their use.

The fact that telepresence failed to predict state hostility might lead some to argue that immersion in these games increases the enjoyment experienced and, as a result, reduced hostility would be expected as an outcome of positive mood states induced from the entertainment value of these games. Nevertheless, even if this accurately describes the short-term impact of mood under these circumstances, this rationale

would not be at odds with GAM logic positing that repeated exposure of this type strengthens hostile cognitive structures associated with long-term increased aggressive tendencies.

Violent Video Games, Gender and Hostility

Though the surprisingly high level of hostility in females following exposure to violent video games was unanticipated, post hoc examination of the interaction between gender and media environment is informative here. In addition to the main effects for gender ($F(1,172) = 16.76, p < .01, \eta^2 = .09$) and media condition ($F(3,172) = 12.03, p < .01, \eta^2 = .17$), analysis of variance shows a significant interaction on hostile thoughts, $F(3,172) = 3.31, p < .05, \eta^2 = .06$. The pattern of means reveals unusually high hostility in females who watched the violent video game. Independent sample *t*-tests show that the interaction is explained by significant differences between male and female hostility scores in the violent observation condition, $t(54) = 4.57, p < .01$, where females ($M = 5.07, SD = 3.01$) showed more hostility than males ($M = 2.03, SD = 1.88$). Notably, while the findings for males show that hostility in those watching the violent game was lower than those playing either the standard ($M = 2.25, SD = 2.07$) or VR game ($M = 2.84, SD = 1.86$), for females, hostility among those watching a violent game was considerably higher than among those playing the game on either a standard ($M = 3.73, SD = 3.07$) or VR system ($M = 3.77, SD = 2.25$). For both males ($M = .55, SD = .89$) and females ($M = .73, SD = .90$), hostility was near zero in the non-violent condition.

One possible interpretation is that females in this study had a dislike for violent video games in general, and this dislike was more salient to them when they were simply watching these games rather than playing them. In addition to hostility resulting from aggressive scripts primed by the mere exposure to violent video games, active dislike for these games might have added to the production of hostile thoughts. By contrast, for males, hostility might have increased gradually along with the salience of violent media as the environments progressed from observing a violent game to playing a standard violent game and then to playing a VR violent game, as posited.

Future Research

Because several of the findings in this study were not expected, there are still many questions to be answered—some associated with procedural issues in the present study, and others dealing with factors not included in our investigation. The procedural issues reveal limitations with the present study. For example, we have assigned order to the four conditions of our media variable based on our a priori belief that this ordered set of violent virtual media would affect telepresence and state hostility. The fact that it did not affect these outcomes as expected challenges the a priori assignment. While we still see the four conditions as conceptually

ordered in the assigned fashion, and interpret the unexpected outcomes as resulting from factors such as familiarity with the virtual technology, the validity of our approach and our interpretation are empirical questions only answerable by additional research. Related to issues regarding our media conditions, the inclusion of a condition where participants are exposed to a violent VR game without playing it would seem a logical addition to this study design. Unfortunately, the technology available to us did not allow us to include it, and this too is open to future study.

Other procedural changes also could improve this protocol. Using a random rotation of measures between gaming sessions would allow for researchers to exclude potential order effects that may currently exist in the current study. Additionally, we would recommend that future research consider physiological measures when observing perceived telepresence and aggression. This modification would integrate the current line of research with earlier work on video game violence (Calvert & Tan, 1994) and allow exploration of the potential mediating impact of arousal on the relationship between telepresence in violent VR environments and aggression.

In addition to physiological measures, a measure of physical aggression more closely matched to the actions of the game played would provide additional insight. Though this is difficult to accomplish with a shooter game like *Duke Nukem 3D*, more closely matched measures of aggression for games with other less lethal forms of physical violence are more plausible. Moreover, a less deadly game might be expected to create an environment more salient to some users and conducive to greater engagement. For example, a game in which participants engage in fisticuffs might present a more plausible and subsequently more involving activity for some participant subpopulations. This is important not only for theoretical reasons but for practical reasons as well. Recent study shows that 59% of the human characters that commit violent acts in video games engage in aggression without the use of weapons, while an additional 22% of those characters engage in violent behavior both with and without weapons (Children Now, 2001). Many adolescents are likely to encounter situations in which fisticuffs is a common solution to problems while gunfights are not. This type of game violence is not only more prevalent than weapon-oriented violence, but it offers an environment that is better suited to testing some of the theoretical rationales offered, and with potentially greater impact.

An important issue not addressed by the current study is the effect of long-term repeated exposure to violent virtual game environments. Using a repeated-measures design, researchers could determine when, if at all, the effect of playing these types of violent video games attenuates. Because this type of longitudinal study would require participants to play the same VR game several times, problems with early stages of the learning curve could be overcome. In addition, repeated measures of physical aggression and hostile thoughts would provide more sensitive data on the subtle impact of a violent virtual video game's extended use.

Beyond these procedural limitations, the present study advances our knowledge of media violence effects by extending them into a new context, that of the interactive

virtual environment. It also illustrates the potential for telepresence-inducing technologies such as virtual reality to influence user response. This opens up a number of avenues for scientific inquiry, several of which are already being explored. Persuasion scholars, for example, are investigating the potential for VR-related telepresence to enhance the effectiveness of advertisements (Klein, 2001; Li, Daugherty, & Biocca, 2002). Similarly, social psychologists have hailed immersive virtual reality technology as a promising tool for experimental research, given its potential to ameliorate methodological problems such as the experimental control/mundane realism tradeoff, lack of replication, and unrepresentative sampling (Blascovich et al., 2002). Clearly, telepresence-inducing media have much more to offer than antisocial effects such as increases in aggression. By considering all types of outcomes of media exposure through the rubric of telepresence, theories can be developed to address issues essential to our knowledge of new and emerging media technologies and benefit our understanding of their valued purpose and context of use (Ijsselstein & Riva, 2003).

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