Violent Virtual Video Games and Hostile Thoughts

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Abstract

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 either: (1) play a VR violent video game, (2) play a standard violent video game, (3) observe a violent video game, or (4) observe a non-violent video game. Following exposure, measures of telepresence experienced and hostile thoughts were obtained. Findings support predictions that personal (prior video-game use) and situational variables (violent media exposure) influence telepresence experienced in media environments and promote aggressive outcomes.

Violent Virtual Video Games and Hostile Thoughts

The enormous controversy surrounding violent video games has been fueled by conflicting claims about the ferocious nature of their content and the relationship between game use and hostility. Spurred by frightening tragedies like those at Columbine, concern has led scholars, social critics, game manufacturers, and media professionals to look at the content of video games, and to question their impact on aggressive behavior.

If violent video games can impact our children, many are at risk today. Anderson (2000) tells us that nearly all children spend time playing video games. The average 7^{th} grader plays for almost 4 hours a 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, in press). By the time they reach college many young men report playing these games more than 15 hours a week. With the promise of even more alluring video games coming in the form of virtual reality (VR) technology, misgiving 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 twenty 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 contemporary violent video games, but that playing these games was followed also by increased aggressive behavior. They claim that characteristics inherent in violent video-game technology make the impact of these games on aggressive behavior considerably more powerful than violent television or film. Though the paucity of research makes a conclusive causal link between violent video-game use and aggressive behavior difficult to establish, the General Aggression Model (GAM) promises to strengthen arguments concerning outcomes from these games (Anderson & Bushman, 2002). GAM suggests that features of media attributes increasing a user's identification with an aggressor will elevate subsequent aggressive behavior. We argue that features of VR technology such as interactivity, real-time three-dimensional graphics and full immersion (Gustafson, 2002) will heighten identification with aggressive characters and increase resulting aggression. We also argue that individual differences in prior exposure to violent media environments make some users more susceptible to these influences.

The present investigation was designed to extend the work of Anderson and Dill (2000). Using GAM as a framework, it compares 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 this technology and relevant past experience will lead to an increase in the sense of *telepresence* – feeling 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 media technology experience (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 (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 effect 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. More importantly from a theoretical perspective, the results provide strong support for the General Aggression Model advanced by Anderson and Dill (2000).

The General Aggression Model. Anderson and Dill's (2000) GAM presents a multi-stage process resulting in both a short-term and a long-term impact 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, provocation) impacting the interaction among the internal states of cognition (e.g., chronic accessibility or priming of aggressive scripts), affect (e.g., trait or state hostility) and arousal (chronic or state excitation). These internal state variables activate automatic appraisal processes (e.g., threat and coping reactions of fight or flight) and controlled re-appraisal (e.g., revenge) which govern behavior (e.g., immediate or delayed verbal or physical aggression). 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 process is a simple extension of the short-term model showing how short-term experiences impact long-term personal and situational variables. The present study limits itself to tests of short-term influences. However, to the extent that short-term experiences impact long-term processes, an impact on these habitual states can also be expected.

GAM and violent video games. The GAM framework explains the impact of video-game violence on aggressive behavior through theoretical 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. The active role and first person point of view can be understood as a crucial influence on situational variables initiating short-term processes in GAM. 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 act as situational variables activating 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 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. 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.

Witmer and Singer (1998) identify involvement and immersion as psychological states that embody as the essence of experiencing telepresence. According to Tamborini (2000), the vivid and interactive natures found in different media technology 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. This is expected to dramatically increase a user's identification with aggressive characters and heighten the impact of violent video games 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 attempts to identify determinants of telepresence deal with characteristics of specific media, some attempts have been made to uncover the characteristics of individuals that impact this experience. Witmer and Singer (1998) considered a person's tendency to identify with characters in stories, sports or video game 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 their 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 could also help answer Anderson's (2000) call for research that pinpoints attributes increasing 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 media in question. These personal attributes and characteristics of a media experience can be seen as examples of what we would consider personal and situational variables initiating aggressive scripts within the GAM framework.

Telepresence in VR violent video games. Many of the factors 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.

The interactive features of video games also should contribute to feelings of telepresence. The speed with which users can influence the form and content of an environment is almost instantaneous in games today. Newer games provide great range in terms of the number of environmental features that can be manipulated. And though many games use unnatural actions associated with joystick switches and buttons, some shooter games with guns provide a natural map of the motor skill 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 impact 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. Unlike these 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 involving qualities of a video game are easy to observe, however, those leading to immersion are more in question. Most games are unlikely to insulate users from their physical surroundings, therefore decreasing the opportunity or 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, we should expect the isolation provided by video games to suffer. Surrounding intrusions will be radically reduced, however, when using VR technology. We expect the isolation provided by goggles, gloves, and earphones in VR game environments to go far beyond the involvement found in today's standard video games, and to 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 what occurs within a mediated world, they compel us to consider how personal preferences for an environment's content and form will impact 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 impacts 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

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 violent video 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 immersive environments with more salient primes should 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 non-violent 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 goggles and gloves of VR games promise a different experience. Here, 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 a 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: (1) playing a VR violent video game, (2) playing a standard violent video game, (3) observing a violent video game, and (4) observing a non-violent video game. In each condition, participants were exposed to the assigned game condition for five minutes three separate times in a one hour session.

Subsequent to each exposure individuals completed one of the following: a thought listing task, a self report measure of telepresence experience, and a game recommendation task. Following the game recommendation, 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 media environments (VR game, standard game, violent observation, or non-violent observation) on aggressive thoughts and behaviors.

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=1.521). Participants were informed that the investigation was designed to study the way people experience different types of media.

Procedures

Participants came to the lab in pairs and were greeted by one of three different male researchers and one of two male research assistants. During each session, the first participant was assigned to one of the two game conditions (VR or standard), while the second participant was assigned to one of the two observation conditions (violent or non-violent). After administering a written consent form to the participants, the researcher then began the instructions for the procedure. All instructions given to the participants were audio taped ahead of time in order to ensure consistency across conditions. Following the first set of taped instructions, the assistant took the second participant into an adjacent room. At this time, the researcher continued to supervise the first participant as they received taped instructions in how to play the game.

Following these instructions and a brief practice session designed to allow the game player to become accustomed to the environment, the researcher left the first participant and let him/her play alone for five minutes. At this time, the second participant watched either a feed of the game being played in the other room (violent observation), or a previously recorded game (non-violent observation). In both cases, participants in the observation condition were told that they were watching the game being played by another participant. After five minutes, the assistant returned, administered the thought-listing task, and left the participants alone for four minutes. At the conclusion of four minutes, the assistant played a set of taped instructions and left the participants to play or observe for another five minutes.

Following this five-minute interval the assistant returned and administered the telepresence experience survey. When both of the participants had completed the survey (typically about eight minutes), the assistant once again entered the observation and game-play rooms and collected the surveys. After another set of instructions the assistant left again and the third and final period of playing and observing began.

At the conclusion of another five minutes, the assistant entered each of the two rooms and administered a game recommendation questionnaire designed to evaluate their enjoyment of the game as well as how much the participant thought retailers could reasonably charge for the game. After collecting the game recommendation questionnaire, the researcher returned and administered a research assistant evaluation form, and then played a taped debriefing statement.

This was followed by probing questions designed to identify any demand effects during the procedure. Participants were then thanked, given course credit, 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 provides an immersive headmount system that isolates 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 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 non-violent observation condition watched output from the game CoolBoarders 3 that had been previously recorded on a CD-ROM. Participants in the standard game and 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) wandering through urban landscapes and indoor labyrinths while being attacked by heavily armed mutants. In order to advance, Duke must kill mutants and recover items. He can acquire weapons such as handguns, rocket launchers, chain-fed machine guns, and pipe bombs. For this study, the game was set so Duke had all necessary weapons and tools at the outset. Additionally, to avoid the problem of having to restart the game, a "God Mode" was set so Duke could not die.

The graphics are shown from Duke's perspective. The player sees no more of himself than a weapon extended outward, and is literally looking through the eyes of the character they are controlling. 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.

CoolBoarders 3 is another popular home video game. Players control a character as they snowboard down different slalom and half-pipe courses, and 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 screen, and are not looking at the game in the type of first-person perspective found in Duke Nukem 3D.

Pre-test measures

A self-report questionnaire was created to collect the data on prior video-game use, and the Buss-Perry Aggression Questionnaire (Buss and 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 amount of time spent playing video games in general, regardless of type of content. Participants were asked to list their five favorite video games. They were provided with an inventory of popular video games to help their memory. For each game listed, participants responded (from 1 to 7) to two items rating how often they played and the level of game violence. Responses of 1 were labeled "rarely" and "little or no violent content" respectively. Responses of 7 were labeled "often" and "extremely violent content" respectively. Reports in this study are based on the first game listed. Ratings of how often they played were used as a measure of prior game use (*M*=1.80, *SD*=2.29). This prior-game use score was multiplied by measures of game violence to form a prior violent-game use score (*M*=5.27, *SD*=9.36).

Trait aggression. The 29 items 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, α = .71), hostility (8 items, *M*=2.71, *SD*=.73, α = .74), physical aggression (9 items, *M*=2.23, *SD*=.79, α = .74), and verbal aggression (4 items). One item was dropped from the original 5 items in the verbal aggression scale. Removal of this item improved reliability from α = .32 to α = .70 (*M*=2.85, *SD*=.86). Items such as "Some of my friends think I'm a hothead" represent 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 physical aggressiveness and verbal aggressiveness respectively.

Outcome measures.

Three measures served as outcome variables in this study including a self-reported measure of telepresence experience, thought listing task responses coded for state hostility, and responses on the researcher evaluation form coded for aggressive behavior.

Telepresence experience. 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 measuring sensory factors and control factors were averaged to create a measure labeled telepresence experienced (M=2.58, SD=.71, α = .87).

State hostility. Hostile thoughts listed by the participant immediately after exposure to the media environment were recorded and coded following the thought-listing procedure described by Cacioppo and Petty (1981). Participants 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 hypotheses in the study, counted the number of hostile thoughts listed by each participant. A hostile thought was defined operationally as any word having a hostile connotation. They were more specifically sub-categorized as expressions of negative affect, verbally abusive terms, profanity, and references to destruction or physical harm. Both coders were trained in recognition of these types of hostile words. 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, and the item is 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 test of mean differences were conducted using LSD 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 impacts 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 non-violent 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*=.21. Results of LSD subsequent analysis demonstrate 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 non-violent 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 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 (dummy coded non-violent observation=1, violent observation=2, standard game =3, VR game=4) and gender (dummy coded male=1, female=2) were entered to account for other influence. This block accounted for a significant portion of the variance in telepresence, $R^2 = .17$, F (6, 169) = 5.68, $p < .01$. The individual regression coefficients for both media condition ($\beta = .38$, $t = 5.36$, $p < .01$) and gender ($\beta = -.21$, $t = 2.51$, $p < .05$) 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 ($\beta = .38$, $t = 5.52$, $p < .01$) and prior violent game use ($\beta = .28$, $t = 2.85$, $p < .01$.). Consistent with 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.

[Insert Table 1 about here]

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 video game play, violent video observation, and non-violent 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* =.16. Results of LSD subsequent 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 evaluation. For regression on hostile thoughts, scores on prior game use, prior violent-game use, the four subscales of trait aggression (BPAQ), media environment condition (dummy coded), and gender (dummy coded) were entered to account for its influence. This block explained a significant portion of the variance in telepresence ($R^2 = .20$, $F(8, 166) = 5.28$, $p < .01$). Significant regression coefficients were found for media condition ($\beta = .22$, $t = 3.20$, $p < .01$) and gender ($\beta = .32$, $t = 3.18$, $p < .01$), while the effect for the hostility subscale of the BPAQ approached significance ($\beta = .13$, $t = 1.69$, $p < .10$.). 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 ($R^2\ \Delta = .01$, $F(1, 165) = 2.15$, *ns*). Though analyses failed to support H4, results show that hostile thoughts were higher in females and, to some extent, those high on trait hostility (see Table 2).

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 video game violence would increase hostility, and that immersive violent video-game environments would intensify this impact. Though the findings here support some of our predictions, others remain unsupported. In general, the findings support Anderson and Dill's (2000) GAM. By contrast, the finding that females expressed more hostility following exposure is unexpected, and raises questions about the video-game experience of participants in this study.

Violent video games and hostility

Consistent with the notion that violent media content influences hostility, more hostile thoughts were found in the three violent media content conditions than were found in the non-violent media observation control. Similarly, though not significant, the tendency for more hostile thoughts among those high on trait hostility is also compatible with the model. These finding provide important support for GAM (Anderson & Dill, 2000) predictions that personal variables (e.g., trait hostility) and situational variables (e.g., violent media) impact the interaction among the internal cognitive states to prime aggressive scripts and promote to aggressive outcomes.

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*= .09) and media condition ($F\,(3,172) = 12.03$, $p < .01$, *eta*= .17), analysis of variance shows a significant two-way interaction on hostile thoughts, $F\,(3,172) = 3.31$, $p < .05$, *eta*= .06. The pattern of means reveals that the interaction appears to result from unusually high hostility in females watching 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 notably 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 for those playing the game on either a standard (M=2.25, SD=2.07) or VR system (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). Of course, 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 gradually increased along with the salience of violent media as the environments progress from observing a violent game to playing a standard violent game and then to playing a VR violent game, as posited.

Violent media environments and telepresence

Consistent with our predictions, the findings show greater telepresence 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 as expected; rather, the standard game environment had a slight tendency to incite the higher feelings 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, since 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. Moreover, the context from which lab experiments are tested could also be a contributor. For example, in a normal gaming situation as defined by this study contains distractions, however, in a lab setting distractions are not present and thus, participants are able to give complete focus to the game. This lack of distraction could increase 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. Those familiar with the type of game environments used in this study experienced more telepresence. Familiarity should increase a player's ability to control the game environment and the experience of telepresence that results from this feeling of control. By contrast, the struggle associated with the initial learning curve for 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 make telepresence highest in the standard game condition. If this account is correct, the predicted patterns of telepresence should occur once player populations become more familiar with and skilled at VR game environments. Efforts to overcome this set of circumstances should improve our ability to identify not only VR technology's impact on the experience of telepresence, but the role of telepresence in determining the outcomes of experience in violent virtual environments. If individual differences are important determinants of telepresence and outcomes resulting from media environments, consideration of traits and experiences relevant to different virtual environments would be essential to any functional understanding of these environments as well as the outcomes expected from their use.

Of course, it should also be noted that telepresence failed to predict state hostility. Some might argue that immersion in these games increases the enjoyment experienced. In this case, reduced hostility would be expected as an outcome of positive mood states induced from the game's entertainment value. 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. Anderson and Dill (2000) suggest that these long-term personal variables are developmentally influenced by each short-term aggressive experience through the leaning, rehearsal and reinforcement of aggression-related knowledge structures. Even if immediate responses from the emersion-enhanced enjoyment experienced while playing the game inhibited its short-term impact, the leaning of aggressive knowledge structures through these experiences should still impact chronic long-term aggressive tendencies.

Future research

Because several of the findings in this study were not expected, there are still many questions to be answered. There is a need to explore the relationships among level of immersion, telepresence, and hostile thoughts. In addition, a measure of physical aggression more closely matched to the actions of the game played would improve the present protocol. Though this is difficult to accomplish with a shooter game like Duke Nukem, 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 where participants engage in fists-fights might present a more plausible and subsequently more involving activity for some participant subpopulations. This is important not only for theoretical reasons but practical reasons as well. Recent study shows that 59% of the human characters committing violent acts in video games engaged in aggression without the use of weapons, while an additional 22% of those characters engaged in violent behavior both with and without weapons (Children Now, 2001). Many adolescents are likely to encounter situations where fist fighting is a common solution to problems while gun fights are not. This type of game violence is not only more prevalent than weapon oriented violence, it offers an environment better suited to testing some of the theoretical rationales offered, but one with potentially greater impact.

Finally, an important issue not addressed by this research is the impact of long term repeated exposure to violent virtual game environments. Using a repeated measure 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.

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Table 1

Hierarchical Multiple Regression on Telepresence Experienced and Hostile Thoughts

Predictor Variables	Telepresence Experienced	Hostile Thoughts
Block 1		
Gender	-.11	.31**
Media Environment	.38**	.27**
Buss-Perry hostility	.03	.14
Buss-Perry anger	.11	.05
Buss-Perry verbal aggression	-.08	-.08
Buss-Perry physical aggression	-.06	-.01
Prior Game Use	entered in Block 2	.05
Prior Violent Game Use	entered in Block 2	-.05
(Block 1 Δ R^2)	(.17**)	(.20**)
Block 2		
Prior Game Use	-.06	entered in Block 1
Prior Violent Game Use	.28**	entered in Block 1
Telepresence Experienced	not included in analysis	-.11
(Block 2 Δ R^2)	(.05**)	(.01)