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The effect of the amount of blood in a violent video game on aggression, hostility, and arousal

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Abstract

The current study utilized the General Aggression Model, with an emphasis on aggression-related priming, to explore the different effects on hostility, physiological arousal, and state aggression in those who played a violent video game (*Mortal Kombat: Deadly Alliance*) with differing levels of blood (maximum, medium, low, and off). Simple effects analyses showed that those in the maximum blood and medium blood conditions had a significant increase in hostility and physiological arousal, while those in the low blood and no blood conditions did not have such an increase in arousal and hostility. Further analyses indicated that those in the maximum and medium blood conditions used the character's weapon significantly more often than those in the low and blood absent conditions. Implications and future research are discussed.

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Over two decades of research has been conducted on the effect that violent video games have on aggression (see [Bensley & van Eenwyk, 2001](#) for review). Overall, this literature shows that those who play a violent video game will demonstrate increases in aggression, defined as the intent to harm someone who is motivated to avoid that harm ([Anderson & Bushman, 2001](#)). These findings have been shown in a laboratory setting with a college-age sample (e.g., [Anderson & Dill, 2000](#)) and field settings with children (e.g., [Schutte, Malouff, Post-Gordon-Joan, & Rodasta, 1988](#)). Recently, [Bushman and Huesmann \(2006\)](#) found that children are less likely to demonstrate short-term effects to violent media because their associative memory network is underdeveloped relative to college-aged participants.

General Aggression Model

The General Aggression Model (GAM) posits that person factors (e.g., gender, exposure to violence) and situa-

tional factors (e.g., playing a violent video game) influence an individual's internal state variables (physiological arousal, feelings, and thoughts), which interact with one another. All three of these internal state variables lead to a decision process, which leads to behaviors that are aggressive ([Anderson, 2004](#); [Anderson & Bushman, 2001](#); [Anderson, Gentile, & Buckley, 2007](#); [Bushman & Anderson, 2002](#); [Carnagey & Anderson, 2003](#); [Kirsh, 2003](#)).

An important process within the GAM is aggression-related priming. Constant exposure to violence causes more aggressive thoughts to be activated in memory ([Geen, 1990](#)). These thoughts activate other aggressive thoughts in memory, which continues until an entire network of aggressive thoughts is produced. Research by [Anderson, Benjamin, and Bartholow \(1998\)](#) found that those who were exposed to aggressive words (e.g., “kill” and “fight”) had more aggressive thoughts than those who were exposed to neutral words (e.g., “narrate” and “desert”), suggesting that strong semantic associations are produced in memory which lead to more aggressive thoughts.

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Factors in video games and aggression

Research has identified factors within video games that can influence aggression, besides the content. The presence of blood is one factor that may activate more aggressive nodes in the associative network, thus increasing aggression (Ballard & Wiest, 1996). Recently, Farrar, Kremer, and Novak (2006) found those who played a violent video game with the blood present had higher levels of physical aggression intentions than those who played the same video game without the blood. Overall, these two studies suggest that the presence of blood in a video game does significantly increase aggression¹.

Overview of the current studies

Within the context of culture and the mass media, there is an abundance of blood shown on television (Martin, 2003) and video games (Anderson, 2003). Prime-time television shows, such as *CSI*, and video games, such as *Grand Theft Auto*, depict many violent behaviors and emphasize such actions with blood, with more blood being indicative of more violence. Thus, in today's mass media culture, blood means a violent act just occurred, and the aggression-related priming hypothesis (Geen, 1990) would suggest that blood may activate more aggressive thoughts.

What effect does the amount of blood have on aggression and arousal? Past research has not been able to investigate the effects that differing levels of blood in a violent video game have on aggression, beyond comparing blood absent versus blood present conditions. However, recent video games allow for more such comparisons to be made.

Study 1

The current study will compare four levels of blood to one another and blood present compared to blood absent conditions on aggression and arousal. Theoretically, those who play the video game with the highest amount of blood should have the highest activation of aggressive-related thoughts. All participants should have activation in their associative network because the video game is violent, however, the presence of blood (especially high amounts) should lead to further activation of the aggressive nodes, which will lead to the increase in the internal state variables in the GAM. Based on the past literature, the following research questions and hypotheses were derived:

¹ A possible limitation to Ballard and Wiest (1996) is the low sample sizes across conditions. Ballard and Wiest (1996) had ten subjects per condition. Thus the current studies will have similar sample sizes across conditions in order to attempt to replicate the findings from Ballard and Wiest (1996). Due to the anticipated low sample size for each condition, any non-significant results in the current studies will still be followed up by appropriate statistical tests, because any non-significant findings may be a function of low statistical power.

RQ1: Will hostility and arousal significantly increase over time for all participants who play a violent video game?

H1: There will be a significant increase in hostility and physiological arousal for all participants, independent of condition.

This is predicted because the participants are playing a violent video game. Therefore, all participants should show an increase in hostility and arousal, as predicted by the GAM.

RQ2: Will those in the maximum blood condition have greater increases in hostility and arousal than those in other conditions?

H2: There will be a significant time by condition (maximum blood, medium blood, low blood, and blood absent) interaction on hostility and physiological arousal.

It is predicted that those in the maximum blood condition will have the most increase in hostility and arousal. Further, those in the medium blood condition will have a greater increase in hostility and arousal than the low and blood absent conditions.

RQ3: Will those who play the violent video game with blood have a greater increase in hostility and arousal than those who do not play the game with blood?

H3: There will be a significant time by condition (blood present and blood absent) interaction on each of hostility and physiological arousal.

This is predicted based off of the results of Ballard and Wiest (1996), and Farrar et al. (2006). The test for this hypothesis is a planned comparison between the maximum, medium, and low conditions compared to the blood absent condition.

RQ4: Will the amount of blood in a violent video game impact the amount of time playing the game using the character's weapon?

H4: The more blood present in the video game will lead to the player using the character's weapon more frequently.

Method

Participants

Seventy-four (65 male) participants from a large Midwestern University participated in the current study. The average age for these participants was 19.43 ($SD = 1.14$) years. Since frequently video game players were specifically recruited for this study, all participants played video games an average of 16.51 ($SD = 20.77$) hours per week. High video game playing participants were sampled because

the current researcher wanted to be able to generalize the findings from the current study to those who play video games frequently. The majority of the sample was Caucasian (79.7%), freshman (62.2%) undergraduates. All participants received partial course credit for their General Psychology class.

Materials

Equipment. The video game that was used was *Mortal Kombat: Deadly Alliance* for the PlayStation 2. This is a violent fighter video game and the objective is to use martial arts to defeat an opposing character. This game uses a best-out-of-three win system, in which the player must win two out of three rounds to advance to the next character, which is progressively harder. The maximum time limit for each round is 60 s.

This game was selected because the researcher could manipulate four levels of blood (maximum, medium, low, and absent). In the maximum blood level, when any character is hit, a number of units of blood would be expelled and fall onto the ground. The more severe the hit, the more blood would be expelled. Also, blood would be dripping from the character's body after certain hits were landed. Finally, the blood on the ground would stay there and accumulate, and when a character stepped on the blood, they would track the blood onto other locations. In the medium blood level, it was more difficult for the blood to be expelled. It took a harder hit to equal the same amount of blood expelled in the maximum blood condition. The low condition did not have any blood drip from the body or land on the ground. Blood would only be expelled in low amounts after an extremely hard hit. Therefore, the low condition was identical to the blood absent condition with the exception of the small amounts of blood that would be expelled.

Second, the player was able to choose when the character's weapon was used. All fighters had three different fighting styles. The first two were martial arts-based (e.g., karate) and the third was a weapon-based fighting style, and the players could wield the weapon that every character had (e.g., broad sword). The player could choose to use whichever fighting style for as long as they wanted.

Trait aggression. The Buss and Perry (1992) Aggression Questionnaire was used to measure trait aggression. This is a 29-item questionnaire which asked participants to respond to various questions on a 1 (*not characteristic of me*) to 5 (*extremely characteristic of me*) Likert Scale. A sample item included, "Once in awhile, I cannot control the urge to hit another." The total range for this scale was 29–145 and certain items were reverse coded, such that higher scores were indicative of higher trait aggression. The reliability for this scale for the current study was acceptable ($\alpha = .79$).

Aggressive feelings/thoughts. Hostility can be conceptualized as a feeling and a thought internal state variable

within the GAM. Therefore, hostility served as both a thought and a feeling. The State Hostility Scale (Anderson, Deuser, & DeNeve, 1995) was used to measure state hostility. This is a 35-item questionnaire which asks participants to respond on a 1 (*strongly disagree*) to 5 (*strongly agree*) Likert Scale. The possible range for this scale is 35–165, with higher scores being indicative of higher state hostility. Sample items include, "I feel furious" and "I feel mean." The reliability of this scale for the current study was acceptable for both times this scale was administered ($\alpha = .84$ for baseline and $\alpha = .94$ for post-video game).

Aggressive behaviors. Aggressive behaviors were measured by using the ratio of total weapon time to total game playing time in the game. We justified this measure as a gauge of aggressive behavior two ways. The first is that the participants got to choose how long they wanted to use the character's weapon. All participants were told that the use of the weapon causes more damage. If they decided to use the weapon more, that suggests that they want to cause more damage to their opponent, which fits with the operational definition of aggression. Therefore, the number of seconds spent with their weapon and the time each round was played was recorded, with a higher ratio of time with a weapon being indicative of aggressive behavior. Second, past research has used other such measures to assess aggressive behavior (Anderson & Morrow, 1995; Lin & Lepper, 1987). Although this is not an overt measure of aggressive behavior (like the CRT), this measure is not confounded by demand characteristics because the participants do not know that the amount of time using the weapon is an important variable.

Physiological arousal. Heart rate was the measure of physiological arousal. The device (produced by Tanita) instructed users to place their right index finger on a sensor and take a reading three times and then average them to get a reliable reading.

Demographics. A demographic questionnaire was used to assess participant's age, gender, ethnicity, and year in school. Further, questions were used to assess the video game experiences, such as the number of hours spent playing video games weekly, whether or not they have played the game used in the current study, and if they own a video game system.

Suspiciousness questionnaire. A suspiciousness questionnaire was implemented to determine if the participants knew the purposes of the study before they were debriefed. Two 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. No participants were excluded from the main analyses because of their knowledge about the exact variables of interest.

Table 1
Correlations for the positive and negative performance variables in Study 1

	1	2	3	4	5	6	7
1. Avg. time to get past opponents	—	−0.39**	−0.24*	−0.42**	−0.39**	−0.32**	−0.49**
2. Rounds won		—	0.22	0.86**	0.88**	0.29*	0.85**
3. Rounds lost			—	0.69**	0.06	0.71**	0.12
4. Rounds played				—	0.69**	0.59**	0.69**
5. Players beat					—	0.06	0.90**
6. Times died						—	0.21
7. Fighters gotten to							—
Mean	31.71	10.59	4.72	15.31	4.73	1.99	5.53
SD	4.63	1.90	1.34	2.55	0.94	0.63	0.98

* $p < .05$, ** $p < .01$.

Procedure

Upon completion of the informed consent sheet, participant's heart rate was measured. Then, participants completed the Aggression Questionnaire and the State Hostility Scale. Participants were randomly assigned to one of four conditions (maximum blood, medium blood, low blood, or blood absent). The video game was set up in a practice mode in which participants would fight as one character against a static character for approximately 3 min. Within this 3-min time frame, the participants were instructed to become familiar with the functions of each button. After the participants were ready to proceed, the researcher allowed them to play the video game with the appropriate blood level for their condition and to select one, of twelve possible characters to play as for the entire experiment.

The researcher began to record performance, while the participants played the video game for 15 min. After the 15-min time period, heart rate was measured, then the State Hostility Scale, the demographic questionnaire, and suspiciousness questionnaire were completed. Participants were then thanked and fully debriefed.

Results

Performance

Analysis of the performance variables showed that it took participants 31.71 (4.63) seconds to play each round, won an average of 10.59 (1.90) rounds, played 15.31 (2.55) total rounds, and defeated 4.73 (0.94) opposing characters of the 5.53 (0.98) opponent reached. Correlations between all performance variables showed that the number of rounds lost and the number of rounds won did not significantly correlate with one another, $r = .22$, $n.s.$, the number of players beaten significantly correlated with number of rounds won, $r = .88$, $p < .0001$, and all variables were negatively correlated with the average time to beat an opponent (see Table 1).

Trait aggression

A one-way analysis of variance (ANOVA) was conducted on the scores of the Aggression Questionnaire.

The results showed that there were no significant differences between the four groups, $F(3, 73) = 0.55$, $n.s.$

State hostility²

To test the first hypothesis, a 2 (time) \times 4 (condition) mixed ANOVA was conducted, which revealed a significant main effect for time, $F(1, 67) = 10.34$, $p < .003$, $d = .37$. Specifically, there was a significant increase in hostility from baseline ($M = 65.35$, $SD = 14.02$) compared to after the video game was played ($M = 69.94$, $SD = 17.94$), thus supporting the first hypothesis (see Table 2).

To test the second hypothesis, a 2 (time) \times 4 (condition) mixed ANOVA showed that there was a significant time by condition interaction, $F(3, 67) = 5.03$, $p < .004$, $d = .19$. Simple effects analyses showed that there was a significant increase in hostility for the maximum blood, $F(1, 67) = 21.13$, $p < .001$, $d = .98$, and the medium blood, $F(1, 67) = 4.43$, $p < .05$, $d = .48$, conditions. Non-significant increases were found for the low blood, $F(1, 67) = 0.01$, $n.s.$, and blood absent conditions, $F(1, 67) = 0.12$, $n.s.$, conditions (see Table 2).

The third hypothesis compared the hostility between those who saw blood (maximum, medium, and low conditions) compared to those participants who saw no blood. A 2 (time) \times 2 (condition) mixed ANOVA showed a significant time by condition interaction, $F(1, 69) = 5.09$, $p < .03$, $d = .61$. Simple effects analyses showed that there was a significant hostility change for the blood conditions, $F(1, 69) = 14.56$, $p < .001$, $d = .56$, and a non-significant hostility change for the no blood condition, $F(1, 67) = 0.12$, $n.s.$

² As a supplemental analysis, all hypotheses were tested using a linear contrast for the state hostility and physiological arousal data. The following weights were given to each condition: no blood -3; low blood -1; medium blood 1; and maximum blood 3. One-way analyses of covariance (ANCOVAs) were conducted with Time 1 measures as the covariate and the condition as the independent variable. The results showed a significant main effect for condition on state hostility at Time 2, $F(3, 66) = 4.98$, $p < .01$, $partial \eta^2 = .19$. However, there was a non-significant main effect for condition on physiological arousal, $F(3, 66) = 1.16$, $n.s.$. Therefore, further results of analyses using the physiological data need to be interpreted with some degree of caution.

Table 2
Mean scores for each variable by conditions and time in Study 1

Condition	State hostility (T1)	State hostility (T2)	Arousal (T1)	Arousal (T2)
Maximum	63.68 (14.00) ^a	76.21 (21.49) ^b	64.86 (21.72) ^a	77.82 (14.68) ^b
Medium	67.63 (12.65) ^a	73.88 (15.02) ^b	75.00 (13.87) ^a	75.22 (14.58) ^a
Low	67.94 (12.87) ^a	68.29 (14.58) ^a	74.26 (11.87) ^a	75.66 (16.34) ^a
Off	62.79 (16.36) ^a	61.84 (16.90) ^a	72.87 (12.96) ^a	74.82 (14.54) ^a
Total*	65.35 (14.02) ^a	69.94 (17.94) ^b	71.38 (16.00) ^a	75.93 (14.78) ^b
Blood	66.29 (13.12) ^a	72.90 (17.54) ^b	71.07 (17.03) ^a	76.31 (14.97) ^b
No Blood	62.79 (16.35) ^a	61.84 (16.90) ^a	72.28 (12.96) ^a	74.82 (14.54) ^a
Total*	65.35 (14.02) ^a	69.94 (17.94) ^b	71.38 (16.00) ^a	75.93 (14.78) ^b

*Significant group by dependent variable interaction, $p < .05$.

Means with differing superscripts indicate significant differences based on simple effects analyses (read horizontally), $p < .05$.

Table 3
Total weapon time for each condition in Study 1

Condition	Weapon to total time ratio
Maximum	0.49 (0.17) ^a
Medium	0.56 (0.33) ^a
Low	0.41 (0.22) ^b
Off	0.35 (0.17) ^b
Total	0.45 (0.24)*
Blood	0.48 (0.25) ^a
No Blood	0.35 (0.17) ^b
Total	0.45 (0.24)*

*Significant difference, $p < .05$.

Means with differing superscripts indicate a significant difference, $p < .05$.

Physiological arousal²

Prior to analysis of the heart rate, means had to be calculated for the three measurement times. The output on the heart rate device, however, was partially dependent upon the amount of pressure the participants put on the device. For example, a participant may receive scores of 73, 78, and 76, but other times have scores of 78, 89, and 156. Two rules were devised in order to deal with such inconsistent outputs. The first was to take the average of the two closest numbers if one of the three scores was an outlier score (a difference of over ten beats per minute). For example, if the scores were 73, 78, and 100, then the average of 73 and 78 were taken. The second was that if all three numbers had a difference of ten from one another, then only the middle number was used. For example, if the three scores were 62, 83, and 102, the score of 83 was used. This was done to reduce the possible measurement errors associated with this heart rate device.

To test the first hypothesis, a 2 (time) \times 4 (condition) mixed ANOVA was conducted. The results showed that there was a significant change in heart rate over time, $F(1, 70) = 5.44$, $p < .03$, $d = .27$. Examination of the means and standard deviations reveal a significant increase in arousal from baseline ($M = 71.38$, $SD = 16.00$) to after the video game play ($M = 75.93$, $SD = 14.78$), thus supporting the first hypothesis (see Table 2).

To test the second hypothesis, the results from a 2 (time) \times 4 (condition) mixed ANOVA showed a significant

time by condition interaction, $F(3, 70) = 2.67$, $p = 0.05$, $d = .19$. Simple effects analyses showed that only those in the maximum blood condition had a significant increase in physiological arousal, $F(1, 70) = 13.55$, $p < .001$, $d = .42$. The other three groups had a non-significant increase in heart rate over time, all F 's < 1.00 .

To test the third hypothesis, a 2 (time) \times 2 (condition) mixed ANOVA was conducted which found a non-significant time by condition interaction, $F(1, 72) = 0.39$, $n.s.$ Despite the non-significant result, simple effects analyses were conducted in order to determine if any of the groups did have a significant increase in heart rate. This is an appropriate analysis to conduct because it has been suggested that the simple effects analysis for a non-significant omnibus F test is a more powerful test (Howell, 2002; Keppel & Zedeck, 1989; Myers & Well, 1995). The results showed that those in the blood conditions had a significant increase in arousal, $F(1, 72) = 5.65$, $p < .05$, $d = .27$, while those in the no blood condition did not have a significant increase in arousal, $F(1, 72) = 0.46$, $n.s.$

State aggression

To test the fourth hypothesis a one-way ANOVA was conducted with the condition as the fixed factor and the state aggression measure as the dependent variable. These analyses show that there was a significant main effect for condition for ratio of weapon time to total time, $F(3, 70) = 3.08$, $p < .05$, $d = .21$. Post hoc analysis revealed significant differences ($p < .05$) between those in the maximum and medium blood conditions and the low/blood absent conditions (see Table 3).

A second one-way ANOVA was conducted to determine if those in the blood conditions (maximum, medium, and low blood) would significantly differ from those in the blood-absent condition on ratio of weapon time to total time. The results showed a significant main effect of condition, $F(1, 72) = 5.11$, $p < .05$, $d = .26$. Examination of the means and standard deviations show that those in the blood conditions used their weapon more ($M = .49$, $SD = .25$) than the blood absent condition ($M = .35$, $SD = .17$).

Study 2

The results of Study 1 suggest that those in the maximum and medium blood conditions had significantly more aggression and arousal than those in the low and blood absent conditions. The purpose of Study 2 was to determine if playing a game with maximum amount of blood would lead to more aggressive-related priming compared to the same game without any blood. The current study differed from Study 1 in a variety of respects. First, Study 2 sampled more females and non-video game players. Second, Study 2 had participants play with only the maximum or no blood conditions. Third, the Word Completion Task (Anderson, Carnagey, & Eubanks, 2003) was used to indicate the amount of aggressive-related priming. Finally, Study 2 did not use measures of aggressive feelings, arousal, and performance, as the goal of Study 2 was to only investigate aggressive-related priming. The following research question and hypothesis was derived:

RQ1: Will the amount of blood in a violent video game affect the number of aggressive thoughts in semantic memory?

H1: Those who played the violent video game with the maximum level of blood would be able to generate more aggressive thoughts than those who played the game without any blood.

If confirmed, this will show a relationship between the amount of blood and aggressive thoughts. Coupled with the results of Study 1, this will provide possible insight into why bloody video games increase aggression.

Method

Participants

Thirty-one (16 male) participants from a large Midwestern University participated in the current study. The average age for these participants was 18.53 ($SD = 0.73$) years. The average amount of time spent playing video games during the week was 5.18 ($SD = 5.39$) hours per week. The majority of the sample was Caucasian (83.9%), freshman (87.1%) undergraduates. All participants received partial course credit for their General Psychology class.

Materials

Equipment. Identical to Study 1, *Mortal Kombat: Deadly Alliance* for the PlayStation 2 video game system was used, however, only the maximum and no blood conditions were selected.

Questionnaires. There were four questionnaires used in the current study. Identical to Study 1, the Aggression Questionnaire (Buss & Perry, 1992) was used to measure trait aggression, the demographic questionnaire was used to assess participant's demographics and video game habits, and a suspiciousness questionnaire. No participants were

excluded from the main analyses because of their knowledge about the exact variables of interest.

To measure aggressive-related priming the Word Completion Task was utilized. This questionnaire contains 98 incomplete word fragments (half of which contain aggressive possibilities, half of which do not contain aggressive possibilities). For example, when presented with the word fragment "K I __", participants could complete this with an aggressive word (e.g., "KILL") or non-aggressively (e.g., "KISS"). This measure is scored by taking the number of aggressive thoughts divided by the total number of word fragments completed, creating a ratio of aggressive thoughts to total thoughts (Carnagey & Anderson, 2005).

Procedure

Upon completion of the informed consent and experimental credit cards, participants were randomly assigned to either the maximum or no blood conditions. Participants completed the Aggression Questionnaire and half of the Word Completion Task. After completing these questionnaires, the participants were given a brief tutorial on how to play the video game and played the game in the practice mode. Participants then played *Mortal Kombat: Deadly Alliance* for 15 min. After the 15-min of video game play, participants completed the other half of the Word Completion Task, the demographic questionnaire, and the suspiciousness questionnaire. Participants were then thanked and fully debriefed.

Results

Trait aggression

A 2 (condition) \times 2 (gender) ANOVA was conducted on the scores of the Aggression questionnaire. The results showed a non-significant main effect for condition, $F(1, 27) = 0.52$, *n.s.* However, there was a significant main effect for gender, $F(1, 27) = 5.18$, $p < .05$, $d = .40$, such that males were higher in trait aggression ($M = 68.69$, $SD = 16.80$) than females ($M = 53.80$, $SD = 14.15$). Therefore, trait aggression was statistically controlled for in the primary analyses.

Aggressive-related priming

A 2 (gender) \times 2 (condition) analysis of covariance (ANCOVA) was conducted with the ratio of aggressive thoughts to total thoughts at Time 1 as the dependent variable and trait aggression as the covariate. The results showed no main effect for gender or condition and no significant gender by condition interaction (all F 's < 1.00 , all p 's $> .05$).

To test the current hypothesis, a 2 (gender) \times 2 (condition) ANCOVA was conducted with the ratio of aggressive thoughts to total thoughts at Time 2 as the dependent variable and trait aggression as the covariate. In support of this hypothesis, these results show a significant main effect for condition, $F(1, 26) = 8.98$, $p < .01$, $d = .52$. These results show that those in the maximum blood condition

had a greater number of aggressive thoughts generated after playing the violent video game ($M = .28$, $SD = .07$) than those who played the video game without any blood ($M = .21$, $SD = .06$). All other main effects and interactions were not statistically significant.

Conclusion

The results showed that those who played a violent video game with the maximum level of blood present generated more aggressive thoughts. This effect was robust because this result remained significant when trait aggression was covaried. These results support the GAM and the aggression-related priming hypothesis by showing that video games with the most blood activated more aggressive-related thoughts.

General discussion

Results from Study 1 suggest that playing a violent video game does increase hostility and heart rate over time. This was predicted by the GAM and replicates the findings from previous work (e.g., Anderson & Dill, 2000; Bartholow & Anderson, 2002).³ Further analyses revealed the blood present conditions had a significant increase in arousal and hostility, while those in the blood absent condition did not have such an increase, which replicates past work (Ballard & Wiest, 1996; Farrar et al., 2006).

An advantage to Study 1 was that planned comparisons were used that could not be conducted in the past research. The first planned comparison was between all four levels of blood. As predicted, there was significantly higher arousal and hostility increases in the maximum blood condition compared to the other three. However, this analysis also showed that there were non-significant increases in hostility and arousal for the other conditions. The long-term GAM (Anderson & Bushman, 2001) states that those who view media violence frequently (as is the case with the heavy video game players in Study 1) may be desensitized to media violence. These participants who played the video game with no blood or low blood may think that this game is not as violent as some other games, which could explain these results.

The findings from this study also showed that those who saw more blood in the violent video game had an increase in state aggression, which was quantified by the ratio of weapon time to total time. Results showed that those in blood present conditions used the character's weapon more. This can be explained by the Weapons Effect (Berko-

³ Other theoretical models, besides the GAM, make similar predictions, and the results could support these other theories. Such theoretical models include: Excitation Transfer Theory (Zillmann, 1983), The General Arousal Model (Tannenbaum & Zillmann, 1975), Social Learning Theory (Bandura, 1994), and the Cognitive-Neoassociation Theory (Berkowitz, 1993). The GAM was selected as the theoretical model for these studies because the GAM incorporates aspects of these theories into the model (see Carnagey & Anderson, 2003).

witz & LePage, 1967) because the presence of a weapon is an aggression-eliciting stimulus. The weapon, the blood, and the violent content together facilitates the aggressive thoughts/feelings, physiological arousal, and aggressive behavior.

The results from Study 2 suggest that those who played the violent video game with the maximum level of blood had more aggressive thoughts activated in semantic memory than those who played the violent video game without blood. Overall, the results from Study 2 also support the findings from Study 1 by adding a test of aggressive-related priming.

Despite these results, the current studies do have some limitations. The first is that data transformations had to be used on the physiological arousal measurement, due to possible inaccurate estimates in Study 1. However, research has shown that the quality of the physiological device does not moderate the overall relationship between aggression and anti-social behavior (Ortiz & Raine, 2004). The data transformations were necessary in order to attempt to get reliable estimates of heart rate. Second, there were only 74 participants across four different conditions in Study 1, and 31 participants across two different conditions in Study 2. However, the current research used sample sizes that were comparable to those of Ballard and Wiest (1996).

One important strength of the current research was the use of a within-game experimental design. This was beneficial because this type of design allows for more experimental control than studies that use more than one game. Research has shown that different video games do have different parameters that can impact aggression. The use of a within-game experimental design rids the researcher of this potential source of error by having all the participants playing the same game.

Overall, the results showed that those who played the game with the highest blood levels had a significant increase in the aforementioned variables, while those in the blood absent condition did not have such increases. The aggression-related priming hypothesis, explains these findings by suggesting that the violence plus the high amount of blood primes more aggressive thoughts in memory compared to just playing the violent video game without the blood.

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