VIOLENT VIDEO GAMES AND AGGRESSION

Causal Relationship or Byproduct of Family Violence and Intrinsic Violence Motivation?

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Two studies examined the relationship between exposure to violent video games and aggression or violence in the laboratory and in real life. Study 1 participants were either randomized or allowed to choose to play a violent or nonviolent game. Although males were more aggressive than females, neither randomized exposure to violent-video-game conditions nor previous real-life exposure to violent video games caused any differences in aggression. Study 2 examined correlations between trait aggression, violent criminal acts, and exposure to both violent games and family violence. Results indicated that trait aggression, family violence, and male gender were predictive of violent crime, but exposure to violent games was not. Structural equation modeling suggested that family violence and innate aggression as predictors of violent crime were a better fit to the data than was exposure to video game violence. These results question the common belief that violent-video-game exposure causes violent acts.

Keywords: computer games; violent crime; aggression; personality; family violence

Concerns that video games promote violent behavior in players began shortly after the inception of commercial product availability in the 1970s. The first major controversy occurred with the release of a game entitled "Death Race" (Exidy) in 1976 (Kent, 2001). This game featured the player as an automobile driver whose goal was to run over screaming "gremlins," transforming them into tombstones. Primitive graphics caused the "gremlins" to look like stick-figure humans; thus, the game appeared to condone the massacre of innocent civilians with a car. The uproar was fueled by the game's working title, "Pedestrian," and protestors reportedly pulled some machines out of arcades and burned them. With ensuing waves of protest, the production of "Death Race" was cancelled. Renewed attention to the potential effects of violent video games occurred in the early 1990s with the

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releases of the first-person shooter game, "Wolfenstein 3D" (Muse Software, 1992), and the franchises of Mortal Kombat (Midway Games, Inc., 1992) and Street Fighter (Capcom, USA, 1987), all of which featured frequent person-on-person violence (Carnagey & Anderson, 2004).

Some researchers (e.g., Anderson & Dill, 2000) suggest that the participatory nature of violent video games may have greater influence on players than violent television, whereas others (e.g., Pinker, 2002) suggest that any link between video games and aggression is best explained by "third" variables, such as family environment or innate aggression. This controversy remains unaddressed, as the sparse research on violent video games often overlooks "third" variables. The purpose of the current article is to examine, through two separate studies, whether violent video games directly cause subsequent player aggression or whether any relationship between video games and aggression is better explained as a byproduct of "third" variables, such as exposure to family violence and innate violence motivation.

RESEARCH ON VIOLENT VIDEO GAMES

As with research on other forms of media violence (see Anderson et al., 2003, for a review), research on violent video game effects tends to fall within two broad categories: namely, correlational and experimental studies. Meta-analytic reviews of the few studies that currently exist suggest that the overall effect size (denoted $r^2 \times 100$) for correlational and experimental studies of violent video games and violent behavior are positive but small, ranging between 1% and 4% shared variance between video game playing and violent behavior (Anderson & Bushman, 2001; Sherry, 2001). Larger effects were found for young adults, with smaller effects found for children. However, as many of the studies included in these analyses fail to consider "third" variables (e.g., intrinsic motivation, exposure to family violence, or sometimes even the gender of the player), it remains unclear whether these results are truly causal as opposed to spurious. A more recent meta-analysis has identified significant problems with publication bias in the literature and found that the relationship between video game habits and aggressive behavior was effectively 0% (Ferguson, 2007).

Regarding correlational studies, Anderson and Dill (2000) examined the relationship between violent video game playing and self-reported violent crime in 227 undergraduate students. Overall, the authors found a positive relationship, although the effect for violent video games interacted with innate aggression and gender. Specifically, innately aggressive males demonstrated greater correlations between violent video game playing and violent crime than did other groups. Thus, the results suggest that although a relationship between violent video games and violent crime exists, third variables, such as innate aggression and gender, may influence this relationship. Unfortunately, this study did not control for variance caused by exposure to family violence.

Few other correlational studies of the relationship between violent video game playing and real-life aggression find results as strong as those in the Anderson and Dill (2000) study. Many such findings (e.g., Colwell & Kato, 2003; Funk, Buchman, & Germann, 2000; Weigman & van Schie, 1998) have effect sizes less than Cohen's (1992) recommendation of $r \geq .10$ as the cutoff for a "small" effect size. Some (e.g., Williams & Skoric, 2005) find no relationship between violent video game playing and real-life aggression, whereas others find positive, but weak, relationships (e.g., Colwell & Payne, 2000). Most of these studies fail to account for participants' exposure to family violence.

Several experimental studies have examined the effects of playing violent video games on aggressive cognitions (Anderson & Dill, 2000; Ballad & West, 1996; Bushman & Anderson, 2002) and physiological arousal (Ballad & West, 1996; Bartholow, Bushman, & Sestir, in press; Fleming & Rickwood, 2001). Results from these studies suggest generally weak, but positive, effects on arousal level and aggressive thoughts. It is not particularly surprising that violent games are arousing or that players would still be thinking about the content of the game that they just played. The critical question is not whether individuals who play violent video games are merely aroused or thinking of aggressive concepts but whether their behavior is altered such that they are more likely to engage in violent acts.

Because it is not ethical to provoke interpersonal violence in the lab, researchers must rely on proxy measures of aggression. Perhaps the most commonly employed test of aggression used in the laboratory is the Taylor Competitive Reaction Time Test (TCRTT; see Anderson & Dill, 2000), which uses the intensity and duration of noise blasts as a measure of aggression (see Study 1: Method section for a full description). The TCRTT is designed to function as a provoked aggression test. One concern with the TCRTT is that, although the administration is standardized, the measurement of results is not. It is unclear whether aggression is measured by the intensity and/or duration of the noise blast or whether total average intensity should be recorded versus only blasts that occur on a cutoff point such as 8 on a 10-point scale. The various studies of video game violence that use the TCRTT (Anderson & Dill, 2000; Anderson & Murphy, 2003; Bartholow & Anderson, 2002; Bartholow et al., in press; Carnagey & Anderson, 2005) have all measured the results differently. This lack of standardization raises the possibility that the TCRTT may be open to capitalization on chance. Furthermore, these studies do not report the reliabilities of the measures nor the degrees to which the intensity and duration settings correlate (as they should if they are both measures of aggression). Without the use of a standardized version of the TCRTT and knowledge of the instrument's reliability, the interpretive value of these studies' findings is in question.

A further concern regarding the interpretation of these studies is in regards to using the TCRTT to make multiple comparisons without using Bonferroni corrections. For example, Anderson and Dill (2000) measured aggression with four separate data points from the TCRTT (noise intensity and duration after both win and lose trials). Although Anderson and Dill suggests a positive effect for violent video game playing and aggression, in fact only one of the four TCRTT data points proved significant (duration after loss trials), and this fourth data point would have been insignificant as well had a Bonferroni correction been applied. The two studies presented in this article will improve on previous research by more carefully examining family violence exposure and trait aggression as well as by using a standardized, reliable version of the TCRTT to measure aggression in the experimental study.

THEORETICAL EXPLANATIONS OF VIOLENT VIDEO GAME EFFECTS

Theoretical explanations for the potential effects of violent video games (and other forms of violent media) fall into two broad categories: namely, those that suggest that violent video game playing directly causes subsequent violent behavior through a social-learning paradigm and those that suggest that violent behavior is largely innate (i.e., genetic or caused by biological insult), with only an incidental relationship between violent video games and violent behavior. Examples of both will be discussed.

Social learning theories of video games and aggressive behavior. Many researchers examining the effects of violent video games endorse a theoretical model known as the general aggression model (GAM; Bushman & Anderson, 2002), which borrows from social modeling and other cognitive theories (Anderson & Dill, 2000). According to the GAM, viewing violent media causes the formation of aggressive cognitive scripts. These cognitive scripts provide automatic information on how the individual should behave under certain social circumstances. The greater extent to which a person is exposed to violent stimuli, the more aggressive scripts that are formed and subsequently called on when presented with potentially hostile environmental stimuli. More specifically, when an environmental situation appears ambiguous, an individual may rely on these scripts to interpret that situation as hostile, warranting aggressive action. Violent stimuli, such as video games, should provoke both short- and long-term violent behavior. This theory implies passive modeling in which individuals exposed to violent media will more often engage in violent behavior regardless of personality, family environment, genetics, or other biological contributions.[1] This approach does not specifically deny genetic, personality and family environment influences, but they are excluded from the model. This theory states that no individuals are immune to the effects of violent stimuli; thus, the relationship between media violence and violent behavior should be observable in all populations (e.g., Carnagey & Anderson, 2004). Therefore, this passive-modeling theory implies that individuals can begin with no preexisting motivation to violent behavior but can acquire it through repeated exposure to media violence, and is, as such, a "tabula rasa" approach (Pinker, 2002). This approach is reflected in the American Psychological Association's (2006) position statement on youth violence, which denies the influence of genetic factors.

Support for the GAM overall has been sporadic. Although playing violent video games seems to increase aggressive thoughts and physiological arousal (Anderson & Bushman, 2001), because of the unstandardized use of the TCRTT, it remains unknown whether this has resulted in either short- or long-term changes in the levels of violent behavior (or laboratory aggression) seen in players. Furthermore, as the GAM does not include variables related to exposure to violence in the family or caused by genetic or other biological factors that influence violent behavior, it remains unclear whether the GAM is adequate for predicting violent behavior.

Biological/innate motivational theories of video games and violent behavior. An alternate view of the relationship between violent video games and violent behavior is one in which an innate motivation for or against violent behavior exists within individuals (Pinker, 2002). According to such a theoretical view, any relationship between violent video games (and other forms of violent media) and violent behavior is correlational but not causal (Pinker, 2002). This view is supported by research suggesting that a considerable portion of the variance in antisocial personalities and violent criminal behavior is explained through genetic factors (Eley, Lichtenstein, & Moffitt, 2003; Hines & Saudino, 2004; Larsson, Andershed, & Lichtenstein, 2006).

A new model for how genetic and environmental factors (i.e., family violence and media violence exposure) may interact—here called "the catalyst model"—is presented in Figure 1. According to this model, the development of a violence-prone personality occurs through a largely biological pathway in which genetic predisposition (particularly in males) leads directly to an aggressive child temperament and aggressive adult personality

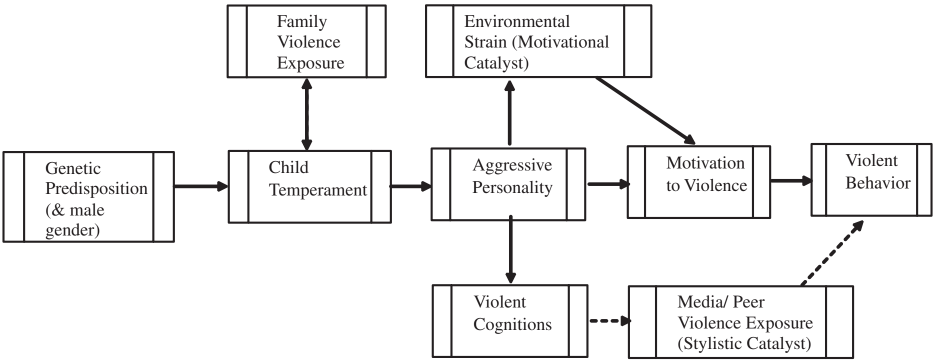

Figure 1: The Catalyst Model of Violent Crime

through maturation. Environmental factors moderate the causal influence of biology in this model, particularly through the influence of family violence. This model suggests that individuals who have an aggressive personality are more likely to engage in violent behavior during times of environmental strain. Thus, although the environment does not cause violence propensity, times of stress may act as *catalysts* for violent acts for an individual already prone to them. Such environmental strains could include financial and social problems caused by divorce, legal troubles, and similar events. Put another way, although the basic propensity to respond to events violently is brought about primarily through biological factors and family violence, the environment can supply the immediate motive for violence. Violent behaviors would then be expected to occur more frequently at times during which environmental motives are more plentiful. Individuals with higher violence proneness are likely to require less environmental strain to engage in violent behavior, although the possibility exists that a considerable proportion of individuals may engage in violent behavior under significant environmental strain (e.g., war-like conditions).

The role of media violence (including video games) in such a model is not causal. Rather, violent video games may act as s*tylistic catalysts*. When an individual high in violence proneness decides to act violently, this person may then model violence that he or she has seen in the media. As such, the style or form of violence may be socially modeled but not the desire to act violently itself. Thus, an individual may model violent behaviors he or she has witnessed in a video game, but had that video game been removed from that individual’s sphere of modeling opportunities, the violence would still occur in another form. Therefore, video game violence does not cause violent behavior but may have an impact on its form.

To the extent that violent behavior is influenced by social learning in the catalyst model, the individual is an “active” modeler. This means that the individual, predisposed (or not) to violent behavior because of genetic factors, begins to actively seek out modeling opportunities that are consistent with an innate motivational system. This model predicts that an individual predisposed to violence would be more prone to model violence even when presented with contrasting (violent and nonviolent) modeling opportunities, whereas an individual not so predisposed would be prone to actively seek out nonviolent models. This model could be tested by exposing experimental participants to contrasting stimuli and examining whether their subsequent behavior is consistent with a preexisting predisposition (as indicated by measures of trait aggression). Information from twin studies already provides a basic confirmation of the genetic transmission of violent behavior, although this does not rule out environmental (which refers to nongenetic rather than "learned" per se) effects (Eley et al., 2003; Hines & Saudino, 2004; Larsson et al., 2006).

The catalyst model presented here is a relatively new theoretical model of violent behavior and has not yet been examined in relation to the GAM. It is the purpose of this article, in part, to examine which of these theoretical models is best supported by correlational and experimental data on video game exposure.

THE PRESENT STUDY

Study 1: Aggression in the laboratory. The first study was an experimental design in which undergraduate student volunteers were randomly assigned to one of three groups. The first group was assigned to play a violent video game; the second group was assigned to play a matched nonviolent video game. Individuals in the third group were given a brief written description of the two games, particularly whether the games included violent content. Participants in the third group were then allowed to select which video game they wished to play (effectively assigning themselves to a violent-choice or nonviolent-choice group). This design provided a test of whether participants' perspective of personal responsibility for playing a violent video game produced different effects from randomization. Participants were also asked to report their real-life exposure to violent video games. Two basic hypotheses were tested, as follows:

Hypothesis 1: Exposure to video game violence in a controlled environment results in increased aggression on a subsequent laboratory measure of aggression.
Hypothesis 2: Individuals who are exposed to more violent video games in real life are more aggressive on a laboratory measure of aggression.

The GAM would be supported if both violent-video-game groups (random and choice) were significantly more aggressive than both nonviolent-video-game groups (random and choice). Similarly, the GAM would have been supported if individuals exposed to more violent video games in real life demonstrated higher aggression in the laboratory. Conversely, the catalyst model would have been supported if the violent-video-game groups did not differ significantly from the nonviolent-video-game groups. Although aggressive individuals, given the choice, may be expected to select the violent game more often than nonaggressive individuals, the catalyst model does not conclude that playing such a game would increase the individual's aggressiveness beyond previous levels. Cohen's (1994) suggestions for using effect-size confidence intervals were employed to examine whether any null findings were "true" or potentially caused by reduced power. This design used a reliable version of the TCRTT that is available for standardized administration and scoring, thus improving on previous studies using the TCRTT.

Study 2: Violent crime in real life. The second study used a correlational design to examine the predictive relationship between exposure to family violence, personality and trait aggression, video-game playing habits, and violent crime commission. Specifically, this study was designed to examine whether video-game playing habits retained any unique predictive value in explaining violent criminal behavior once exposure to family violence was controlled.

If video-game playing habits continued to possess unique predictive variance, this would have been supportive of the GAM. If video-game playing habits did not possess unique predictive variance after family violence exposure was controlled, this would have supported the catalyst model. In accordance with the catalyst model, it was expected that video-game-violence exposure and aggressive personality would be correlated, as aggressive individuals seek out violent games. However, it was expected that once family violence exposure and gender were controlled, video-game-violence exposure would not uniquely predict aggressive personality or violent crime.

STUDY 1: METHOD

PARTICIPANTS

One hundred and one undergraduate students from two public universities in Texas and Wisconsin participated in this study in exchange for extra credit in their coursework. Of the students involved, 46 (45.5%) were male and 55 (54.5%) were female. Regarding ethnicity, 42 (41.6%) of the students were Caucasian, 49 (48.5%) were Hispanic, 7 (6.9%) were African American, 2 (2%) were Asian and 1 (1%) was listed as "other." Mean age (range: 18 to 40) for this sample was 20.9 years (SD = 3.7), and they possessed a mean education level equivalent to college sophomore standing. One male volunteer whose age differed significantly from the rest was considered an outlier and not included in the analyses.

MATERIALS

Demographic sheet. On a single page, participants indicated their age, gender, self-described ethnicity, and education level.

Trait aggression. To measure trait aggressiveness, participants completed the Aggression Questionnaire–Short Form (AQ; Buss & Warren, 2000). The shortened version of AQ consists of the summed score of the first 15 items of the original 34-item version and was designed to measure the degree to which respondents endorse statements about their levels of aggression. Item responses were based on a 5-point, Likert-type scale, ranging from 1 (*not at all like me*) to 5 (*completely like me*), with higher scores indicating more aggressiveness. An example item is, "At times I get very angry for no good reason." Based on the normative sample reported in the manual, the AQ obtained an alpha coefficient of .90 for the total score. The AQ has been demonstrated to have good predictive validity (Felsten & Hill, 1999) and convergent validity with other measures of trait aggression (Garcia-Leon et al., 2002). Within the current sample, the AQ obtained an alpha coefficient of .85.

Video game habits. A measure of video-game playing habits adapted from that described in Anderson and Dill (2000) was used to measure such habits. Because some video games may have violent content but relatively nonviolent graphics (e.g., no blood or dismemberment) and vice versa, separate measures of storyline and graphic violence were obtained. Participants were asked to report the top five video games that they most regularly played, noting how often they played these games, how violent the story of the game was, and how violent the graphics of the game were using Likert-type scale items. Composite scores were obtained for the games the participants played. Participants were also asked to report how many hours per week they played video games recently as well as during high school and middle school. This allowed for a general measure of video-game playing habits in participants. Anderson and Dill (2000) reported a coefficient alpha of .86 for the scores of video-game-violence rating and .84 for time spent playing video games. In our sample, the measure of exposure to violent video-game storylines obtained a coefficient alpha of .88, whereas the measure of exposure to violent video-game graphics obtained a coefficient alpha of .88. The coefficient alpha for time spent playing video games currently and in the past was .83. Agreement between the measures of storyline violence and graphics violence was .96. As these measures are essentially identical, only the measure of exposure to violent games was used in subsequent analyses to prevent multicollinearity effects. It should be noted that this is not a perfect measure of violence exposure. However, because of the wide range of games available for play as well as the rapid production of new games, objective ratings of violent content in games quickly become outdated and require significant expense to produce. Furthermore, it is unlikely that such ratings themselves would be objective, as they would reflect experimenter beliefs as to what constitutes violence.

Aggressive behavior. This experiment used a modified version of the TCRTT that is procedurally identical to those used in other studies of media violence (e.g., Anderson & Dill, 2000; Anderson & Murphy, 2003). The TCRTT provides an opportunity for the participant to play a "reaction time game" against a fictional opponent. Participants are asked to set the level of a noise blast that will serve as punishment for their competitor in a reaction time game. This noise blast can vary both in terms of intensity (loudness) and duration. There are 25 trials in the TCRTT, and the noise level and duration can be reset each time. For each of the 25 trials, participants are told that if they win, their opponent will hear the noise blast that they have set themselves, but if they lose, they will hear a noise blast that their opponent has set for them. The pattern of wins and losses is actually preset in the computer, as there is no human opponent. The win-and-loss trials are standardized for all participants regardless of reaction time. White noise levels range between 0 and 95 decibels. Note that this is just more than the United States Safety and Health Standards recommendations for *sustained 8-hour* exposure of 90 decibels for full-time workers and much less than the pain threshold of 125 decibels.

The internal consistency coefficient alpha of the 25 trials on the TCRTT was used to examine the reliability of this laboratory measure of aggression. The reliability of intensity and duration scores were calculated separately across the 25 trials to examine for consistency in aggressive response. High internal consistency would demonstrate little conceptual difference between the responses to win-and-loss trials. Both the intensity measure ($\alpha = .90$) and the duration measure ($\alpha = .98$) proved to be reliable. The intensity and duration measures significantly correlated with each other ($r = .30$) lower than expected, which called into question whether the two measures were both measuring aggression. Given other research to suggest that the duration measure, in particular, may have poor validity, failing to correlate with other measures of aggression (Ferguson, Smith, Miller-Stratton, Fritz, & Heinrich, in press), the duration measure was dropped from further analysis. Although Anderson and Dill (2000) reported that the TCRTT has good construct and external validity, the TCRTT would benefit from predictive research regarding its relationship to the violent criminal activity that is typically the conceptual focus of violent-video-game research. The TCRTT is not, for instance, used in violence-risk assessments with inmate populations.

Follow-up survey. A follow-up survey was given to participants after they had completed all tasks. This survey asked participants about their perceptions of the video games they had played and whether they found the games to be fun, exciting, and/or frustrating; how competent they had felt playing the game; whether they had played the game before; and whether they would choose to play the game of their own free will in their personal lives. Participants were asked to rate each of these factors on a 5-point, Likert-type scale. Four of these items (fun, exciting, competent, play of free will) were highly correlated with each other ($\alpha = .88$) and were used to make a measure of game excitement. Frustration level and previous experience with the games were kept as separate variables. Previous research (Anderson & Dill, 2000) has noted that violent video games are often perceived as more exciting than nonviolent video games and that this element needs to be controlled as a covariate in laboratory studies. Frustration level may have similar effects on subsequent aggression, and familiarity was included because of potential decreased excitement resulting from playing an overly familiar game.

Video games. Anderson and Dill (2000) noted that violent video games with a first-person perspective (known as first-person shooters) are best matched with nonviolent games that also offer a first-person perspective, such as *Myst* (Cyan Inc., 1993). In the current study, a first-person shooter game called *Medal of Honor: Allied Assault* (Electronic Arts Inc., 2002) was chosen as the violent video game. Content analyses have shown this game to be among the highest in violence (Krahe & Moeller, 2004). In this game, a player takes the part of an American soldier fighting Germans during World War II. Although various missions may include participating in battles and sabotaging enemy installations, human-against-human violence is a constant and repetitive factor in the game. The nonviolent game chosen was *Myst III: Exile* (Cyan Inc., 2001), a game in which the player also takes a first-person perspective to solve puzzles and search for clues to return a stolen book. *Myst III* has no violent content. The two games were matched for their first-person perspective, relative quality of graphics, popularity, and year of release.

PROCEDURE

All procedures were approved by relevant institutional review boards and were designed to be consistent with APA ethical standards. Participants who volunteered for this study signed up for a 2-hour appointment time to assure that all procedures could be completed. Participants were given a cover story for the study: that the study was designed to examine whether playing video games enhanced reaction time performance. They were informed that the study would conclude with them playing a reaction time test against a human opponent seated in a nearby room with computers communicating through the local Ethernet. After being asked to read and sign an informed consent form and invited to ask any questions about their rights, participants were given the surveys. After these were completed, participants who were randomly assigned to either the *Medal of Honor* or *Myst III* conditions were then seated at a PC to play. Participants who were randomized into the "choice" condition were provided with brief, three-sentence descriptions of the two games. Both descriptions were designed to have three main components. The first sentence described the game's story. The second sentence described the gameplay. The last sentence of each description noted whether the game had violent content or not; thus, the participants were aware of which game was violent and which game was not prior to choosing the game that they wanted to play. The description for *Medal of Honor* read, "Play as a World War II American soldier sent to rescue a French prisoner of war from Nazi soldiers. Involves shooting your way through enemy defenses. Involves a high degree of violent action." By contrast, the description of Myst III read, "Play a story-based game involving completing a man's quest to find a new home for a civilization of exiled people. Involves solving puzzles and answering riddles in order to find the way to save their civilization. Does not involve any form of violent action or play." After their selection, "choice" participants were seated at the personal computer. It is worth noting that it is possible that participants may have chosen one game over the other because of gameplay or story rather than because of the violent content. All participants were allowed to play the game for a 45-minute interval. After this interval, the game was stopped, and the TCRTT begun.

Participants received a standardized set of verbal instructions for use of the TCRTT (see Anderson & Dill, 2000, for standardized administration instructions). Participants then completed the 25 trials of the TCRTT. After the TRCTT task was completed, participants were asked to fill out the follow-up questionnaire. Finally, participants were thoroughly debriefed, informed of the deception in the TCRTT and the hypotheses of the study, queried for suspicion, and invited to ask any questions.

STUDY 1: RESULTS

Several possible covariates were considered potentially relevant in regards to having an impact on intensity settings on the TCRTT. These were participant gender (except when this is used as an independent variable), perceived game excitement, perceived game frustration, and past familiarity with the game. Correlations between these potential covariates and the intensity setting showed that frustration ($r = -.01$) and experience ($r = -.05$) were not related to intensity settings. Game excitement ($r = .14$) and ethnicity ($r = .19$), however, were slightly correlated with intensity settings (although not statistically significant), and male gender ($r = .28$) was moderately and significantly correlated with intensity settings. As such, excitement level, ethnicity, and gender will be used as covariates when appropriate in subsequent analyses.

VIDEO GAME IMPACT

To examine whether violent video games were considered more exciting, a *t* test analysis was conducted comparing follow-up ratings for the two games. As expected, the violent game, *Medal of Honor*, was rated as more exciting ($M = 13.81$, $SD = 3.87$) than *Myst III* ($M = 9.79$, $SD = 3.48$), $t(99) = 5.47$, $p < .001$. By contrast, *Myst III* was rated as more frustrating ($M = 3.52$, $SD = 1.13$) than *Medal of Honor* ($M = 2.68$, $SD = 1.12$), $t(99) = 3.75$, $p < .001$). Participants were also more familiar with *Medal of Honor* ($M = 1.75$, $SD = 1.18$) than *Myst III* ($M = 1.06$, $SD = 0.32$), $t(60) = 4.12$, $p < .001$) through previous experience. This supports the use of game excitement and frustration as well as previous experience as covariates in future analyses.

VIDEO GAME PREFERENCE

Part of the study design allowed participants who were randomized into the "third" group to choose between the violent and nonviolent video game. One issue worth examining is whether the choice made could be predicted on the basis of individual differences such as gender, trait aggression, or previous exposure to video games. To examine this, a logistic regression was employed, with gender entered on the first step, ethnicity on the second, trait aggression on the third, and current hours spent playing video games and previous exposure to violent video games on the final step, with study game preference (violent or nonviolent video game) as the dependent variable. Results indicated a positive predictive relationship ($\chi^2 = 15.98$, $p \leq .01$). In this regression equation, only gender ($b = -3.05$, $p \leq .01$) was predictive of video game choice. Trait aggression and previous exposure to video games were not predictive of game choice, nor was ethnicity. In the "choice" condition, females appeared more inclined to select *Myst III*, whereas males were more inclined to select *Medal of Honor.* Because of this gender effect in game choice, gender will be included as a test variable in further analyses so that variance caused by gender effects is accounted for in subsequent statistical models.

VIDEO GAMES AND AGGRESSIVE BEHAVIOR

To examine the effects of playing a violent video game on aggressive behavior in the laboratory, a 4 (video game condition) × 2 factorial (gender) analysis of covariance (ANCOVA) was employed to examine the effects of video game condition and gender on the levels of noise intensity that participants set for their opponent. Excitement level of the video game and ethnicity were used as a covariates. Noise-blast intensity was the dependent variables in this model.

Table 1 presents the group means and standard deviations for noise intensity for the four game-playing groups. Results indicated a significant main effect for gender, $F(1, 91) = 6.97$, $p < .01$; $r = .27$, $.08 \leq r \leq .44$. Men used higher noise intensity ($M = 6.56$, $SD = 1.47$) than women ($M = 5.67$, $SD = 1.42$). No group differences were found for video-game-playing condition, $F(3, 91) = 0.28$, $p > .05$; $r = .06$, $-.14 \leq r \leq .25$. Specifically, neither violent nor nonviolent games produced more aggression, nor did free-choice game conditions differ from randomized groups. Similarly, a Group × Gender interaction was not found to be significant, $F(3, 91) = 1.00$, $p > .05$; $r = .10$, $-.10 \leq r \leq .29$. Neither the ethnicity nor the excitement covariates were found to be significant. Null results are traditionally more difficult to interpret than are significant results. Although the null hypothesis can not traditionally be accepted as "true," Loftus (1996) presented that if the 95% confidence interval in group difference scores (e.g., $\mu_1 - \mu_2$) is reasonably small, the null hypothesis can be effectively accepted as true. Similarly, Cohen (1994) suggested examining the confidence interval around the effect size. Effect-size confidence intervals that cross zero effect can be reasonably concluded to be "untrue" and, thus, support the null. This was further analyzed by conducting a series of planned Tukey post hoc comparisons for noise intensity. These comparisons compared the control group (randomized nonviolent group) against the experimental groups (randomized violent, choice nonviolent, choice violent) to allow for more sensitive testing of these group differences. A Bonferroni correction (minimum *p* value for significance corrected to .016) was applied because of multiple contrasts. None of these comparisons were statistically significant, supporting the absence of any real group differences. Table 1 presents the point-difference estimate, significance level, and 95% confidence interval for the group differences for the four post hoc comparisons. This allowed us to conclude, on a practical level, that no effective group differences existed between the game-playing conditions and that a Type II error had not occurred. Regarding Cohen's

TABLE 1: Demographics and Comparisons Between Randomized Nonviolent Control Group and Experimental Groups

Group	*D.V.*	*Difference*	*Sig.*	*95% CI*	*Int.*	*Gender*	*Ethnicity*
Random nonviolent (control)	Int.	N/A	NA	NA	6.23 (1.24)	12 male 14 female	13 Caucasian 3 African American 9 Hispanic 1 Asian American 0 Other
Random violent	Int.	0.30	0.90	–0.82-1.41	5.96 (1.61)	12 male 12 female	14 Caucasian 3 African American 7 Hispanic 0 Asian American 0 Other
Choice violent	Int.	0.39	0.78	–0.72-1.50	6.35 (1.57)	18 male 9 female	5 Caucasian 1 African American 19 Hispanic 1 Asian American 1 Other
Choice nonviolent	Int.	–0.25	0.94	–1.41-0.90	5.69 (1.58)	4 male 20 female	10 Caucasian 0 African American 14 Hispanic 0 Asian American 0 Other

Note. D.V. = dependent variable; Int. = noise intensity; 95% CI = confidence interval.

recommendations, the effect size for group differences, converted to r, was $r = .06$ with a confidence interval of $–.14 \leq r \leq .25$. As this confidence interval clearly crosses zero, it indicates support for the null hypothesis.

REAL-LIFE VIOLENT VIDEO-GAME EXPOSURE AND AGGRESSIVE BEHAVIOR

This analysis examined whether exposure to violent video games in real life or trait aggression impacted the behavior of individuals in the lab. Trait aggression (as measured by the AQ) and video game exposure were examined through the use of quartiles based on mean and standard deviation scores, similar to Anderson and Dill's (2000) method. A 4 (trait aggression) × 4 (video game exposure) factorial ANCOVA was employed to examine the effects of past violent-video-game exposure and trait aggression. Quartile scores for aggression and video game exposure were entered as independent variables, with gender (to eliminate variance because of gender effects noted in previous analysis) and ethnicity entered as covariates. The game excitement, experience, and frustration variables were not used as covariates in this model, as it was not the purpose of this model to evaluate the laboratory game conditions. Intensity on the TCRTT was entered as the dependent variable. No effects were found for past violent-video-game exposure, $F(3, 84) = 0.03$, $p > .05$; $r = .02$, $–.18 \leq r \leq .22$, or trait aggression, $F(3, 84) = 1.02$, $p > .05$; $r = .06$, $–.14 \leq r \leq .25$, on aggressive behavior in the laboratory. Likewise, the interaction between video-game violence exposure and trait aggression $F(8, 84) = 0.49$, $p > .05$; $r = .08$, $–.12 \leq r \leq .27$, was not found to be significant. In this analysis, gender was not found to be a significant covariate nor was ethnicity, although ethnicity approached significance, $F(1, 84) = 3.83$, $p \leq .06$; $r = .21$, $.01 \leq r \leq .39$. Results for trait aggression, though theoretically puzzling, are consistent with Anderson and Dill's (2000) observations that trait aggression was generally unrelated to TRCTT performance.

DISCUSSION

Results from this study provide several important answers related to the hypotheses discussed earlier. The analyses presented here fail to support the hypothesis that exposure to a violent video game causes short-term aggression in a laboratory environment. Individuals who played *Medal of Honor* were no more aggressive after playing than were individuals who played *Myst III*. Thus, it does not appear that aggressive behavior is modeled after a short-term exposure to violent video games, as had been predicted by the GAM. Similarly, long-term exposure to violent video games, as indicated by self-reported exposure to violent games and violent graphics, produced no differences in measured laboratory aggression. Post hoc comparisons, effect-size confidence intervals, and group-difference confidence intervals support that no group differences exist. These results are consistent with the catalyst model but are not supportive of the GAM.

Results did indicate that males were more aggressive than females. Interestingly, although males appeared to prefer to play violent video games relative to females, there was no evidence from this study to suggest that people who prefer violent video games are more innately aggressive than those who do not prefer violent video games, aside from gender effects. Namely, males were both more aggressive and preferred more violent games than did females. As such, violent video games and aggression do not appear related either directly or indirectly aside from as a function of gender.

The second study examined whether video-game-violence exposure retains predictive value regarding violent crime once family violence exposure, trait aggression, and gender have been controlled.

STUDY 2: METHOD

PARTICIPANTS

Participants in this study included 428 undergraduates from a public university in Florida who participated in exchange for extra credit. Of these participants, 173 (40.4%) were male and 255 (59.6%) were female. Regarding ethnicity, 163 (38.1%) were Caucasian, 223 (52.1%) were Hispanic, 22 (5.1%) were African American, 10 (2.3%) were Asian American, and 10 (2.3%) identified as “other.” The mean age for this sample was 20.68 (SD = 5.16), and their mean years of education were equivalent to freshman status in college.

MATERIALS

*Demographic sheet. O*n a single page, participants indicated their age, gender, self-described ethnicity, and education level.

Trait aggression. The Buss Aggression Questionnaire short form (AQ; Buss & Warren, 2000), described in detail under Study 1, was used to measure trait aggression in this study. With this sample, the AQ obtained a coefficient alpha of .87.

Video game habits. The measure of video game habits discussed in Study 1 was employed in this study to obtain an estimate of exposure to violent video games and past video-game-playing habits. The coefficient alpha for the measure of exposure to violent video games was .89. The coefficient alpha for the measure of exposure to violent graphics in video games was .88. The coefficient alpha for time spent playing video games was .86. The agreement between the measures of exposure to violent games and violent graphics was similar (r = .98). As these measures are essentially identical, only the measure of exposure to violence games was used in subsequent analyses to prevent multicollinearity effects.

Family violence exposure. Although a variety of child trauma and family environment scales exist, none of these specifically address components of family violence exposure or the degree to which these behaviors related to how loved the child felt in his or her family. As such, this study made use of a relatively new scale, currently in development with this research group. Specifically, the Family Conflict_Scale (FCS) is a 49-item questionnaire designed to look at specific components of family violence exposure, including subscales for direct physical and sexual abuse, witnessing domestic violence, neglect and failure to provide for basic needs, exposure to drug abuse, use of spanking in discipline, verbal abuse and insulting language, and the degree to which education was valued in the family. This measure also included a subscale regarding the degree to which the respondent felt loved by his or her parents or caregivers. Scales used in the current study included those for physical abuse (6 items, $\alpha = .64$), witnessing domestic violence in the family (11 items, $\alpha = .82$), use of spanking in the family (4 items, $\alpha = .63$), verbal abuse (9 items, $\alpha = .76$), and the degree to which the child felt loved by his or her parents (5 items, $\alpha = .83$).

Violent criminal behavior. Measurement of self-reported violent crime was obtained using the National Youth Survey (Elliot, Huizinga, & Ageton, 1985), a measure first developed in conjunction with the National Institute of Mental Health and modified slightly for this study. This measure is a 35-item self-report measure of violent and nonviolent crimes in which individuals are asked to estimate how many times in the past year they have committed those behaviors. Anderson and Dill (2000) described a procedure for developing an index of violent crime from 10 of those items. Items on this scale include estimates of how often in the past a respondent has committed acts such as “hit a parent or caregiver” or “attacked/seriously injured someone on purpose.” Items are summed to present a single score. For this study, the addition of an estimate for “total past” crime commission was included, in addition to the 12-month estimate. This was added out of concern for a low base rate for recent commission of crimes in a population of current adult college students, although some of those students may have committed crimes earlier as juveniles. Anderson and Dill reported that the internal consistency of these 10 items from National Youth Survey violent crime items in their sample was .73 for the reporting of crimes committed in the prior 12 months. However, consistent with our concerns here, we were not able to independently verify the reliability of this 12-month estimate scale. Thus, the 12-month estimate scale was dropped from further analysis. However, the total-past version of this scale proved to have adequate reliability. Of the items included, 2 (related to sexual assault and threatening a teacher with a weapons) had little variance in our sample and were dropped. Coefficient alpha for the remaining 8-item index of total past commission of violent crime with the current sample was .64. As the violent acts involved differed in terms of severity (ranging from assault to attempted homicide), a somewhat lower alpha was not

TABLE 2: Zero-Order Correlations Between Outcome and Predictor Measures

Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Crime	1.00	0.33*	0.27*	0.12	0.19*	0.18*	–0.04	0.11	0.10	–0.19*	–0.01
2. TA		1.00	0.25*	0.16*	0.16*	0.26*	–0.16*	0.21*	0.22*	–0.23*	–0.09
3. Physab			1.00	0.50*	0.53*	0.49*	–0.39*	0.04	0.04	0.06	0.07
4. Domvio				1.00	0.30*	0.47*	–0.33*	–0.09	–0.09	0.07	0.07
5. Spank					1.00	0.30*	–0.23*	0.08	0.07	–0.04	0.09
6. Verbal						1.00	–0.46*	0.03	0.03	0.05	–0.05
7. Love							1.00	0.06	0.07	–0.07	–0.02
8. Gameviol								1.00	0.98*	–0.51*	–0.18*
9. Graphviol									1.00	–0.52*	–0.15
10. Gender										1.00	0.16*
11. Ethnicity											1.00

Note. $n = 428$. Crime = violent crime ratings; TA = trait aggression; Physab = exposure to physical abuse; Domvio = exposure to family domestic violence; Spank = family of origin's use of spanking; Verbal = exposure to verbal abuse; Love = perceptions of parental affection; Gameviol = exposure to violent video games; Graphviol = exposure to violent game graphics (note multicollinearity with game violence).
*$p \leq .001$

unexpected. As such, a Guttman split-halves reliability was also calculated, with a resultant score of .73.

PROCEDURE

Participants were approached in undergraduate classrooms and invited to participate in exchange for extra credit and provided with an informed consent form. Total administration time for the questionnaires was approximately 1 hour.

Results were analyzed using hierarchical multiple regressions. In addition to main effects for predictor variables, interactions between aggressive personality and violent-video-game exposure will also be examined because of these effects demonstrating relevance in previous literature (Anderson & Dill, 2000). The continuous variables included in interaction cross-products will first be centered to improve interpretability, as recommended by Keith (2006). A structural equation modeling (SEM) approach will also be applied to examine the relative goodness of fit of the current data to the GAM and catalyst models. The SEM was conducted using the Statistica software package.

STUDY 2: RESULTS

DEVELOPMENT OF TRAIT AGGRESSION

Simple bivariate correlations (Bonferroni corrected minimum p value for significance set to $p = .001$) between trait aggression, violent criminal acts, and the various predictor variables are presented in Table 2. As can be seen from these results, video-game-violence exposure is related to trait aggression ($r = .21$) but not violent crime ($r = .11$). The following analyses will examine whether the aggression–video games relationship holds once gender and family violence have been controlled.

To examine the GAM and catalyst theoretical models, a hierarchical multiple regression was used with gender and ethnicity entered on the first step, the exposure to family violence

TABLE 3: Trait Aggression Regression: Beta Weights and Significance of Entered Variables

Variable	b	β	t *Test*	*Significance*
Constant	38.88		12.16	.001*
Gender	–3.84		–3.56	.001*
Ethnicity	–.50	–.05	–1.14	.260
Physical abuse	1.57	.14	2.32	.020*
Domestic violence	0.17	.03	0.57	.570
Spanking	0.19	.02	0.42	.680
Verbal abuse	0.92	.16	2.84	.005*
Parental affection	–0.80	–.09	–1.73	.080
Video game violence	0.04	.09	1.61	.110

Note. β = standardized regression coefficient.
*$p \leq .05$.

variables entered on the second step, and exposure to video game violence entered on the third step, with trait aggression as the outcome variable. Results indicated a positive predictive relationship, $R = .42$ ($R^2 = .18$), which was statistically significant, $F(8, 413) = 11.27$, $p \leq .001$. An examination of standardized coefficients (β or beta-weight; see Table 3) illustrates the relative contribution of the predictor variables in the regression model. Note that gender, as a dichotomous variable, cannot be meaningfully standardized and, because female gender was coded higher than male, a negative *b* indicates higher results for male gender. Results indicated that male gender ($b = –3.84$) and exposure to verbal abuse (β = .16) were significant predictors of trait aggression, as was physical abuse (β = .14). Exposure to violent video games, or other forms of family violence (spanking, witnessing domestic violence, perceptions of parental love), was not predictive of trait aggression. Results indicated that male gender was the strongest predictor of aggression score, with physical and verbal abuse also predictive of increases in aggression score. Other variables, including video-game-violence exposure, did not predict increases in aggression score. This model accounted for 18% of the variance in aggression scores. Collinearity statistics were satisfactory with no tolerance levels less than .5 and no VIF levels greater than 1.9.

DEVELOPMENT OF VIOLENT CRIMINAL BEHAVIOR

The next step was to examine which variables actually predicted the commission of violent crimes. The catalyst model suggests that trait aggression provides the most direct route, whereas the GAM model suggests that a direct route can be traced through exposure to violent video games irrespective of trait aggression. In this hierarchical multiple regression, gender and ethnicity were entered on the first step, exposure to family violence variables were entered on the second step, exposure to video game violence was entered on the third step, trait aggression was entered on the fourth step, and the interaction between trait aggression and video-game-exposure variables was entered on the fifth step. Frequency of violent crimes was the outcome variable.

Results indicated a positive predictive relationship, $R = .47$ ($R^2 = .22$), which was statistically significant, $F(10, 411) = 11.62$, $p \leq .001$. Male gender ($–b = 1.62$) and exposure to physical abuse (β = .22) were significant predictors of violent criminal behavior, as was trait aggression (β = .25) and the perception of parental affection (β = .11). The interaction between trait aggression and video game exposure was also a significant predictor (β = .19),

TABLE 4: Violent Crime Regression: Beta Weights and Significance of Entered Variables

Variable	b	β	t *Test*	*Significance*
Constant	–3.07		–1.97	.050*
Gender	–1.62		–3.56	.001*
Ethnicity	.07	.02	0.38	.710
Physical abuse	1.03	.22	3.66	.001*
Domestic violence	–0.03	–.01	–0.25	.810
Spanking	0.05	.01	0.26	.780
Verbal abuse	0.17	.07	1.23	.220
Parental affection	0.41	.11	2.11	.040*
Video game violence	–0.02	–.10	–1.77	.080
Trait aggression	0.11	.25	5.18	.001*
TA/VGV	0.01	.19	4.04	.001*

Note. β = standardized regression coefficient; TA/VGV = Trait Aggression × Video Game Storyline Violence Exposure interaction.
$*p \leq .05$

whereas direct exposure to violent video games itself was not. These results are plotted in Figure 2. This was done by breaking trait aggression and video-game-violence exposure into quartiles. As can be seen in Figure 2, exposure to violent video games had little effect on players, with the exception of players among the top quartile in regards to trait aggression. As video game exposure itself was not related to aggressive personality development, it is likely that this interaction reflects a subtype of aggressive individuals who are both prone to violent behavior and enjoy violent entertainment. Collectively, these results suggest that trait aggression and exposure to physical abuse are the best predictors of violent crime. Male gender and the interaction between trait aggression and video game exposure were also significant predictors. This model accounted for 22% of the variance in violent crime. Exposure to violent video games or other forms of family violence (e.g., spanking, witnessing domestic violence, verbal abuse) was not predictive of violent crime. Collinearity statistics were satisfactory, with no tolerance levels less than .5 and no VIF levels greater than 1.9. Table 4 presents the beta-weights and significance levels for all entered variables.

SEM: COMPARING THE GAM AND THE CATALYST MODELS

To examine the relative goodness of fit of the current data to the GAM and catalyst models, an SEM (maximum likelihood) approach was employed. The GAM model was built in accordance with that presented in Anderson and Dill (2000). In this model, exposure to violent video games leads to the formation of an aggressive personality and that aggressive personality leads to violent criminal acts. Thus, the causal model tested in the current analysis examined a causal pathway through video-game-violence exposure variables to aggressive personality to violent criminal acts. As family violence exposure and gender were not included in the GAM, they were not included in this causal model.

Although the catalyst model agrees that aggressive personality is the causal agent for violent crime, this model suggests that the origins of aggressive personality lie in exposure to family abuse and biological sex. Thus, this causal model tested a pathway through biological sex coupled with physical and verbal abuse exposure (as significant predictors in the regression equations) through aggressive personality and the commission of violent crimes.

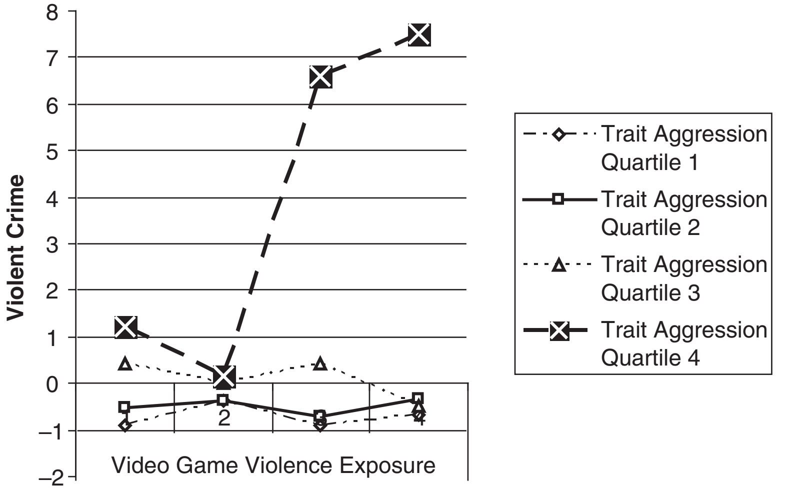

Figure 2: Trait Aggression and Video Game Interaction

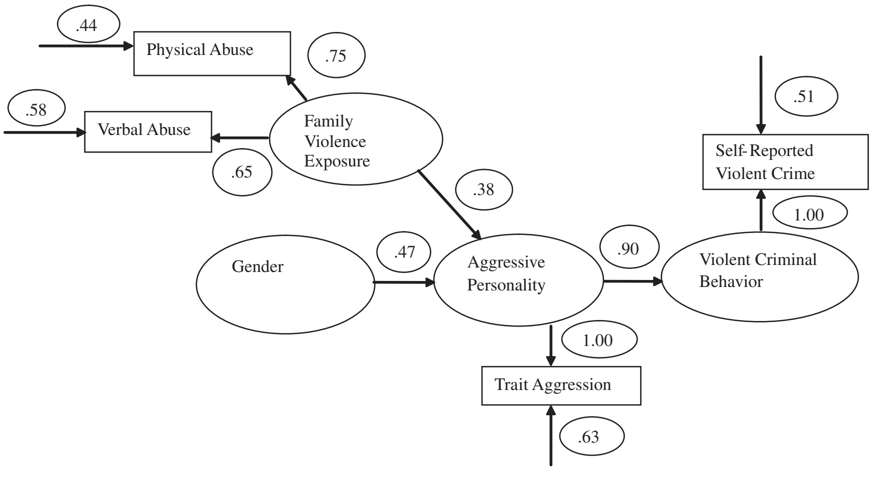

Figure 3: Elements of the Catalyst Model: SEM Results

SEM can be used to examine the relative goodness of fit of competing models to a given set of data. Goodness of fit can be demonstrated both through a nonsignificant chi-square analyses and several goodness-of-fit indices such as the nonnormed fit index and the adjusted population gamma index (APGI; see Lance & Vandenberg, 2002, for a discussion of goodness-of-fit indices). Goodness of fit is indicated by either a nonsignificant chi-square or by fit indices of .90 or greater. The root mean squared error of approximation (RMSEA) is often suggested as one of the better fit indices, as it is less sensitive to sample size (Schermelleh-Engle, Moosbrugger, & Muller, 2003). An RMSEA value less than .10 is considered an indication of good fit. Table 5 presents the two models side by side, allowing for a comparison of results for the goodness-of-fit indices. As can be seen, although both

TABLE 5: Structural Equation Modeling Results

Model	χ^2	p *Value*	*NNFI*	*CFI*	*RMSEA*	*APGI*
General aggression model	4.22 (1)	.04	.99	.99	.09	.84
Catalyst model	5.30 (4)	.26	.99	.99	.03	.96

Note. Chi-square degrees of freedom are in parentheses; χ^2 = chi-square statistic; NNFI = nonnormed fit index; CFI = comparative fit index; RMSEA = root mean squared error of approximation; APGI = adjusted population gamma index.

models demonstrated a good fit to the data (with the exception of the APGI, which indicated that the GAM was not a good fit), the results obtained by the catalyst model are a better fit to the data on most goodness-of-fit indices, particularly the chi-square analyses and RMSEA, as well as the APGI, although results for other goodness-of-fit indices were similar. These results suggest that the catalyst model is better supported by the current data. Figure 3 presents the path model analyzed in this study in support of the catalyst model. Please note that all parameter estimates in this model were significant at the $p < .001$ level.

DISCUSSION

In this study, once exposure to family violence was controlled, direct exposure to violent video games did not hold any predictive power regarding the commission of violent crimes. The results did suggest, however, that the interaction between aggressive personality and violent-video-game exposure is predictive of violent crime. Given that video game exposure does not have a direct effect on criminally violent behavior or aggressive personality, but aggressive personality (both directly and through an interaction with video game exposure) does predict violent crime, this is suggestive that some aggressive individuals are actively seeking out (rather than passively modeling) examples of violence. This is consistent with the catalyst model's prediction of violent behavior fueled directly by trait aggression, with aggressive individuals actively seeking out media models to act as a stylistic catalyst. By contrast, the GAM advocates a direct, causal media effect, which was not found in these analyses. As video game exposure did not predict the development of trait aggression, the hypothesis that video game exposure increases aggressive tendencies can be ruled out. Therefore, it appears to be that there is a subset of highly aggressive individuals who are both highly violent and also show a marked preference for violent entertainment, which is consistent with the catalyst model. As such, these results support the catalyst model and do not support the GAM. Family violence exposure, particularly exposure to verbal and physical abuse (but not spanking), remained a predictor of trait aggression as well as violent criminal acts. Furthermore, SEM demonstrated that the catalyst model had a better fit to the current data than did the GAM. Thus, the results described here are more supportive of the catalyst model than the GAM.

These results call into question whether a person's propensity toward violent crimes can be predicted based on their direct exposure to violent-video-game play. Although such a relationship would not necessarily have been causal, these results refute that players of violent video games can be categorized as being prone to violent criminal acts. Instead, some aggressive individuals may be influenced to commit violent acts through a combination of biological and family violence exposure factors and may also choose to play violent video games, perhaps using these as a stylistic catalyst.

GENERAL DISCUSSION

The two studies discussed above examined the link between violent-video-game playing and violent or aggressive acts in both the laboratory and in real life. No link, either causal or correlational, was found between violent-video-game playing and aggressive or violent acts. Males were generally more aggressive than were females. Some aggressive individuals appeared to self-direct toward choosing violent video games, perhaps to use these as a stylistic catalyst for violent crimes.

The research presented here builds on, and contrasts with, the existing research in several ways. Regarding the experimental study, the current analysis presented a standardized and reliable method of measuring aggression using the TCRTT. This study also examined not only short-term exposure to violent video games but also previous lifetime exposure to violent video games, which had not been done in previous studies. Neither short-term laboratory exposure nor long-term real-life exposure were related to aggressive behaviors in the lab. Although this appears to contradict much of the previous literature (however, a close examination of Anderson & Dill, 2000, suggests that study found no effect either), these results can be understood by noting that this is the first study to use a standardized version of the TCRTT. It may be likely that had the TCRTT been standardized across all other studies, many of them would have failed to produce positive findings as well. This, indeed, is the reason why standardized measurement is important for a construct of such critical importance as aggression.

Regarding the correlational study, this study was the first to include measures of family violence exposure as well as violent-video-game exposure. Previous correlational research on violent video games is fairly contradictory; thus, the current results are not necessarily different from previous findings. However, our results suggest that once family violence and aggressive personality are controlled, violent-video-game exposure is not predictive of violent crimes.

Findings from the two studies were mutually supportive. These results suggest that playing violent video games does not constitute a significant risk for future violent criminal acts. Because there was no evidence in either study to support a direct link between video game exposure and aggressive or violent behavior, these results call into question the GAM as a useful predictive model of aggression. It may be more useful to turn to broader models of aggression, such as the catalyst model, that include family violence exposure, personality, and genetic risk, to better understand the etiology of violence. Study 2, in particular, supported the view that violent crime can best be explained through a combination of innate personality factors, gender, and family violence exposure. It may be that genetics sets a range of possible outcomes in regards to violent behavior, with exposure to family violence determining the specific outcome.

In this article, it is argued that the pathway to violent criminal acts occurs through a combination of innate propensity (e.g., genetics or brain injury) and exposure to violence in the family. Media violence, particularly video game violence, may have limited or no causal role. These results are important as they suggest that preventative efforts regarding violent crime should focus on the family and reducing parental abuse of children. This is the one part of the catalyst model pathway that has both empirical support and relative potential to react to preventative efforts. Genetic elements of the catalyst model, although supported both by the current research and by twin studies (Eley et al., 2003; Hines & Saudino, 2004; Larsson et al., 2006), are less obviously amenable to intervention.

Future research efforts should examine whether the link between parental-physical-abuse exposure and the development of aggressive personality (and subsequent violent crime) is learning based or biological in nature. Previous twin studies (Eley et al., 2003; Hines & Saudino, 2004; Larsson et al., 2006) have suggested that even this link may be genetic, more so than learned. If this is so, can this link be effectively targeted through preventative measures? Further, the media violence link itself should be examined through twin methodology. Once genetics are included in the equation, does media violence or family violence retain any predictive value regarding violent criminal acts? Study 2 also identified a subset of highly aggressive individuals who both engaged in violent criminal behavior and also consumed highly violent media. Future research may need to examine why some highly aggressive individuals engage in violent behaviors and others do not. These results suggest the potential for separate biological mechanisms for aggression and for aggressive impulse control, though much more research is needed to understand how these dual processes may function and interact.

The catalyst model described here would benefit from further research. In particular, the twin research described above would be useful in determining whether the pathway described in the catalyst model is correct. Furthermore, if environmental stress provides a "catalyst" for violent acts, what prevention measures can be undertaken with those predisposed to violence to ensure that the frequency of such acts is reduced?

School shootings, such as the infamous Columbine massacre, invariably tempt laypersons and scientists alike to draw conclusions between exposure to violent video games and violent crimes. Yet if violent-video-game exposure is fairly common, drawing such a link may be spurious without clear, consistent evidence to support such a link. It is possible that, at times, science itself may be caught in a "moral panic," wherein it is tempting to conclude that a difficult problem is caused by an easily remedied issue. If violence is genetic, undoing its effects will be exceedingly difficult. However, if violence is because of video games, then the solution is evident: Eliminate the games. The influence of the arts on the immoral actions of individuals (whether violent, sexual, political, or religious) has likely always inflamed public opinion. Yet one generation's violent media becomes the next generation's literature, and our fundamental biology, innately aggressive as it sometimes may be, continues.

NOTE

1. The alternative, "active modeling," by contrast implies an internal motive that drives an individual to seek out a modeling experience so as to better perform a specific task or behavior.

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