Longer You Play, the More Hostile You Feel: Examination of First Person Shooter Video Games and Aggression During Video Game Play

Christopher P. Barlett*, Richard J. Harris, and Ross Baldassaro

Department of Psychology, Kansas State University, Manhattan, Kansas

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This study investigated the effects of video game play on aggression. Using the General Aggression Model, as applied to video games by Anderson and Bushman, [2002] this study measured physiological arousal, state hostility, and how aggressively participants would respond to three hypothetical scenarios. In addition, this study measured each of these variables multiple times to gauge how aggression would change with increased video game play. Results showed a significant increase from baseline in hostility and aggression (based on two of the three story stems), which is consistent with the General Aggression Model. This study adds to the existing literature on video games and aggression by showing that increased play of a violent first person shooter video game can significantly increase aggression from baseline. Aggr. Behav. 33:486–497, 2007. © 2007 Wiley-Liss, Inc.

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INTRODUCTION

The effects of video games are a "hot topic" in today's media savvy world. Research has shown that video games are played in extensive amounts, with over 70% of college students reporting being avid video game players [Weaver, 2003]. In addition, sales of video games are steadily increasing, reaching 2.9 billion dollars in 2004 [Morris, 2005]. According to Paul Bryant [2005], an author for a video gaming website (www.gamefly.com), of the top ten video game rentals in 2004, half (and the top two) of the top ten video games were rated M for Mature, whereas eight out of the top ten were rated either Mature or Teen, which would suggest that the most frequently rented video games are violent, often with sexual overtones, and/or contain large amounts of blood and gore. Furthermore, adolescent children prefer to play video games that have violent content [Buchman and Funk, 1996]. With the improvement in video game technology over the years, games are becoming more realistic and, possibly, more immersive, which provides a capturing, almost addictive, quality [Salguero and Moran, 2002]. Thus, it is important for researchers to study the effects of video games, especially the negative effects, such as aggression. This study investigated

aggression over time within a specific video game genre (e.g., a first person shooter game [FPSG]) that uses multiple types of game controllers.

Video Games and Aggression

Research on video games and aggression that began in the 1980s showed positive correlations between the amounts of self-reported time spent in video arcades and teachers, parent, and peer ratings of aggressive play, disrupted school performance, and the delinquency of these children [Lin and Lepper, 1987; Nelson and Carlson, 1985]. The results suggest that those who spend the most time in video arcades are rated as more aggressive. Subsequent studies investigated the short-term effects of aggression on participants who played a violent video game, compared with a non-violent

*Correspondence to: Christopher P. Barlett, Department of Psychology, Bluemont Hall 492, Manhattan KS 66506-5302. E-mail: cpb6666@ksu.edu

video game; those who played a violent video game showed more aggressive behaviors, such as hitting another child or a Bobo doll [Schutte et al., 1988], playing longer with aggressive toys [Cooper and Mackie, 1986], and scoring higher on aggression measures [Anderson and Ford, 1986]. The study of short-term effects of video game play continued into the late 1990s and early 2000s and found consistent results with the previous decades of research, suggesting that aggression levels increase after playing a violent video game [Anderson and Dill, 2000; Panee and Ballard, 2002]. Overall, aggression levels have been shown to increase after playing a violent video game in children [Emes, 1997], women and men [Anderson and Murphy, 2003; Bartholow and Anderson, 2002], and across different video game genres, such as FPSGs [Anderson and Dill, 2000], driving games [Carnagey and Anderson, 2005], action/adventure games [Panee and Ballard, 2002], and fighting games [Ballard and Wiest, 1996; Bartholow and Anderson, 2002].

Considering the past two decades of video game and aggression research, a common methodological paradigm has predominated. Typically, this paradigm has participants play a violent video game, a non-violent video game, or some type of control game, which could be a video game or a paper-and-pencil game [Bensley and Van Eenwyk, 2001]. However, this paradigm may not offer the researchers the necessary amount of experimental control owing to the use of multiple games. For example, certain games contain more violence, increased character development, more character relations, and more salient cues than other games. Therefore, finding a variable to study between video games (and not within a single video game) may be problematic from an experimental control point of view, owing to the numerous differences between video games. Some recent video game studies [Ballard and Wiest, 1996; Carnagey and Anderson, 2005] have found variables of interest to study within the same video game, giving the researchers increased experimental control. Carnagey and Anderson [2005] had participants play the racing game *Carmageddon* (a car racing game whose objective is to win a race) with a differing reward option as the independent variable, whereas Ballard and Wiest [1996] had the participants play *Mortal Kombat II* (a fighter game whose object is to physically attack an opponent) with the blood turned on or off.

Recently, Anderson [2004] conducted a meta-analysis that only used the "best-fitting" video games studies to examine the extent of the past two decades of research would conclude about video games and aggression. A "best-fitting" video game study was one that used a pre–post design, had clearly defined non-violent and violent video games, and produced evidence that the video games differed from one another to not contaminate the experimental conditions. The results from this meta-analysis show that participants playing the violent games had a significant increase in aggressive thoughts, $r = .24$, aggressive feelings, $r = .22$, aggressive behaviors, $r = .26$, and physiological arousal, $r = .21$ [Anderson, 2004]. Using Cohen's [1988] statistic as an effect size standard, these are moderate effect sizes; however, such effect sizes are common in media research studies (especially with aggression) because there are other contributing factors to aggression than just the media presentation [Huesmann et al., 2003].

The General Aggression Model

Multiple literature reviews [Dill and Dill, 1998; Griffiths, 1999] and meta-analytic work [Anderson, 2004; Anderson and Bushman, 2001; Sherry, 2001] have concluded that playing a violent video game significantly increases the aggressive thoughts, aggressive feelings, and physiological arousal of the players, which in turn significantly increases the amount of aggressive behaviors that are observed. Even with the multiple meta-analytic and literature review papers published, there is still much to learn about the influence of exposure to violent video games. For example, video game manufacturers are producing continuously more realistic and violent video games, better measures of aggression are being created, and better research methodologies are being applied to video game studies. Furthermore, there are an increasing number of possible game manipulations that are available to researcher through modifying the levels within specific video games. Overall, the past research that has been conducted on violent video games and aggression led to the application of the General Aggression Model (GAM) to violent video game studies [Anderson and Bushman, 2002; Bushman and Anderson, 2002].

The GAM posits that person factors (attitudes toward violence, trait aggression) and situational factors (exposure to real-life violence or media violence) interact to influence the components of an individual's internal state (physiological arousal, feelings, and thoughts). These internal state variables each interact with one another. For example, a person's feelings impact real world actions. That

decision process leads to behaviors that are either impulsive or thoughtful. The GAM incorporates a feedback loop, such that the behavior that is committed reenters the model as a situational factor. For example, if a person is playing a violent video game, the individual difference variables and the exposure to that violent video game interact to increase the aggressive thoughts, aggressive feelings, and physiological arousal of that person. Those three internal state variables interact to lead to a decision process that could lead to an impulsive decision (if that person accidentally gets bumped into), which will in turn lead to an aggressive action (pushing the person back). That aggressive action is now an aggressive situational factor, which appears at the beginning of the model [Anderson, 2004; Anderson and Bushman, 2001; Bushman and Anderson, 2002; Carnagey and Anderson, 2003; Kirsh, 2003].

According to Kirsh [2003], an important component of the GAM is hostility, which is produced as a function of exposure to a violent video game. Namely, the exposure to the mere presence of the violent content in certain video games significantly raises the state hostility levels of the individuals who play the game and occurs unconsciously [Kirsh et al., 2005]. Past research that has used the GAM has conceptualized hostility as an internal state variable. Kirsh [2003] has described hostility both as an aggressive thought and an aggressive feeling, thus it is implicitly stated that hostility can be either of those internal state variables. For the purposes of this study, hostility is conceptually formulated before the internal state variables and is created as a function of the content at the situation level.

Aggression-Related Priming

An important process assumed by the GAM to explain why exposure to violent video games increases aggression is aggression-related priming. It posits that constant exposure to violent and aggressive content, through some medium (e.g., television, violent video games) causes more aggressive thoughts to be activated in memory [Geen, 1990]. The thoughts that are activated in the associative memory structure branch out to activate other aggressive thoughts in memory, which continues until an entire network of cognitively related aggressive thoughts is produced. Furthermore, concepts in the associate memory that are closely linked together (e.g., "gun" and "shoot") are going to make strong connections in that memory structure [Anderson et al., 1998]. Research conducted by Anderson et al. [1998] found that participants who were exposed to weapon-related words (e.g., "gun" and "knife") had more aggression-related thoughts than those who were exposed to neutral words (e.g., "narrate" and "desert"), suggesting that strong semantic associations in memory are activated and lead to more aggressive thoughts when the stimuli that is presented is violent in nature.

Applying the findings of aggression-related priming, the GAM predicts that constant exposure to violent video game content would activate more aggressive thoughts in memory. Thus, any increases in aggression (especially aggressive thoughts) that are observed after playing a violent video game could be explained. Bushman and Anderson [2002] state that certain internal state variables (e.g., thoughts and feelings) become more aggressive due to constant exposure of the violent content, which is explained by aggression-related priming. Therefore, the GAM incorporates aggression-related priming to explain violent video game effects.

First Person Shooter Games

According to Schneider et al. [2004], a FPSG is defined as a game in which "the player maneuvers through a three-dimensional world, using the computer screen to see through the eyes of their character and shoot opponents [p 367]." The FPSGs allow for the player to be immersed in an interactive video game world because of the point of view that the player takes. Examples of these games are *Goldeneye, Wolfenstein 3D: Return to Castle Wolfenstein,* and *Doom.* Past video game research has used FPSGs for the stimuli in the violent video game condition. For instance, Uhlmann and Swanson [2004] found that playing a FPSG, *Doom,* for 10 min led those individuals to attribute significantly more aggressive traits and actions to themselves.

What Influences Aggression

Multiple factors have been found to significantly impact the aggression levels that individuals experience. Of these factors, few have been investigated in violent video game research.[1] An environmental factor that can influence aggression is the type of competitive or cooperative interaction in which

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[1]Describing the entire spectrum of factors and how they can influence aggression is beyond the scope of this paper. Therefore, the factors that have been investigated in past video game research are the factors that will be described.

multiple players are engaged. A study conducted by Anderson and Morrow [1995] had participants play *Super Mario Brothers* in either a competitive situation (one player's performance against another's) or a cooperative situation (two players completing the game together as a team) and found that participants playing the video game in a competitive situation (versus a cooperative situation) killed significantly more enemy creatures. The conclusion from this study suggests that the type of interpersonal interaction one has (either competitive or cooperative) influences aggressive behaviors.

Another factor that has been shown to significantly increase aggression levels is frustration, defined as the blocking of a goal [Dill and Anderson, 1995]. Research has shown that when participants are made to feel frustrated, their aggression levels increase [Dill and Anderson, 1995]. Frustration can easily be produced in video games by having the character die before the game expires, or not scoring well on a video game. Hence, the possible frustration that could be generated by any video game is a function of game performance. Therefore, it could be speculated that any video game, independent of the violent content, could produce frustration. However, a study by Funk et al. [1999] found that those who played a violent video game (*Terra Nova*) reported significantly higher frustration levels than those playing a non-violent video game (*Marble Drop*).[2] Kirsh et al. [2005] found a significant main effect for gender such that women were more frustrated with video games than men, suggesting that frustration should be a covariate. The importance of these studies lies in the recommendation to measure frustration and add it as a covariate, if significant main effects emerge.

An additional aggression-eliciting factor is the presence of blood and gore. The more blood that is present during video game play, the higher the aggression levels. High amounts of blood and gore are common in the most recent video games. For example, Anderson [2003] stated that a recent FPSG, *Soldier of Fortune*, allows the player to shoot an enemy in the arm and have that arm blown off exposing the bone, sinew, and excess amounts of blood. Blood is common in recent video games of different genres, such as fighter games (e.g., *Mortal Kombat*: *Deadly Alliance*), role-playing games, (e.g., *Grand Theft Auto*: *San Andres*), and shooter games (e.g., *Doom 3*). A study by Ballard and Wiest

[1996] examined aggression in a violent fighter game (*Mortal Kombat II*) with the blood function turned on or off, and found that there was a significant increase in self-reported hostility for the players when the game had the blood option enabled. The authors did not offer a theoretical justification for the difference in hostility, but Geen [1990] states that the visualizing (or seeing) violent depictions can prime individuals to exert more aggressive thoughts or emotions. Therefore, according to Kirsh's [2006] review on aggressive priming, the presence of blood could offer a more salient prime that could increase aggression.

A final factor that may influence aggression, and is potentially applicable to video game studies, is the presence of a weapon. This is commonly known as the Weapons Effect [Berkowitz and LePage, 1967]. The Weapons Effect states that the mere presence of a weapon is going to increase the aggressive behaviors of participants who see the weapon. Berkowitz and LePage [1967] state that the heightened aggressive behavior in the presence of a weapon arose because viewing weapons may cause "an intense aggressive reaction from the person with the gun [p 206]." To date, research on video games implementing the Weapons Effect has been limited; however, current video games have the capability to allow such a study to be implemented. Specifically, some video games require the player to use an interactive gun. An interactive light gun is a special controller that is in the shape of a gun, and contains an aimer, trigger, barrel, and handle just like a real gun. When the trigger of the interactive light gun is pulled, a beam of light hits the television where the gun is aimed, and reflects back into the barrel of the gun, interacting with the game system. An example of this is the original *Duck Hunt* for Nintendo Entertainment System. When the interactive light gun was pointed at the duck and the trigger was pulled, a flash of light would hit the duck, which showed up on the screen after it interacted with the Nintendo system, killing the duck. See Figure 1 for a picture of the interactive light gun that was used in this study.

Overview of the Current Research

Even with the abundance of research that has found a strong relationship between video game play and aggression, the current study adds to the existing literature using the overall objectives of the study and the two corresponding hypotheses. Therefore, this research study examined aggression over time as a function of playing a violent video game that used either an interactive light gun or a

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[2]It is unknown, from this study, whether or not frustration was heightened from one game to another because of the violent content or the difficulty of the video game.

Fig. 1. The interactive light gun used in the current study.

standard controller for a modern FPSG. This research had two main goals.

The first goal was to show that aggression levels would increase from baseline as a function of increased time playing the violent video game. For the purposes of the current experiment, aggression refers to the intent to harm another human who does not want to be harmed [Anderson and Bushman, 2001]. Therefore, the first hypothesis was:

H₁: There will be an increase in the aggression and physiological arousal levels of the participants, compared to baseline, due to the continuation of playing a violent first person shooter video game.

This hypothesis will allow for a test of different process-related models that may explain the effects of continued play of video games. If the data show that aggression, hostility, and physiological arousal significantly increase from baseline, but do not significantly differ after that initial peak, that would lend support to the GAM,[3] which would suggest that there would be an increase in these aggression-related variables, but not a continuous increase. As reviewed by Kirsh [2006], the priming hypothesis would predict that the scores on aggression, hostility, and arousal would significantly increase from baseline, but also significantly increase as violent video game play continued.

The implementation of the current video game allowed for a secondary hypothesis to be tested, which was to determine if the mere presence and handling of an interactive light gun would increase the aggression levels of the players. Therefore the second hypothesis was:

H₂: There will be a stronger increase in aggression, from baseline, after participants play a violent FPSG with an interactive light gun compared with playing the same video game with a standard controller.

This hypothesis, if confirmed, would support the notion that the Weapons Effect could be applied to FPSGs that use an interactive light gun, offering an additional explanation of how specific video games can influence aggression. Furthermore, it is predicted that there will be a significant interaction between the controller type and the time in which participants played the violent video game on the main dependent variables (e.g., aggression, arousal, and hostility). This is predicted because increases in these dependent variables should be expected while playing the game with an interactive light gun, further supporting the Weapons Effect.

METHOD

Participants

There were 99 (85 males) undergraduate participants with an average age of 19.42 (SD = 1.67) years. All of the participants attended a large Midwestern University and received partial course research credit for their General Psychology class. The average video game play, measured by free response, across the sample was 11.52 hr (SD = 10.01) per week. Most (64.5%) of the participants were first year students, and 85.9% of all participants were Caucasian.

Materials

The video game that was used for this study was *Time Crisis 3* for Play Station 2. This game is a FPSG, and the objective is to have the main character infiltrate a peaceful island that has been overtaken by enemy forces. There are a total of three levels to this game, and all levels have a main character to kill to advance, and each level progressively gets more difficult. To reach the main antagonist of each level, the main character must shoot enemy soldiers while avoiding being shot.

This game has various advantages, which gives credence to its specific selection for this study. The first advantage to choosing this game was that this game could be played with either an interactive light gun or a standard controller. This is advantageous

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[3]Anderson and Bushman [2001] provide a long-term GAM; however, this prediction is applicable only to the short-term GAM because this research is not a longitudinal assessment of aggression related to violent video game play, which would be required to test the long-term GAM.

because the current researchers had more experimental control by using the same game and testing some variable within the same game (i.e., controller type). Therefore, using this game allowed us to break away from the traditional video game research paradigm. This study avoided potential confounds by using the same video game at different times while adjusting a variable within that video game.

The second reason that this game was selected was that, at the time of the experiment (2004–2005), this was the latest version of the *Time Crisis* series for the latest video game console. This is a major advantage because it is important for video game researchers to use the most current versions of gaming systems and video games to attempt to generalize the results of the sample to the population of video game players, which is accomplished by using the most modern versions of the games and gaming systems.

Physiological Arousal

The many different measures of physiological arousal in video game studies have included blood pressure [Ballard and Wiest, 1996; Panee and Ballard, 2002] and heart rate [Calvert and Tan, 1994; Panee and Ballard, 2002]. This study measured heart rate as the physiological arousal measure. The monitor that was used was produced by Tanita, Arlington Heights, Illinois and instructed users to apply their index finger onto a sensor that measured their pulse. The participants took their pulse three times for each time heart rate was measured (nine times total) and took an average of those three measures to ensure that the responses were accurate, as instructed.

State Aggression

Researchers using the GAM typically measure state aggression using open-ended story stems [Anderson and Bushman, 2001]. This study differed from that by using three different story stems that asked participants to take the point of view of the character and respond to how they would retaliate after a blatant negative action was conducted on a 1 (*least violent*) to 5 (*most violent*) Likert-type scale to measure state aggression. The first story stem category ("sports stories") had participants rate how they would respond when an opposing player of a sport (baseball, basketball, or football) made a blatant foul against them. The second category of story stems ("child stories") had participants rate how they would punish their child when they broke a rule (fighting at school, cheating on a test at

school, or skipping school). The final story stem category ("judge stories") had participants rate how they would punish an individual who was just convicted of a crime (aggravated kidnapping, second degree murder, or armed robbery). For each story stem category there were three slightly different stories for the participants to respond to, making a total of nine story stems (one of each category per time), all of which were counterbalanced to the order of presentation.[4] See Appendix A for a complete list of the three story stems and their response options.

Hostility

As stated earlier, the GAM posits that video games elicit a certain amount of hostility [Kirsh, 2003]. Therefore, a single item was added that asked participants to rate how hostile they felt at that moment on a 1 (*not at all*) to 5 (*extremely*) Likert scale. This single item was used to assess state hostility, because the hostility subscale of the Aggression Questionnaire measures trait hostility.

Frustration

On the basis of past research showing that video games can be frustrating, a single item was included to assess state frustration. This item asked participants to rate how frustrated they were feeling at that moment on a 1 (*not at all*) to 5 (*extremely*) Likert scale.

Demographic Questionnaire

A demographic questionnaire asked participants about their age, gender, year in college, and ethnicity. In addition, the demographic questionnaire assessed the participant's experience with different video games. These questions consisted of how many hours they play video games each week, what their favorite types of video games are, and what aspects of the game were most fun and what aspects were the most frustrating.

Suspiciousness Questionnaire

The final questionnaire was a suspiciousness questionnaire. This measure was implemented to

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[4]To validate the specific scenarios and order of aggressive responses, a pilot study was conducted which showed that the outcomes of the responses were rank ordered properly from the least to most aggressive (reverse coded for analyses). This pilot study also showed that the majority (over 50%) of participants rated the sports scenarios and child scenarios approximately equal within each scenario.

ensure that the participants did not know the true purposes of the study before they were debriefed. If participants knew the purposes of the experiment, their data would not be included in the analyses. To assess this, specific questions asked participants to write down if they were aware of the true purposes of the experiment or if they had any indication of the experimental goals during the study. Upon review of this questionnaire, no participants were excluded from the main analyses because of their knowledge about the variables of interest.

Procedure

Upon entering the experimental laboratory, participants completed the informed consent and experimental credit cards. Participants' heart rate was then measured three times with the finger monitor, and participants were given the first packet of questionnaires to measure baseline aggression. The first packet included the state hostility and frustration items, and the first set of story stems (one judge story, one sports story, and one child story). After these scales were completed, the participants were given a brief tutorial on how to play the game with the first controller that they were given (either the interactive light gun or the standard controller), and then were instructed to play either level 1 or level 2 (to vary the difficulty) of the game with that particular controller for 15 min. After the conclusion of the 15 min, heart rate was again measured three times and an identical packet was given to the participants, with the exception of the next story stems. As soon as the second scale administration was concluded, participants were given a tutorial on how to play the video game with the other type of controller and played the remaining level of the video game for 15 min. Following this, the heart rate of the participants was measured three times and the same packet (as in time 2) was given, with the addition of the demographic and suspiciousness questionnaires. The presentation of the two different controllers and order of the two levels was counterbalanced across all participants; to help alleviate some of the problems of within-subjects experimental designs, such as practice effects [Hellier, 1998]. Upon completion of the experiment, participants were thanked and fully debriefed.

RESULTS

Before the main analyses, frustration was analyzed to assess if there were any differences between participants over time. If the analyses yielded significant results, frustration would have to be a covariate in the main analyses because frustration would have been shown to be significant contributors to state aggression.

Frustration

As stated previously, frustration can be an aggression-eliciting variable. Therefore, a repeated measures analysis of variance (ANOVA) was conducted to determine if there were any significant differences in frustration over time. The results from this ANOVA show that there were no significant differences in frustration at across time $F(2,192) = 2.83$, n.s. (not significant), $\eta^2 = .03$, power = .55, therefore, frustration was not included as a covariate in any subsequent analyses.

Hypothesis one stated that there would be a significant increase in aggression with continued video game play. The second hypothesis stated that there would be an increase in the main dependent variables while playing the video game with an interactive light gun. To test these hypotheses, main effects and high order interactions were tested using a 3 (game time) $\times$ 2 (level) $\times$ 2 (controller type) repeated measures ANOVA was conducted for the three primary dependent variables.

Physiological Arousal

Before analysis of the heart rate of the participants, averages had to be calculated for the three measurement times that it was assessed. The output on the heart rate device, however, was dependent upon the amount of pressure, the temperature of the participant's index finger and if there was a physical cut on the index finger. For example, sometimes a participant would receive heart rate scores like 67, 66, and 70, but other times have scores like 67, 98, and 212. For these outlier heart rate scores, two rules were devised to deal with such inconsistent measures. The first rule was to only take the average of the two closest numbers if one of the three scores were outlier scores (a difference of over ten beats per minute). For example, if the scores were 66, 67, and 78, then the average of 66 and 67 were taken, because 78 was more than ten above the other two numbers. The second rule was that if all three numbers had a difference of ten from each other, then the middle number was used. For example, if the three scores were 66, 78, and 99, the score of 78 was used as the heart rate measure. These rules were developed and calculated to help make the physiological measure more reliable, due to the fact that

TABLE I. Mean Scores on Each Measure With the Corresponding Scale Administration

	Baseline	Time 2	Time 3
Arousal	77.67$_a$	80.20$_a$**	80.10$_a$
State Hostility*	1.11$_a$	1.44$_b$	1.52$_b$
State aggression*	5.48$_a$	6.62$_b$	6.19$_b$
Frustration	1.41$_a$	1.45$_a$	1.61$_a$

*Overall significant differences, $P < .05$, assessed using repeated measures analyses.
**Represents a marginally significant difference ($P < .024$).
Mean with different subscripts indicates significant differences assessed by pairwise comparisons using $\alpha = .018$ to control for family wise error rates.

certain participants applied too much pressure to the device, which could give them a score of over 200 beats per minute.

The first analysis was conducted on physiological arousal. An overall 3 (game play time) × 2 (level of game) × 2 (controller type) mixed factorial ANOVA was computed to test for main effects and interactions. The results show that the main effect for game play time was statistically significant, $F(2,186) = 3.04$, $P < .05$, $\eta^2 = .03$, power = .58, suggesting that physiological arousal significantly increased from baseline (see Table I). This result is qualified by a significant interaction between game play time and controller type, $F(2,186) = 5.48$, $P < .005$, $\eta^2 = .06$, power = .85. These data suggest that when the participants used the interactive light gun, they had higher physiological scores than when they used the standard controller (see Table II). No other interactions were statistically significant.

State Aggression [5,6]

See Table III for scores on each story stem before the summation. An overall 3 (game play time) × 2 (level of game) × 2 (controller type) mixed ANOVA was conducted on the summation of the two story stem categories to test for the main effect and for interactions. The results show that there was a

[5]The judge story stem category was eliminated from the analyses owing to the different nature of the crimes. The pilot test showed that the judge story stem with the second-degree murder crime was given a significantly more aggressive rating than the other two "Judge" scenarios. Therefore, the sports and the child were the only responses analyzed.
[6]Because the responses to the story stems are ordinal in nature, frequency distributions were conducted to ensure that the data could be analyzed using the GLM. These frequencies show that the summed story stem responses produced a reasonably normal distribution, allowing us to use more powerful parametric statistical tests [Crocker and Algina, 1986].

significant main effect for game play time on the story stems, $F(2,182) = 12.19$, $P < .001$, $\eta^2 = .12$, power = 1.00, such that there was an increase in state aggression from baseline (see Table I). The results are qualified by a significant interaction between game play time and type of controller they used, $F(2,182) = 3.61$, $P < .03$, $\eta^2 = .04$, power = .66, suggesting that playing *Time Crisis 3* with the interactive light gun leads to higher aggression scores than playing it with the standard controller (see Table II). No other interactions were statistically significant.

Hostility

State hostility was measured by asking participants to rate how hostile they are feeling right now, using a single item. An overall 3 (game play time) × 2 (level of game) × 2 (controller type) mixed ANOVA was conducted to test for significant main

TABLE II. Mean Scores for the Interaction Between Each Dependent Variable and Controller Order

Variable	Controller order	Mean
Arousal	None	79.26
	Standard	78.51
	Gun	81.37
	None	75.23
	Gun	82.80
	Standard	77.82
Story stems	None	5.58
	Standard	6.45
	Gun	6.56
	None	5.31
	Gun	6.80
	Standard	5.62
Hostility	None	1.09
	Standard	1.61
	Gun	1.71
	None	1.16
	Gun	1.23
	Standard	1.20

TABLE III. Mean Scores on the Child and Sports Story Stem Before the Summation

Stem category		Time		Controller	
	Baseline	2	3	Standard	Interactive light gun
Child	2.89	3.33	3.26	3.32	3.27
Sports	2.61	3.29	2.88	2.80	3.36

effects and interactions. The results show a significant main effect for game play time, $F(2,188) = 11.48$, $P < .001$, $\eta^2 = .11$, power = .99, suggesting that hostility significantly increased from baseline (see Table I). This result is qualified, however, by a significant interaction between time and controller type, $F(2,188) = 3.87$, $P < .002$, $\eta^2 = .06$, power = .90 (see Table I). This suggests that playing with the interactive light gun significantly produces more hostility than playing with the standard controller (see Table II). No other interactions were statistically significant.

DISCUSSION

This study sought to answer specific research questions and test various hypotheses about the relationship between violent video game play and aggression as posited by the GAM, focusing on the priming hypothesis. The first hypothesis was that there would be a significant increase in aggression over time. State aggression was measured using story stems, which asked participants to respond to actions that were committed against them, and physiological arousal. The results show that there was a significant increase in heart rate from baseline to time 3, and a marginal increase in heart rate from baseline to time 2. Furthermore, these results show that the responses to the story stems significantly increased in aggression from baseline to time 2 and baseline to time 3, which supports the hypothesis that there was a significant increase in aggression from baseline. Furthermore, the data suggest that the continuation of video game play did not increase aggression, as seen in the nonsignificant difference between times 2 and 3 on the aggression, heart rate, and hostility variables. The trend in each of these variables would suggest that as one continues to play violent video games, there is an increase from baseline measures, but not an increase past that initial short-term effect.[7]

The main findings of this study suggest that the GAM offers an adequate explanation of the repeated short-term effects of violent video games. The data show that aggression and hostility increase significantly from baseline but significantly from times 2 to 3, suggesting that there is a short-term aggression-related peak from baseline that does not increase or decrease significantly. This is predicted by the short-term GAM. Future research should use the long-term GAM or use a longitudinal design to determine if the priming hypothesis or the long-term version of the GAM is the more appropriate fit for long-term violent video game playing effects.

The second hypothesis was derived to determine whether or not the Weapons Effect could be applied to FPSGs that used an interactive light gun instead of a standard controller to account for possible increases in aggression. The results from these analyses revealed that there was a significant interaction between the type of controller used by participants to play the game and the increase, from baseline, in aggression, hostility, and heart rate. This lends support for the Weapons Effect being an explanation for aggression.

A final conclusion that can be drawn from this research is that it is possible to find significant differences in a video game effects study using a within-participants, within-game experimental design. Even though there was not one specific statistical procedure to test this hypothesis, overall, the results show that significant and meaningful findings can be produced using this type of experimental design. This conclusion may seem minor, but the experimental design of this study is innovative by not using a between-participants experimental design. The reason that video game effect researchers do not use a within-participants experimental design is concern about order effects, especially practice effects. However, this study showed that if one can find a variable (controller type) within the same video game, whereas alternating game levels and counterbalancing all levels of the independent variable across all conditions, then it is possible to find significant differences in certain variables, whereas helping to eliminate some of the individual difference error variance that is associated with using a between-participants experimental design.

This study does provide important empirical findings that can contribute to the extensive literature on aggression and video game play. The first is that there is a significant increase in aggression after playing a video game for 15 min from the initial baseline measure. This finding, although confirming past literature [Anderson, 2004], is important because it shows that a modern FPSG on the most modern video game system can contribute to significant increases in aggression levels, whereas using a within-participants, within-video game experimental design.

Another implication of this research is that this study offers support for the GAM. This study shows that physiological arousal and state aggression are

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[7]The exception to this is the physiological arousal data, which found that there was a moderate increase from baseline, but then a decrease, which was not significantly different from baseline measures.

significantly affected by the person and by the video game, as suggested by the GAM. A methodological innovation to this model is that state aggression can be measured using forced choice, instead of open-ended, story stems. The idea that hostility is an important component of the GAM, in the presence of a violent video game, was supported while measuring state hostility using a single item adjective.

This study did have some limitations. The first is the heart rate measure was not as reliable as other measures of physiological arousal. Because the output was dependent on the actions of the participants and not fully dependent on the heart rate, this raised many concerns about this particular measure. Therefore, any interpretation of these results needs to be interpreted with caution. However, using the experimenter rules and the fact that significant differences emerged using this measure, it is likely that the mean differences in arousal would be even greater if the heart rate measure were more accurate. In addition, a meta-analysis that investigated antisocial behavior and children found that the quality of the heart rate device did not significantly moderate the relationship between antisocial behavior and arousal [Oritz and Raine, 2004]. Future research might use a more reliable measure of heart rate, or some other physiological measure that was used in past research that can measure heart rate continuously.

A second limitation is that this study did not assess if participants have ever played this game before, or if they have ever handled a real gun. This is an important limitation to state because it is possible that people who have played this game before may not feel as aggressive, hostile, or more aroused because of their familiarity with this particular game. In addition, having held and fired a real gun before might give the participants the skills that are necessary to perform well at this game while using the light gun. Therefore, the skills that these individuals have may transfer over to this game, which may impact the scores. Future research should ask participants about their knowledge of the particular game played and if they had any earlier experience with handling a real gun.

Some might suggest that a limitation of this study is that the current researchers did not measure video game performance. The performance on this type of game may moderate the aggression that the participants felt, as predicted by the frustration aggression hypothesis, as outlined in Dill and Anderson [1995]. For example, perhaps an individual that does not score well has higher aggression because that individual knows he/she is not that good. Inversely,

a participant that scores really well may not have higher aggression levels. Therefore, the overall score on the game should be a covariate. This is a valid claim, however, *Time Crisis 3* did not allow for the researchers to document the performance because the game shows the scores, but it is on a timer. This is problematic because the researcher may not have enough time to document the scores before they disappeared, which would not allow for the full and necessary score outputs to be recorded. It may be beneficial for future research to document the scores and use them in analyses.

A fourth limitation to this study was the use of single-item measures to assess state hostility and frustration. The use of single-item measures are not advocated for usage because one cannot evaluate the validity of the measure, as it is the participant's definition of the construct that is assessed. This study assessed hostility using this single-item measure to ensure that the participants would be able to play the game for 30 min and complete the other dependent measures (e.g., story stems, physiological arousal) within the hour time limit. Future research should implement a scale to measure state hostility [see Anderson et al., 1995] while answering the same research questions. Even though it is a limitation that hostility was measured using a single-item measure, it was less problematic that frustration was measured in a similar way. Even though frustration has been shown to be an aggression eliciting factor [Dill and Anderson, 1995], it was not the main variable of interest for this study. The inclusion of a measure to assess frustration was to serve as a manipulation check to make sure that all participants were not more, or less, frustrated at any given point in time. Future research should use a more valid measure of frustration if that is a major dependent variable for the study.

A final limitation in this study is the implementation of researcher-created story stems to assess state aggression. It may appear problematic that these specific story stems have not been used in previous research; however, previous research has used other researcher-created story stems for a measure of aggression in the same population as the current study's sample [Deselsm and Altman, 2003]. The procedure of creating story stems has also been implemented in video game studies involving children [Funk et al., 2004; Krahe and Moller, 2004]. Therefore, it is not uncommon for researchers investigating video game effects to create story stems to measure variables.

This study offers a multitude of empirical support to add to the aggression and video game literature.

The increased aggression using a modern FPSG while using a within-participant within-game design (with the GAM) warrants additional emphasis. To conclude, this study asked whether or not a violent video game increases aggression. The findings from this study suggest that playing this violent video game does increase aggression, compared with baseline. Additionally, aggression was higher for those who played the video game with the interactive light gun, lending support to the Weapons Effect.

ACKNOWLEDGMENTS

APPENDIX A

See Table A1

TABLE A1.

Judge stories
1. You are the judge in a case in which the jury has convicted the defendant of second-degreemurder. This crime involves intentional, but not premeditated, killing of another person. Assuming you have the authority to give any of the following sentences, which sentence would you give in this case?
  (a) Life in prison
  (b) 30 years
  (c) 20 years
  (d) 10 years
  (e) Probation
2. You are the judge in a case in which the jury has convicted the defendant of aggravated kidnapping. This crime involves a serious and planned kidnapping by a non-family member. Assuming you have the authority to give any of the following sentences, which sentence would you give in this case?
  (a) Life in prison
  (b) 30 years
  (c) 20 years
  (d) 10 years
  (e) Probation
3. You are the judge in a case in which the jury has convicted the defendant of aggravated robbery. This crime involves a violent act of robbery using a weapon. Assuming you have the authority to give any of the following sentences, which sentence would you give in this case?
  (a) Life in prison
  (b) 30 years
  (c) 20 years
  (d) 10 years
  (e) Probation

TABLE A1. Continued

Sports stories
1. You are a baseball player and you are up to bat. The pitcher deliberately hits you with a hundred-mile-an-hour fastball. What do you do?
  (a) Immediately start fighting with the player
  (b) Go up to that player and yell in his/her face
  (c) Yell at that player from afar
  (d) Ask the umpire to penalize that player
  (e) Walk to first base and avoid responding to the pitcher
2. You are a basketball player and you are going up for a lay-up. As you are in the air, a player on the other team purposely grabs your legs and smacks you down on the court floor. What do you do?
  (a) Immediately start fighting with the player
  (b) Go up to that player and yell in his/her face
  (c) Yell at that player from afar
  (d) Ask the referee to penalize that player
  (e) Get up and walk directly to the foul line without any confrontation
3. You are a football player and you just made a nice run down the field. After the play is over, a player on the other team intentionally tackles you from behind. What do you do?
  (a) Immediately start fighting with the player
  (b) Go up to that player and yell in his/her face
  (c) Yell at that player from afar
  (d) Ask the referee to penalize that player
  (e) Get up and immediately walk back to the huddle

Child stories
1. Suppose your son/daughter gets in trouble at school for fighting with his/her classmate. What would you do?
  (a) Ground your child for an entire weekend
  (b) Ground your child for an entire day
  (c) Ground your child for a couple of hours
  (d) Ground your child from certain privileges (i.e. no phone, no television, etc.)
  (e) Serious verbal reprimand of your child
2. Suppose your son/daughter gets in trouble at school for cheating on an exam. What would you do?
  (a) Ground your child for an entire weekend
  (b) Ground your child for an entire day
  (c) Ground your child for a couple of hours
  (d) Ground your child from certain privileges (i.e. no phone, no television, etc.)
  (e) Serious verbal reprimand of your child
3. Suppose your son/daughter gets in trouble at school for skipping classes. What would you do?
  (a) Ground your child for an entire weekend
  (b) Ground your child for an entire day
  (c) Ground your child for a couple of hours
  (d) Ground your child from certain privileges (i.e. no phone, no television, etc.)
  (e) Serious verbal reprimand of your child

REFERENCES

Anderson CA. 2003. Video games and aggressive behavior. In: Ravitch D, Viteritti JP (eds): "Kid Stuff: Marketing Sex and Violence to America's Children," Baltimore: The Johns Hopkins University Press, pp 143–167.
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, Bushman BJ. 2002. Human aggression. Annu Rev Psychol 53:27–51.

Anderson CA, Dill KE. 2000. Video games and aggressive thoughts, feelings, and behavior in the laboratory and 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, Morrow M. 1995. Competitive aggression without interaction: Effects of competitive versus cooperative instructions on aggressive behavior in video games. Pers Soc Psychol Bull 21:1020–1030

Anderson CA, Murphy CR. 2003. Violent video games and aggressive behavior in young women. Aggressive Behav 29:423–429.

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.

Ballard ME, Wiest JR. 1996. Mortal Kombat ™: The effects of violent videogame play and males' hostility and cardiovascular responding. J Appl Soc Psychol 26:717–730.

Bartholow BD, Anderson CA. 2002. Effects of violent video games on aggressive behavior: Potential sex differences. J Exp Soc Psychol 38:283–290.

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

Berkowitz L, LePage A. 1967. Weapons as aggression-eliciting stimuli. J Pers Soc Psychol 7:202–207.

Bryant P. 2005, January. GameFly announces the top video game rentals of 2004. Retrieved from: http://www.gamefly.com/press/pdf/05.01.18%20Top%20Games%20of%202004.pdf.

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.

Buchman D, Funk JB. 1996. Video and computer games in the '90s: Children report time commitment and game preference. Children Today 31:12–15.

Calvert S, Tan SL. 1994. Impact of virtual reality on young adult's physiological arousal and aggressive thoughts: Interaction versus observation. J Appl Dev Psychol 15:125–139.

Carnagey NL, Anderson CA. 2003. Theory in the study of media violence: The general aggression model. In: Gentile DA (ed): "Media Violence and Children: A Complete Guide for Parents and Professionals," Westport, CT: Praeger, pp 131–154.

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

Cohen J. 1988. "Statistical Power Analysis for the Behavioral Sciences." 2nd edition. Hillsdale, NJ: Lawrence Earlbaum.

Cooper J, Mackie D. 1986. Video games and aggression in children. J Appl Soc Psychol 16:726–744.

Crocker L, Algina J. 1986. "Introduction to Classical and Modern Test Theory." New York: Holt, Rinehart, and Winston Inc.

Deselsm JL, Altman JD. 2003. Immediate and prolonged effects of videogame violence. J Appl Soc Psychol 33:1553–1563.

Dill JC, Anderson CA. 1995. Effects of frustration justification on hostile aggression. Aggressive Behav 21:359–369.

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

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.

Funk JB, Hagan JD, Schimming JL. 1999. Children and electronic games: A comparison of parent and child perceptions of children's habits and preferences in a United States sample. Psychol Rep 85:883–888.

Funk JB, Buchman DD, Jenks J, Buchtoldt H. 2004. Playing violent video games, desensitization, and moral evaluation in children. Appl Dev Psychol 24:413–436.

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.

Hellier EJ. 1998. Within-subject designs. In: Nunn J (ed): "Laboratory Psychology: A Beginner's Guide," Philadelphia, PA: Psychological Press, pp 39–58.

Huesmann LR, Moise-Titus J, Podolski C, Eron LD. 2003. Longitudinal relations between children's exposure to TV violence and their aggressive and violent behavior in young adulthood: 1977–1992. Dev Psychol 39:201–221.

Kirsh S. 2003. The effects of violent video games on adolescents: The overlooked influence of development. Aggression Violent Behav 8:377–389.

Kirsh S. 2006. "Children, Adolescents, and Media Violence: A Critical Look at the Research." Thousand Oaks, CA: Sage.

Kirsh S, Olczak PV, Mounts JRW. 2005. Violent video games induce an affect processing bias. Media Psychol 7:239–250.

Krahe B, Moller I. 2004. Playing violent electronic games, hostile attributional style, and aggression-related norms in German adolescents. J Adolesc 27:53–69.

Lin S, Lepper MR. 1987. Correlates of children's usage of videogames and computers. J Appl Soc Psychol 17:72–93.

Morris C. 2005. Video games sales jump 8 percent in 2004. Retrieved January 18 from CNN.com.

Nelson TM, Carlson DR. 1985. Determining factors in choice of arcade games and their consequences upon young male players. J Appl Soc Psychol 15:124–139.

Oritz J, Raine A. 2004. Heart rate level and antisocial behavior in children and adolescents: A meta-analysis. J Am Acad Child Adolesc Psychiatry 43:154–162.

Panee CD, Ballard ME. 2002. High versus low aggressive priming during video-game training: Effects on violent action during game play, hostility, heart rate, and blood pressure. J Appl Soc Psychol 32:2458–2474.

Salguero RT, Moran RB. 2002. Measuring problem video game playing in adolescents. Addiction 97:1601–1606.

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.

Schutte NS, Malouff JM, Post-Gordon-Joan C, Rodasta AL. 1988. Effects of playing videogames on children's aggressive and other behaviors. J Appl Soc Psychol 18:454–460.

Sherry JL. 2001. The effects of violent video games on aggression: A meta-analysis. Hum Commun Res 27:409–431.

Uhlmann E, Swanson J. 2004. Exposure to violent video games increases automatic aggressiveness. J Adolesc 27:41–52.

Weaver J. 2003. College students are avid gamers. Retrieved July 18 from Msnbc.com.