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Effects of Realism on Extended Violent and Nonviolent Video Game Play on Aggressive Thoughts, Feelings, and Physiological Arousal

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Previous research has shown that playing violent video game exposure can increase aggressive thoughts, aggressive feelings, and physiological arousal. This study compared the effects that playing a realistic violent, unrealistic violent, or nonviolent video game for 45 min has on such variables. For the purpose of this study, realism was defined as the probability of seeing an event in real life. Participants ($N = 74$; 39 male, 35 female) played either a realistic violent, unrealistic violent, or nonviolent video game for 45 min. Aggressive thoughts and aggressive feelings were measured four times (every 15 min), whereas arousal was measured continuously. The results showed that, though playing any violent game stimulated aggressive thoughts, playing a more realistic violent game stimulated significantly more aggressive feelings and arousal over the course of play. Aggr. Behav. 35:213–224, 2009.

Keywords: video games; aggression; realism; priming

INTRODUCTION

There have been three decades of video game research that have examined the short-term effects of playing violent video games on aggression [for reviews see Bensley and van Eenwyk, 2001; Dill and Dill, 1998; Emes, 1997; Griffiths, 1999]. These short-term studies have investigated a number of possible outcomes that result from violent (versus nonviolent) video game play, such as aggressive thoughts, aggressive feelings, and physiological arousal [see Anderson, 2004]. Overall, it has been found that violent video game exposure is related to higher levels of these aforementioned variables. Despite the wealth of empirical and theoretical extensions that have been made to the video game violence literature, it is still unclear what role realism in a violent video game has on aggression-related variables.

Video Game Realism as a Moderator

Realism is a difficult construct to measure and study because it has multiple definitions. We believe that there are two plausible definitions of realism that are important to discuss. The first definition is how graphically enhanced the video game is perceived to be. There is a positive relationship between more modern video game technology and improved graphics in the video game. Thus, as video game technology became more advanced, the images on the television screen became less pixilated, leading to a sharper image on the screen. Human characters in the video game began to look like real humans and less like a computer image of a human. Although the research using this definition is small, there has been some research to suggest that this definition of realism yields significant differences in arousal and immersion. Ivory and Kalyanaraman [2007] employed a 2 (video game content: violent/nonviolent) $\times$ 2 (video game release date: old/new) factorial design and assessed aggressive thoughts, aggressive feelings, and physiological arousal (skin conductance). Results showed only a main effect for video game release date on skin conductance, but not aggressive thoughts or

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aggressive feelings. In addition, there was no main effect of video game content or any content × release date interactions for the aforementioned variables [Ivory and Kalyanaraman, 2007].

Another possible definition of realism is the extent to which the images in the video game can actually be seen in real life [see Shapiro et al., 2006 for a review]. In other words, realism is defined as the extent to which the events, characters, and environment in the game can be seen in reality. We are aware of only one study that has used this definition of realism to study video game effects [Anderson et al., 2004]. These researchers manipulated realism by differing color of blood (red realistic; green unrealistic) of the characters in the game. Results showed nonsignificant differences between the violent realistic and the violent unrealistic video game. Anderson et al. [2004] concluded that manipulating only the realistic nature of the blood in violent video games, "…may not have been sufficiently realistic. Further work (not speculation) is needed on the realism effect (pp 232)." This study will build upon the work of Anderson et al. [2004] by manipulating more aspects of the video game besides just the realism of blood color.

Unfortunately, both definitions of realism are not completely independent of one another. For instance, graphics quality should be highly related to the probability of seeing video game images in real life, because less pixilated images make such images appear clearer helping players interpret the attributes of the video game as resembling real life. However, the correlation between these two definitions is not perfect. For instance, older video games such as *Goldeneye*, for the Nintendo 64, depicts pixilated characters, but the guns, environment, and actions of the video game could actually happen in real life (we do realize that the events in that particular game are fiction, but we are referring to the probability that a spy could kill others in real life is not zero). Thus, this game should be rated high on our definition of realism, but low on other definitions that rely on graphics quality. An attempt to disentangle these definitions and specifically test our definition of realism is one of the foci of this study.

Studying the effects of video game realism (using either definition) is important because there is a growing body of evidence to suggest that realism can influence how one experiences a video game. Realism ("telling about life like it is") and identifying with characters have been shown to moderate the long-term effect that TV violence has on youth [Huesmann et al., 2003]. As outlined by Shapiro et al. [2006], people are more willing to respond to certain stimuli in the media, which come from other humans that act in a similar fashion [see Nass et al., 1996]. In addition, adding a story line to a video game to make it more realistic is related to higher levels of immersion compared with a video game that does not contain a story [Schneider et al., 2004]. Character realism is not the only component of realism that can affect a video game player. The setting, pacing of the game, character judgments, and the character's emotions are also meaningful components of realism [see Shapiro et al., 2006]. Overall, the many aspects of realism in a video game may influence one's video game experience; however, we are unaware of any studies that have examined how the different types of realism are related to aggression-related variables.

THIS STUDY

In this study, we test the moderating role of violent video game realism (defined as the probability of seeing an event in real life) by having participants play either a violent realistic video game, violent unrealistic video game, or a nonviolent control video game for 45 min while assessing short-term change in aggressive feelings, aggressive thoughts every 15 min, and physiological arousal continuously.

Although top media violence experts have argued that media violence effects (including violence in video games) are uniform across gender and trait aggression levels [Anderson et al., 2003a], trait levels of aggression and gender play an important role in aggression. Thus, these two variables will be treated as covariates in this study.

This study can expand our understanding of the relationship between exposure to video game violence and aggression in two ways: by elaborating the moderating role of realism, and by examining repitition of play.

The first is to test the impact that realism has on one's internal state (aggressive feelings, aggressive thoughts, and physiological arousal). Theoretically, realism could impact such outcomes in two ways. Because the attributes of a realistic video game could actually happen, perhaps players will have a high psychological and physiological reaction because the players may become more involved in the video game. Highly realistic video games should allow the player to feel as though they are more a part of the game. Eastin and Griffiths [2006] showed that playing a video game in a virtual reality environment (compared with a standard platform) was related to more presence. Furthermore, presence owing to virtual reality play fully mediated the effect between game interface and aggressive feelings, but not aggressive behavior [Persky and Blascovich, 2008]. It is unclear what definition(s) of realism are applied to the games used in these virtual reality studies, but clearly some aspect of realism is related to aggression-related variables.

The second reason why realism can impact one's internal state is because the unrealistic video games may appear ''cartoonish'' to players, because the events could never really happen. The impact of perceived realism has been shown to moderate the effect between exposure to violence in children's media and aggressive behavior [Huesmann and Eron, 1986; see Kirsh, 2006 for a review]. Although the video games used in this study are not animated, one shared aspect of children's television cartoons and unrealistic video games is that the events could never happen in real life.

For the purposes of this study, the theoretical impact that realism has on aggression-related variables may also partially depend on which variable is being assessed. An important process in the short-term effects of violent media is aggression-related priming [Geen, 1990]. Anderson and Huesmann [2003] have argued that cognitions are the most important internal state variable because media violence exposure can activate aggressive thoughts, aggressive knowledge structures, and aggressive scripts in memory, which should all guide behavior. Research has shown that aggression-related concepts in semantic memory are closely linked together and make strong connections after exposure to an aggressive prime, such as ''kill,'' ''shoot,'' and ''gun'' [Anderson et al., 1998]. Because this study will use a violent realistic and violent unrealistic video game, these games should not differ in their effect on aggressive cognitions because their content is violent. Priming research does not make any predictions regarding what aspects of the video game, beyond content, influence the activation of aggression-related nodes being activated. However, it is predicted that realistic violence will lead to a more dramatic aggressive feeling and physiological reaction compared with unrealistic violence. This prediction is based on the idea that depictions of violence that could actually happen in real life may possibly make the participants feel as though they are more in the game, and the violence is not as ''cartoonish.''

The second way in which this study will expand knowledge about the relationship between violent media and aggressive behavior is by assessing what effect repeated video game exposure has on the three internal state variables. It is important to study the effects of repeated violent and nonviolent video game play because we can determine how the internal state variables will change over time. Three contingencies are appropriate concerning this prediction. First, it can be predicted that there will be a continual linear increase over time. Second, it can be predicted that there is an initial increase in aggression and arousal after violent video game play, but then a gradual decrease over time as a function of getting comfortable with the video games or desensitization. The final contingency is that the internal state variables will become initially heightened after violent video game play and then remain stable over time. To test this, this study will measure aggressive thoughts, aggressive feelings, and physiological arousal four different times (baseline, after 15, 30, and 45 min of video game play). Very few researchers typically have participants play a video game for more than 10–20 min. Weber et al. [2006] measured physiological arousal continuously while participants played a violent first-person shooter game for an hour, but used arousal as a control variable, and did not analyze the arousal data across time.

PILOT STUDY

Before the main study was conducted, we completed a pilot study in order to select appropriate games for the main study. We needed two violent games that differed substantially on realism, so we recruited a sample of participants, had them watch videos of someone playing each of six potential games we had selected, and then had them rate each game on realism.

The first pilot study sample consisted of 55 (53 male, 2 female) participants who participated in the ROTC program at a large US-based Midwestern University The average number of months participating in ROTC-related activities was 39.00 (SD = 46.56) months. The average age for the entire sample was 20.44 (SD = 2.34) years.

There were six video games that we selected to be rated by participants in the pilot study. All of these were third-person shooter games for the PlayStation 2 video game system, violent in content, but differing on the degree of realism. Three of the video games (*Conflict Global Terror*, *Conflict Desert Storm 2*, and *Conflict Desert Storm*) involved human characters fighting other human opponents on Earth. Further, when soldiers were shot in these games, they were wounded until another character individually treated the wounds of the fallen soldier to prevent death, increasing the realism. The other three games (*Star Wars Battlefront 2*, *Star Wars Battlefront 1*, and *Neo Contra)* all involved robots in outer space worlds, with long elaborate weapons that never ran out of ammunition. Further, if a player died in these games, then the player would either just get back up or restart at a new location, decreasing the realism.

The participants were told that they would be rating various video games on realism, which was defined as "the probability of seeing an object in real life." The experimenter made sure that the participants understood that realism referred to seeing an event in real life and not graphics quality. The participants then saw a video of someone playing each of six games for 6 min each. The prerecorded video game tapes were presented in random order. After seeing the tape of a game, the participant rated the game on 16 dimensions on a 1 (*not at all*) to 7 (*extremely*) Likert Scale. The dimensions included how realistic (close to resembling real-life) looking was the main character, other characters, weapons, attire, terrain, buildings, vehicles, actions, and the battlefield conditions.

A principal components factor analysis with a Varimax rotation was conducted on the ratings of the video games, which yielded two factors. The first factor was labeled the Appearance Factor ($\alpha = .97$) and the items that loaded onto this factor were how realistic looking was the main character, other characters, weapons, buildings, attire, terrain, and vehicles. The second factor was called the Behavior Factor ($\alpha = .81$) and the items on this factor were how realistic are the behaviors of the main character, the behaviors of the other characters, and how the consequences of death mirror real life. These two factors accounted for 78.52% of the total variance.

The video games differed significantly on the Appearance Factor, $F(5,\ 293) = 94.61$, $P < .0001$, *partial* $\eta^2 = .62$, and the Behavior Factor, $F(5,\ 293) = 24.92$, $P < .0001$, *partial* $\eta^2 = .30$. Post hoc analysis with a Bonferroni correction showed that the *Conflict* games were rated significantly ($P < .05$) more realistic on the Appearance Factor than the other three video games. This trend was also found for the Behavior Factor, with the exception of the nonsignificant difference between *Conflict Desert Storm 2* and *Star Wars Battlefront 2* ($P = .16$). Thus, for the primary study, we selected *Conflict Desert Storm* ($M_{appearance} = 34.69$, $SD_{appearance} = 7.29$; $M_{behavior} = 10.75$, $SD_{behavior} = 3.50$) to serve as the violent realistic video game and *Star Wars Battlefront 2* ($M_{appearance} = 14.49$, $SD_{appearance} = 8.27$; $M_{behavior} = 9.19$, $SD_{behavior} = 4.03$) to serve as the violent unrealistic video game. See Table I for descriptive statistics.

We then used a second pilot sample to rate the three video games that would be used on violence and amount of blood. Fifty-three male participants from a large US-based Midwestern University [Mean age = 19.41 (SD = 1.47), 86.9% Caucasian] viewed movie clips of *Conflict Desert Storm*, *Star Wars Battlefront 2*, and *Hard Hitter Tennis* and rated these games on a 1 (*not at all*) to 7 (*extremely*) Likert Scale how violent and bloody the games were. *Hard Hitter Tennis* was selected as an appropriate control game because it is nonviolent (the characters could not touch each other), uses a third-person point of view identical to the violent video games, and the competitive aspect of the game was similar to the violent video games. Since *Conflict Desert Storm* contains blood and the other two games do not, the bloody rating was treated as a covariate. An analysis of covariance (ANCOVA), showed that there was a significant main effect of video game on the violent ratings, $F(2,\ 96) = 48.46$, $P < .0001$, *partial* $\eta^2 = .50$. Post hoc tests with a Bonferroni correction showed that the two violent video games significantly ($P < .0001$) differed [$M_{CDS} = 4.95$, $SD_{CDS} = 1.11$, $M_{SW} = 3.97$, $SD_{SW} = 1.42$] from the nonviolent video game [$M = 1.00$, $SD = 0.00$], but not from one another ($P = .46$). We could not test whether the nonviolent video game was realistic relative to the violent video games, because the

TABLE I. Means and Standard Deviations of the Video Games in the Pilot Study

Game	Appearance factor**	Behavior factor**
Sample 1 (ROTC)		
Conflict Global Terror	37.85 (6.56)$_A$	12.30 (4.26)$_A$
Conflict Desert Storm	34.69 (7.29)$_{AB}$	10.75 (3.50)$_A$
Conflict Desert Storm 2	30.51 (11.88)$_B$	10.18 (3.59)$_B$
Star Wars Battlefront 1	15.77 (7.00)$_C$	8.62 (3.11)$_{BC}$
Star Wars Battlefront 2	14.49 (8.27)$_C$	9.19 (4.03)$_C$
NeoContra	12.29 (5.43)$_C$	4.92 (2.16)$_D$
Game	Violence**	
Sample 2 (General psychology)		
Conflict Desert Storm	4.95 (1.11)$_A$	
Star Wars Battlefront 2	3.97 (1.42)$_A$	
Hard Hitter Tennis	1.00 (0.00)$_B$	

**$P < .0001$. Means with differing subscripts indicate a significant difference ($P < .05$) using a Bonferroni correction. Note that Step 2 was based on an ANCOVA analysis with the amount of blood as a covariate.

questions were not uniform across studies (for instance, trying to equate how realistic weapons and how realistic tennis rackets are perceived to be would not be appropriate).

MAIN STUDY

Overview of This Study

The purpose of this study was to examine the effects that playing a violent realistic, violent unrealistic, and nonviolent video game had on aggressive thoughts, aggressive feelings, and physiological arousal for 45 min. Based on the past literature on the short-term effects of video games and aggression, it was hypothesized that there would be an increase in aggressive thoughts, feelings, and physiological arousal over time for those who play a violent, compared with a nonviolent, video game. Additionally, it was hypothesized that those who played the realistic violent video game would have higher aggressive feelings and physiological arousal than those who played the violent unrealistic video game at Times 2, 3, and 4, but that aggressive thoughts will not be affected by realism.

METHOD

Participants

Seventy-four (39 male, 36 female) participants from a large US-based Midwestern University participated in this study for extra credit in various psychology classes or requirements for their general psychology class. The average age of the participants was 21.51 (SD = 3.59) years. The majority of the participants were Caucasian (72.60%) and juniors, seniors, or just completed their undergraduate degree (62.10%). For participating in this study, all participants were entered into a raffle to win gift certificates to a local video game.

Materials

Equipment. Based on the results of the pilot study, the video games selected were *Conflict Desert Storm* (violent realistic), *Star Wars Battlefront 2* (violent unrealistic), and *Hard Hitter Tennis* (nonviolent control).

Agressive thoughts. The first measure used was the Word Completion Task [Anderson et al., 2003b), which measures aggressive thoughts. This measure consisted of incomplete word fragments (half of which contain aggressive possibilities, half of which do not contain aggressive possibilities). For example, "K I_ _" could be completed as "KILL" or "KISS." This has been used in past research to measure aggressive thoughts [Anderson et al., 2003a,b; Carnagey and Anderson, 2005]. At each scale administration, the participants had 24 different word fragments to complete.

Aggressive feelings. The second measure, the State Hostility Scale [Anderson et al., 1995], was used to measure aggressive feelings. This is a 35-item scale that asks participants to respond on a 1 (*strongly disagree*) to 5 (*strongly agree*) Likert Scale about how they are feeling right now. Certain items were reverse coded in order to have higher scores indicate higher state hostility. Sample items included, "I feel mean" and "I feel understanding (reverse coded)." The reliability of this scale at each time point was acceptable (all $\alpha s > .91$).

Demographics. The third measure was the demographic questionnaire. This scale assessed information about the participants (age, gender, ethnicity, and year in school).

Trait Aggression. The fourth measure was the Aggression Questionnaire [Buss and Perry, 1992]. This scale is a 29-item scale that uses a 1 (*not a characteristic*) to 5 (*extreme characteristic*) Likert Scale to measure trait aggression. This scale measures trait aggression and a sample item is, "Once in awhile, I cannot control the urge to strike another person." Certain items were reverse coded such that the higher scores were indicative of higher trait aggression. The reliability of this scale was acceptable ($\alpha = .91$).

Suspiciousness. The fifth measure was a suspiciousness questionnaire. Owing to the widely publicized concerns about the effects of video games, this measure asked participants if they had guessed the variables of interest earlier to the end of the study, or if anybody had told them about the nature of this study. Analysis of this scale revealed that 14 (18.92%) of the participants guessed the variables of interest from the questionnaires or procedures of the study. A one-way analysis of variance (ANOVA) was conducted on all of the dependent measures to assess aggression at each time. This analysis showed that there was a nonsignificant difference (all $Fs < 3.11$, all $Ps > .05$) between those who knew the purposes of this study compared with those who did not know the true purposes of this study. Thus, all participants were included in the analyses.

Physiological arousal. In order to measure physiological arousal, the F1000 Biofeedback Sensor System (Focused Technology, Ridgecrest, CA) was utilized. One end of this device was connected to a computer. The other end of the device was connected to seven electrodes that were attached to body of the participant. The electrodes were small and light and connected to various regions of the body that are best for measuring physiological arousal. This device allowed the researcher to continuously monitor heart rate and body temperature. To measure heart rate one electrode was placed on the inside of each forearm and to measure body temperature one electrode was placed on the dorsal surface of the left foot. These locations were selected by professionals in the Biofeedback Center and none of the electrodes were attached on the hands to reduce interference with the video game play, which is why none of the electrodes were placed on the fingers or hands.

As physiological arousal was measured continuously, a potential confound existed in the measurement. Observation of the participant's physiological arousal data showed heightened heart rate and body temperature when the questionnaires were being completed. Heightened heart rate occurred because the participants turned each page of the questionnaire packet, and because the electrodes that measured heart rate were on the arms (near the elbow), heart rate increased. Additionally, the participants sat up during questionnaire administration time, which put more weight on the foot and leg, which caused an increase in body temperature. Therefore, this increase in physiological arousal was purely an artifact of the procedure of this study.

This artifactual confound is especially important for the analyses of this study because arousal increased owing to movement, and, therefore, if a physiological arousal data point was sampled immediately after the scales were completed, then any conclusions drawn from the results would have to be interpreted with caution. In order to alleviate this confound and to ensure that the physiological arousal measurement was reliable, data points were selected within the range of 8–15 min of the total 15-min video game play interval. Four data points were selected within this interval, and averaged. In sum, baseline arousal was assessed using data from the first few minutes (before baseline questionnaires were completed and after the participants felt comfortable with the electrodes). Times 2, 3, and 4 arousal data were gathered from sampling data points with the 8–15 min range during video game play. The reliability of the heart rate ($\alpha = .97$) and body temperature measures were acceptable ($\alpha = .95$).

Procedure

All participants were randomly assigned to one of the three conditions. The first condition ($n = 26$) played the realistic violent video game, the second condition ($n = 25$) played the unrealistic violent video game, and the third condition ($n = 23$) played the nonviolent control video game.

Upon completion of the informed consent sheets, participants were hooked up to the physiological arousal device and the necessary sensors were placed in the appropriate locations on the participant's body by trained professionals in the Biofeedback center. Participants were asked to complete the first set of questionnaires, which consisted of the State Hostility Scale, 24 items on the Word Completion Task, and the Aggression Questionnaire.

After the participants completed the aforementioned baseline measures, all participants received a brief tutorial on how to play the video game. This tutorial included informing the participants about the functions of the buttons on the controller, the objective of the video game, and how to succeed at the video game. In order to demonstrate understanding to the researchers, the participants were instructed to move the main character and perform some actions (i.e., shooting a gun, or serving a tennis ball). Participants were provided with a sheet of paper that had the function and label for each button. After demonstrating compliance with the video game, the participants played their video game for 15 min. Then the participants completed the next set of questionnaires, which consisted of the State Hostility Scale and the next 24 word fragments of the Word Completion Task (which took approximately 3 min to complete both measures). As soon as the participants had completed the next set of questionnaires, the video game was played for another 15 min. This same procedure was repeated until the questionnaires had been completed four times and the video game was played for 45 min. The participants were then unhooked from the physiological arousal device, completed the demographic questionnaire, and then were thanked and fully debriefed.

It should be noted that, as evident from the previous paragraph, we utilized a repeated measures design, such that all participants completed the State Hostility Scale and Word Completion Task four times. Although repeated measure designs have the potential to have carryover or practice effects, we do not believe this is problematic for this study. First, different word stems were used for the Word

Completion Task at each time, which eliminates any practice effects. Second, the amount of time between the State Hostility Scale administrations was 15 min, and it is unlikely that participants remembered their responses to all 35 items. Barlett et al. [2007] found significant changes in hostility using a similar hostility measure and time frame between scale administrations. However, the results from the aggressive feelings analysis should be interpreted with a certain degree of caution owing to possible practice effects of completing the scale four times.

RESULTS

The means, standard deviations, and intercorrelations between all variables are presented in Table II.

Aggressive Feelings

In order to test the hypothesis that violent games lead to increases in aggressive feelings over time and the increases are greater for realistic violent games, a one-way multivariate analysis of covariance (MANCOVA) was conducted with aggressive feelings at Times 2, 3, and 4 as the dependent variables, trait aggression, gender, and aggressive feelings at baseline as covariates, and the condition as the independent variable. Results showed a significant overall main effect for condition, Wilks $\Lambda = .72$, $F(6, 122) = 3.50$, $P < .01$, *partial* $\eta^2 = .15$. Univariate ANCOVAs were conducted as follow-up analyses. Results showed a nonsignificant main effect for condition at Time 2, $F(2, 62) = 2.44$, $P = .10$. However, there were significant main effects for condition at Time 3, $F(2, 62) = 6.90$, $P < .01$, *partial* $\eta^2 = .18$, and Time 4, $F(2, 62) = 9.34$, $P < .001$, *partial* $\eta^2 = .23$. Baseline means did not significantly differ between conditions, $F(2, 62) = 0.67$, $P > .05$.

Pairwise comparisons with a Bonferroni correction showed that those who played the violent realistic video game had significantly higher aggressive feelings than the other two conditions at Times 3 and 4 ($P < .013$). The violent unrealistic and nonviolent video games did not differ from one another at any time point (all Ps $> .05$). For all analyses, baseline aggressive feelings (all Fs > 6.50, all Ps $< .05$, range of Bs $= 0.46$–0.65) and trait aggression were significant covariates at each time point (all Fs > 4.00, all Ps $< .05$, range of Bs $= 0.19$–0.27). Gender was a significant covariate at Times 3 and 4 (all Fs > 3.50, all Ps $< .05$, range of Bs $= 10.07$–11.99). See Figure 1 for these results.

Aggressive Thoughts

Before the main analyses two independent coders rated each participants responses into aggressive, neutral, or nonaggressive words. Results show that the two coders were reliable on this classification (average $r = .96$).

A one-way MANCOVA was conducted with aggressive thoughts at Times 2, 3, and 4 as the dependent variables, gender, trait aggression, and baseline aggressive thoughts as covariates, and the condition as the independent variable in order to determine if the three conditions differed significantly from one another at each time point. Results showed a significant overall main effect for condition, Wilks $\Lambda = .55$, $F(6, 126) = 7.44$, $P < .001$, *partial* $\eta^2 = .26$. Univariate ANCOVAs were conducted as follow-up analyses and the results showed significant main effects for condition at Time 2, $F(2, 65) = 11.27$, $P < .001$, *partial* $\eta^2 = .26$, Time 3, $F(2, 65) = 12.23$, $P < .001$, *partial* $\eta^2 = .27$, and Time 4, $F(2, 65) = 7.47$, $P < .01$, *partial* $\eta^2 = .19$. Trait aggression was only a significant covariate at Time 3, $F(1, 65) = 5.31$, $P < .03$, *partial* $\eta^2 = .08$, $B = -0.001$, and baseline aggressive thoughts were only a significant covariate at Time 4, $F(1, 65) = 7.33$, $P < .01$, *partial* $\eta^2 = .10$, $B = 0.61$. No other covariates were significant at any other time point. Pairwise comparisons with a Bonferroni correction showed a significant difference between the two violent video games and the nonviolent video game at Times 2, 3, and 4, ($P < .013$), but a nonsignificant difference between the two violent video games at these times.[1] See Figure 2 for these results.

Heart Rate

A one-way MANCOVA was conducted with heart rate at Times 2, 3, and 4 as the dependent variables, trait aggression, gender, and baseline heart rate as covariates, and condition as the independent

[1]Upon examination of the means, the data showed that all participants, independent of condition, had a decrease in the number of aggressive thoughts at Time 3. A post-experimental study ($N = 15$) had participants complete the Word Completion Task without exposure to any violent media in fourths, identical to the participants in Study 2. The means and standard deviations suggest that this drop at Time 3 is a function of the inability to think of aggressive thoughts (divided by the total number of words) ($M = 0.17$, SD $= 0.08$), compared with the other times ($M = 0.20$–0.22, SD $= 0.05$–0.10). Therefore, this drop in the number of thoughts is a function of the difficulty in thinking of aggressive words for the particular stems in that Time 3 list. The results still showed that, despite this confound, those in the violent realistic video game condition still had the highest number of aggressive thoughts than the other two conditions.

TABLE II. Zero-Order Correlations Between Each Dependent Measure at Each Time

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	–																	
2	.50**	–																
3	.37**	.85**	–															
4	.35**	.78**	.86**	–														
5	−.01	.10	−.05	−.03	–													
6	.16	.21†	.31**	.33**	−.17	–												
7	−.02	.16	.32**	.26*	−.20†	.42**	–											
8	.02	.17	.19	.21†	.19	.18	.38**	–										
9	−.07	−.10	−.12	−.08	.04	−.30*	−.25*	−.08	–									
10	−.08	−.08	−.06	−.03	.06	−.22†	−.16	−.04	.90**	–								
11	−.09	−.08	−.07	−.06	.09	−.18	−.18	−.06	.87**	.95**	–							
12	−.05	−.04	−.01	.02	.06	−.15	−.19	−.01	.86**	.94**	.96**	–						
13	−.05	−.17	−.11	−.10	−.04	.06	−.01	−.13	.37**	.31**	.30**	.25*	–					
14	−.05	−.15	−.12	−.15	−.04	−.01	.02	−.06	.28*	.22†	.22†	.18	.84**	–				
15	−.01	−.12	−.10	−.13	.02	.04	−.04	−.03	.27*	.17	.18	.13	.79**	.89**	–			
16	−.01	−.14	−.11	−.15	.02	.07	−.05	−.02	.20†	.07	.08	.04	.72**	.83**	.97**	–		
17	−.05	−.14	−.15	−.07	−.02	.21†	.24*	.18	−.50**	−.54**	−.56**	−.60**	−.06	−.14	−.03	.04	–	
18	.30**	.45**	.36**	.30*	−.15	−.02	−.20†	−.03	−.06	−.06	−.09	−.05	−.23**	−.14	−.17	−.17	.07	
Mean	60.10	76.76	78.58	76.00	0.16	0.28	0.20	0.30	79.78	79.44	79.07	79.91	83.90	82.78	83.58	83.34	.05	90.68
SD	12.85	21.40	21.50	22.35	0.06	0.10	0.09	0.11	13.45	12.02	11.16	11.40	5.62	7.21	6.64	6.73	1.01	25.51

1 = baseline aggressive feelings, 2 = Time 2 aggressive feelings, 3 = Time 3 aggressive feelings, 4 = Time 4 aggressive feelings, 5 = baseline aggressive thoughts, 6 = Time 2 aggressive thoughts, 7 = Time 3 aggressive thoughts, 8 = Time 4 aggressive thoughts, 9 = baseline heart rate, 10 = Time 2 heart rate, 11 = Time 3 heart rate, 12 = Time 4 heart rate, 13 = baseline body temperature, 14 = Time 2 body temperature, 15 = Time 3 body temperature, 16 = Time 4 body temperature, 17 = sex (1 = male, −1 = female), 18 = trait aggression. $^{**}P<.01$, $^{*}P<.05$, $^{\dagger}P<.10$.

variable in order to determine if the three conditions differed significantly from one another at each time point. The results showed a significant overall main effect for condition, Wilks $\Lambda = .70$, $F(6, 126) = 4.07$, $P < .01$, *partial* $\eta^2 = .16$. Univariate ANCOVAs were conducted as follow-up analyses and the results showed that there was a significant main effect of condition for Time 2, $F(2, 65) = 8.37$, $P < .01$, *partial* $\eta^2 = .21$, Time 3, $F(2, 65) = 5.74$, $P < .01$, *partial* $\eta^2 = .15$, and Time 4, $F(2, 65) = 9.81$, $P < .001$, *partial* $\eta^2 = .23$. Gender was a significant covariate for all these analyses (all Fs > 10.00, all Ps < .01, range of Bs = 4.26–6.62). Pairwise comparisons with a Bonferroni correction showed that at Time 2, those who played the violent realistic video game had significantly higher beats per minute than those in the other two conditions ($P < .01$), which did not differ from one another. At Time 3, those in the violent realistic video game marginally differed from those in the violent unrealistic video game ($P = .022$, using $\alpha = .016$ as the cutoff for the region of rejection in the sampling distribution owing to the Bonferroni correction), but those who played the violent realistic video game significantly differed from those who played the nonviolent video game. Finally, at Time 4 those who played the two violent video games significantly differed from those who played the nonviolent video game ($P < .016$), but not from one another. See Figure 3 for these results.

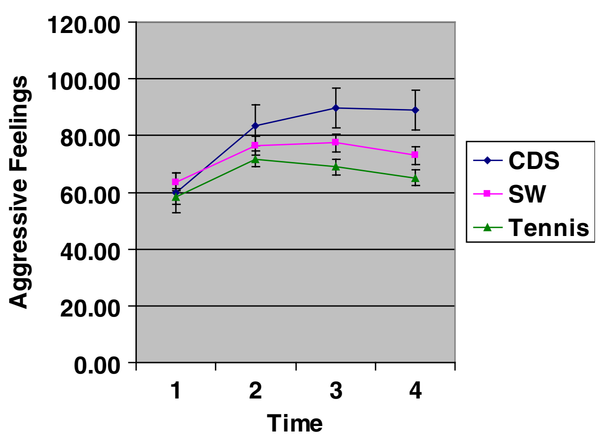

Fig. 1. Results for the aggressive feeling analysis. CDS (Conflict Desert Storm) = Violent Realistic; SW (Star Wars) = Violent Unrealistic; Tennis = Nonviolent. Bars represent one standard error around the estimated population mean. Note: Units on the Y-axis are based on the responses on the State Hostility Scale.

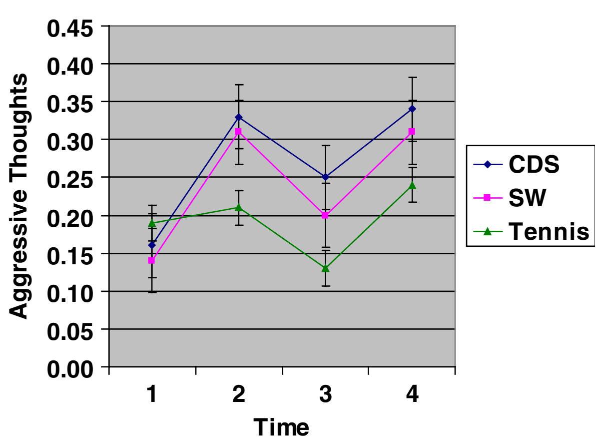

Fig. 2. Results for the aggressive thought analysis. CDS (Conflict Desert Storm) = Violent Realistic; SW (Star Wars) = Violent Unrealistic; Tennis = Nonviolent. Bars represent one standard error around the estimated population mean. Note: Units on the Y-axis are based on the ratio of the number of aggressive thoughts to the total number of thoughts.

Body Temperature

A one-way MANCOVA was conducted with body temperature at Times 2, 3, and 4 as the dependent variables, gender, trait aggression, and baseline body temperature as covariates, and the condition as the independent variable in order to determine if the three conditions differed significantly from one another at each time point. Results showed no significant overall main effect for condition, Wilks $\Lambda = .92$, $F(6, 130) = 0.91$, $P = .49$.

DISCUSSION

The results of this study suggest that those who played a violent video game had an increase in aggressive thoughts, aggressive feelings, and heart rate from baseline. Despite the increases in aggression from baseline for the two violent video games,

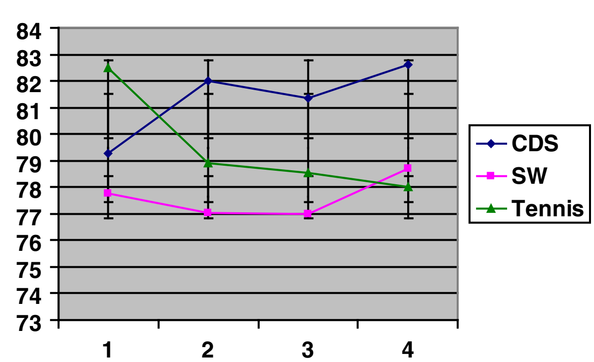

Fig. 3. Results for the heart rate analysis. CDS (Conflict Desert Storm) = Violent Realistic; SW (Star Wars) = Violent Unrealistic; Tennis = Nonviolent. Bars represent one standard error around the estimated population mean. Note: Units on the Y-axis are based on the beats per minute.

those in the violent realistic condition had higher heart rate initially and higher aggressive feelings after the initial 15 min compared with the unrealistic violent condition. Aggressive thoughts did not differ between the two violent conditions. Those in the nonviolent control condition did not have such a dramatic change in the dependent variables over time. Overall, the trend in the means for all conditions suggests a stabilization effect such that there is an initial increase in aggression and arousal, which does not change after that initial increase.

Realism as a Moderator for Aggressive Feelings

The purpose of the current research was to determine if video game realism, defined as the probability of seeing an event in real life, moderated the effect between video game violence and aggressive feelings, aggressive thoughts, and physiological arousal. First, with the exception of body temperature, results showed a main effect of video game condition. Recall that Ivory and Kalyanaraman [2007] did not find a significant video game violence effect in their analyses, which suggests that the quality of video game graphics did not moderate the relationship between video game violence and aggression. Examination of the means and standard deviations in this study showed that the violent video games (collapsed across all four time points) were related to more aggressive feelings and aggressive thoughts compared with the nonviolent video game. This is consistent with GAM [Anderson and Bushman, 2001; Bushman and Anderson, 2002], as well as the abundant amount of research on violent video games and aggressive thoughts [e.g., Carnagey and Anderson, 2005] and aggressive feelings [e.g., Anderson and Ford, 1986].

For aggressive feelings, results showed no difference between the violent realistic and unrealistic video games at baseline or 15 min after game play. However, after the initial increase in hostility, results show that the violent realistic video game was related to significantly higher aggressive feelings than the violent unrealistic video game. This suggests that video game realism does make a difference in state hostility, but only after the initial 15 min of game play. We believe that there are two possible explanations for this effect. First, the fact that the events in a realistic video game could actually occur in real life may have contributed to a steady increase in aggressive feelings with repeated violent video game play, as indicated by the steady (although nonsignificant) trend in the data to increase with each questionnaire administration period. Second, perhaps participants who played the unrealistic violent video game realized that the events in the game could never really happen, and became more "cartoonish" or "fake." This may have accounted for why there was a trend in the data for the means to slightly decrease (after the first initial increase) over time for those who played the violent unrealistic video game. Although we believe both explanations are viable and are not independent of one another, more work is needed to specifically test this thesis.

Interestingly, this trend is not found for aggressive thoughts. This suggests that the activation of nodes in semantic memory is not dependent upon the amount of realism in a violent video game, but does matter for hostile feelings. The former finding is consistent with the theorizing on aggression-related priming, which suggests that exposure to media violence (independent of realism) will activate aggressive thoughts in memory [Anderson et al., 1998; Geen, 1990].

Video Game Realism and Arousal

Similar to the results of aggressive feelings, results showed that heart rate was significantly impacted by violent video game realism. Although neither the pilot nor main study asked participants if the games were rated similarly on how exciting, boring, arousing, and so forth, the results suggest that this was not a concern. The main analyses showed that nonsignificant main effects of time or condition (when the means were appropriately collapsed) on heart rate or body temperature, suggesting that the games were fairly equal on how exciting the game was. However, there was an initial increase in heart rate for the violent video game conditions, and an initial decrease for the nonviolent video game. Interestingly, violent video game realism was important for the initial increase in heart rate for the violent video game conditions. The violent realistic video game showed an initial increase in heart rate, whereas there was no change for those in the violent unrealistic condition. This effect dissipated with repeated game play, as there was no difference between the two violent video games. This suggests that, unlike the findings from the aggressive feeling outcome, violent video game realism does moderate the relationship between video game play and heart rate within the first 15 min, but not after repeated violent video game play.

This effect was not found for body temperature. Although trends in the data would suggest that those who played the violent realistic video game had the largest decrease in body temperature (indicative of being aroused), results showed nonsignificant main effects of condition or time, and a nonsignificant Time $\times$ Condition interaction.

Repeated Video Game Play

The results of this study show that with repeated violent video game play, there is an initial increase in aggression then a stabilization effect. This is especially evident because most short-term experimental video game studies have participants play the video game for only a short amount of time (e.g., 15 min) then assess post-game aggression [e.g., Carnagey and Anderson, 2005]. Theoretically, the results suggest that once participants are primed with violent media, there is not a continuation of that priming, but rather a stabilization effect.

Limitations and Future Research

Like all studies, there are weaknesses of this study that need to be addressed. The first limitation was that there was no unrealistic nonviolent video game. The second limitation is that the use of questionnaires after each 15 min time increment interrupted the continual physiological data collection, which resulted in an artificially heightened physiological arousal measurement owing to the participant's movement. The third limitation is that the pilot study and the main study did not ask participants to rate the games on how exciting, arousing, frustrating, difficult, or boring the games are [see Anderson and Dill, 2000]. Given the effects that the video games had on arousal, we do not suspect that the games were different on dimensions related to being aroused (e.g., excited, aroused). However, we are less confident in our ability to state that the games were similar on frustrating or difficultly. This could have impacted the results from the aggressive feeling analyses. Furthermore, participants in the pilot study only viewed, and not played, the video games. This could potentially change the results of any pilot study, if participants played the game rather than watched the game being played on prerecorded video clips, because certain games could be rated differently. Although we feel as though this was appropriate for the questions asked in the pilot study, if future research is to replicate this study, participants who play the game should rate them on a variety of dimensions and treat such ratings as covariates, if appropriate.

Final Remarks

Overall, the results of the current research suggest (a) that violent video game play stimulates an increase in aggressive thoughts over the entire course of 45 min of play but that the realism of the violent game does not exacerbate that effect; (b) that playing a realistic violent game increases aggressive feelings after 15 min of play through 45 min of play but playing an unrealistic violent game does not; (c) that heart rate is steadily increased by realistic violent play over the course of 45 min but that unrealistic violent play has no different effect from nonviolent play; and (d) that neither realistic nor unrealistic violent play has an effect on body temperature. In other words, these results suggest that if one plays a realistic violent video game, there will be an initial increase in aggressive thoughts and arousal and in aggressive feelings after 15 min, and those increases will be maintained or increased over the course of playing a realistic violent game.

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REFERENCES

Anderson CA. 2004. An update on the effects of playing violent video games. J Adolesc 27:113–122.

Anderson CA, Bushman BJ. 2001. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. Psychol Sci 12:353–359.

Anderson CA, Dill KE. 2000. Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. J Pers Soc Psychol 78:772–790.

Anderson CA, Ford CM. 1986. Affect of the game player: Short-term effects of highly and mildly aggressive video games. Pers Soc Psychol Bull 12:390–402.

Anderson CA, Huesmann LR. 2003. Human aggression: A social-cognitive view. In: Hogg MA, Cooper J (eds). Handbook of Social Psychology. London: Sage Publications, pp 296–323.

Anderson CA, Deuser WE, DeNeve KM. 1995. Hot temperatures, hostile affect, hostile cognition, and arousal: Tests of a general model of affective aggression. Pers Soc Psychol Bull 21:434–448.

Anderson CA, Benjamin AJ, Bartholow BD. 1998. Does the gun pull the trigger? Automatic priming effects of weapon pictures and weapon names. Psychol Sci 9:308–314.

Anderson CA, Berkowitz L, Donnerstein E, Huesmann LR, Johnson JD, Linz D, Malamuth NM, Wartella E. 2003a. The influence of media violence on youth. Psychol Sci Public Interest 4:81–110.

Anderson CA, Carnagey NL, Eubanks J. 2003b. Exposure to violent media: The effects of songs with violent lyrics on aggressive thoughts and feelings. J Pers Soc Psychol 84:960–971.

Anderson CA, Carnagey NL, Flanagan M, Benjamin AJ, Eubanks J, Valentine JC. 2004. Violent video games: Specific effects of violent content on aggressive thoughts and behavior. Adv Exp Soc Psychol 36:199–249.

Barlett CP, Harris RJ, Baldassaro R. 2007. The longer you play, the more hostile you feel: Examination of first person shooter video games and aggression during video game play. Aggressive Behav 33:486–497.

Bensley L, van Eenwyk J. 2001. Video games and real life aggression: Review of the literature. J Adolesc Health 29:244–257.

Bushman BJ, Anderson CA. 2002. Violent video games and hostile expectations: A test of the General Aggression Model. Pers Soc Psychol Bull 28:1679–1686.

Buss AH, Perry M. 1992. The Aggression Questionnaire. J Pers Soc Psychol 63:452–459.

Carnagey NL, Anderson CA. 2005. The effects of reward and punishment in violent video games on aggressive affect, cognition, and behavior. Psychol Sci 16:882–889.

Dill KE, Dill JC. 1998. Video game violence: A review of the empirical literature. Aggression Violent Behav: Rev J 3: 407–428.

Eastin ME, Griffiths RP. 2006. Beyond the shooter game: Examining presence and hostile outcomes among male game players. Commun Res 33:448–466.

Emes CE. 1997. Is Mr. Pac Man eating our children? A review of the effect of video games on children. Can J Psychiatry 42:409–414.

Geen RG. 1990. Human Aggression. Pacific Grove, CA: Brooks/Cole.

Griffiths M. 1999. Violent video games and aggression: A review of the literature. Aggression Violent Behav 4:203–212.

Huesmann LR, Eron LD (eds). 1986. Television and the Aggressive Child: A Cross–National Comparison. Hillsdale, NJ: Erlbaum.

Huesmann LR, Moise-Titus J, Podolski CP, Eron LD. 2003. Longitudinal relations between childhood exposure to media violence and adult aggression and violence: 1977–1992. Dev Psychol 39:201–221.

Ivory JD, Kalyanaraman S. 2007. The effects of technological advancement and violent content in video games on player's feelings of presence, involvement, physiological arousal, and aggression. J Commun 57:532–555.

Kirsh SJ. 2006. Cartoon violence and aggression in youth. Aggression Violent Behav 11:547–557.

Nass C, Fogg BJ, Moon Y. 1996. Can computers be teammates? Int J Hum Comput Stud 45:669–678.

Persky S, Blascovich J. 2008. Immersive virtual video game play and presence: Influences on aggressive feelings and behavior. Presence 17:57–72.

Schneider EF, Lang A, Shin M, Bradley SD. 2004. Death with a story: How story impacts emotional, motivational, and physiological responses to first-person shooter video games. Hum Commun Res 30:361–375.

Shapiro MA, Pena-HerbornJ, Hancock JT. 2006. Realism, imagination, and narrative video games. In: Vorderer P, Bryant J (eds). Playing Video Games: Motives, Responses, and Consequences. Mahwah, NJ: Lawrence Erlbaum Associates, pp 275–290.

Weber R, Ritterfeld U, Mathiak K. 2006. Does playing violent video games induce aggression? Empirical evidence of a functional magnetic resonance imaging study. Media Psychol 9:39–60.