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College Men's Psychological and Physiological Responses Associated with Violent Video Game Play

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COLLEGE MEN'S PSYCHOLOGICAL AND PHYSIOLOGICAL RESPONSES ASSOCIATED WITH VIOLENT VIDEO GAME PLAY

by

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Under the Direction of Dr. Dominic Parrott

ABSTRACT

Research suggests that playing violent video games increases the likelihood of aggression. However, less clear is how individual characteristics influence the mechanisms that lead to aggression. Using Anderson and Bushman's (2002) General Aggression Model as a framework, the present study examined the independent and joint effects of individual differences and situational factors on affective and physiological reactivity to playing a violent video game. One hundred thirty-three participants completed self-report measures of trait aggression and violent video game exposure. They were randomly assigned to groups instructed to play a video game using either violent or nonviolent strategies while facial electromyography, heart rate, and electrodermal activity were measured. Positive and negative affect was assessed via self-report prior to and following video game play. It was hypothesized that trait aggression and level of past exposure to violent video games would be positively related to increases in physiological arousal and negative affect among participants in a violent, relative to a nonviolent, condition. Hierarchical regression analyses failed to detect a significant relationship between trait aggression and changes in heart rate, facial electromyography, or self-reported affect as a function of game condition. However, significant positive relationships were found between trait aggression and skin conductance, but only in the nonviolent condition. Analyses revealed that past exposure to violent video games was positively related to increased skin conductance among participants in the non-violent, but not the violent video game condition. Past exposure to violent video games was also positively related to increased heart rate, but this was among participants in the violent, but not the non-violent condition. Significant relationships between past exposure to violent video games and changes in facial electromyography and self-reported affect as a function of video game condition were not found. Findings are discussed in terms of how trait aggression and past exposure to violent video games influence arousal, and potentially, the likelihood of aggressive behavior.

INDEX WORDS: General Aggression Model, Video Games, Facial Electromyography, Heart Rate, Skin Conductance

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DEDICATION

This dissertation is dedicated to my extremely supportive family members, who encouraged me through good and bad times to succeed. I especially want to thank my wife Keisha, and my son Christopher, both of whom provided motivation to move forward. Thanks to you all.

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CHAPTER 1: LITERATURE REVIEW

College Men's Psychological and Physiological Responses Associated with Violent Video Game Play

In the 2002 video game *Grand Theft Auto: Vice City*, Tommy Vercetti, the main character, must complete several "missions", one of which involves entering a police station, killing several police officers, and stealing a police cruiser to escape. In 2003, an Alabama teenager, arrested for suspicion of stealing a car, killed two police officers and a dispatcher while at the police station and escaped in a police cruiser. After he was recaptured, he was quoted as saying, "Life is a video game. Everybody's got to die sometime" (60 Minutes, 2005). The families of the victims sued the companies involved in the production and sales of *Vice City*, drawing parallels between the shooting and the game, which the teen reportedly spent many hours playing. The attorney who represented the victims' families stated that the teen "…was in effect, trained to do what he did. He was given a murder simulator…the video game industry gave him a cranial menu that popped up in the blink of an eye, in that police station. And that menu offered him the split-second decision to kill the officers, shoot them in the head, flee in the police car, just as the game itself trained them (sic) to do."

It is evident that many view the playing of violent video games as being a cause for violence in modern society. Many opponents of violent video games have made efforts to outlaw their sales. In addition, there is a movement to create legislation that heavily regulates the content of these video games and individual's access to them. Video games, like other forms of popular new media, are oftentimes cited as explanations for why a person has committed a violent act.

Historically, viewing of violent television shows or violent movies has been seen as a possible cause for increasing aggressive behavior (Anderson, 1997). This begs the question of why violent video games have seemingly replaced such fare as a major source of blame for societal violence. One likely explanation involves the increasing popularity of video games. In the past decade, video games have become a major form of entertainment. Sales of video game software (not including actual game systems) in the United States alone reached 8.2 billion dollars in 2004, and are expected to reach 15 billion dollars by 2009 (Crandall & Sidak, 2006).

In addition, the playing of video games has become a mainstream activity. Although video games were enjoyed primarily by adolescent males years ago, recent data show a change in this trend. The Electronic Software Association (ESA), a leading consumer organization, has found that although young males comprise the largest group of video game players, both males and females enjoy video games, the average age of a video game player is 33 years old, and he or she has been playing video games for an average of twelve years. When both computer and console games are included, sixty-nine percent of heads of households play video games (ESA, 2006). With such a high level of popularity, it is evident that many people play and enjoy video games. Consequently, the public and policymakers have become increasingly concerned about the effects of exposure to violent games, especially games in which the player can use violence against others. This concern has led to a call for research to study the effects of violent video games on behavior.

Extant literature suggests that this concern is valid. Research has demonstrated that violent imagery in media, including video games, causes short-term increases in fearful and/or aggressive behavior among children (Browne & Hamilton-Giachritsis, 2005). The authors concluded that these effects were large enough to be considered a public health problem.

Anderson (2004) similarly compared the effect of violent video games on children to other public health threats. He concluded that the effect of violent video game exposure on aggression is "larger than the effect of condom use on decreased HIV risk, the effect of exposure to passive smoke at work and lung cancer, and the effect of calcium intake on bone mass (p. 120)." Collectively, these data provide strong evidence that playing violent video games can lead to significant ill effects. The question then becomes: Does playing violent video games contribute to individuals' aggressive behavior? Alternatively, are there other mechanism(s) at work that increase the likelihood of future aggression? The present study will examine individual and situational factors that independently and jointly create an environment after violent video game play that increases the likelihood of aggressive behavior.

General Aggression Model

Several theories have been developed to explain the effect of violent media on aggressive behavior. Bensley and Van Eenwyk (2001) identified five primary theories to describe these effects, including Social Learning Theory (individuals learn aggressive behavior by watching others), Arousal Theory (anger combined with arousal causes aggression), Cognitive Neoassociation Theory (violent media consumption promotes aggressive thoughts and actions), Catharsis Theory (violent media provides a positive outlet for aggressive behavior), and the General Aggression Model. Of these models, the most parsimonious is the General Aggression Model. This model draws from each of the other theories, excluding catharsis theory, which has been empirically refuted (Bushman, Baumeister, & Stack, 1999), and integrates them into a framework for understanding the relation between violent video games and aggression.

According to the General Aggression Model (GAM), input variables "influence the final outcome behavior through the *present internal state* they create (Anderson & Bushman, 2002, p.

38).” These inputs may include the personal characteristics of the person (e.g., hostile attitudes and beliefs, gender, personality traits) and environmental or situational factors (e.g., aggressive cues in the environment, frustration, provocation, etc.). This component of the GAM is consistent with Social Learning Theory, which emphasizes the interactive effects of individual differences and the environment on aggressive behavior. For example, if a person is high in trait hostility (i.e., he tends to interpret social cues as threatening) and overhears a co-worker making overly critical comments about that person’s quality of work, aggressive behavior is more likely. In contrast, if the same person is not provoked (e.g., did not overhear the statement), aggressive behavior is less likely.

However, the interaction of input variables does not directly cause aggressive behavior. Rather, these variables elicit changes in one or more internal states, including an increase in aggressive thoughts, anger-related affect, and/or physiological arousal. These components of the GAM most closely resemble Cognitive Neoassociation Theory and Arousal Theory, which collectively posit that input variables elicit negative thoughts, emotions, and arousal. For example, consider the trait-hostile person who has been provoked by a co-worker. In this instance, the interaction between trait hostility and provocation may 1) cause the person’s heart rate to increase and facilitate perspiration (both showing physiological arousal), 2) increase feelings of anger, and/or 3) elicit hostile- or aggression-related thoughts (e.g., “Who does Bob think he is? I worked very hard on that project, and he just embarrassed me in front of the boss. I need to find a way to get him back, so he can feel as awful as I feel”). The GAM further posits that various combinations of input variables may not always activate all three of these routes. Nonetheless, these internal states are linked within an associative network, such that activation of one route (e.g., hostile cognition) may spread activation to other routes (e.g., arousal and anger).

Ultimately, the decision to react with aggression is based upon a person's appraisal processes. Initially, an individual relies upon a primary appraisal that is immediate and automatic. If time and/or cognitive resources are not available for further processing, immediate appraisal results in an impulsive action that may be aggressive or non-aggressive. The likelihood of an impulsive aggressive response is largely dictated by the content of the appraisal as influenced by the relative activation of the various pathways. Hence, if angry affect and hostile thoughts are activated, impulsive aggression was more likely to occur. If time and cognitive resources are available, the individual evaluates further the results of the primary appraisal, as well as other relevant factors, in a more thoughtful and deliberate manner. This process, termed *reappraisal*, is conscious, slow, and leads to a thoughtful action that may be aggressive or non-aggressive.

The display of an aggressive or a non-aggressive response subsequently influences, via a feedback loop, individual and situational factors. Suppose the person has acted aggressively toward the co-worker (e.g., planting evidence of wrongdoing in the co-worker's files) and the co-worker is fired. This outcome, which would be considered satisfactory to the person, will likely become internalized over the long-term, and become a part of the person's stable behavioral tendencies (e.g., aggressive acts work well) that will influence future behavior.

The GAM as Framework for Understanding Video Game-Related Violence

The GAM is a particularly effective theoretical framework to guide research on the effects of violent video games on aggression. These effects have been studied empirically in relation to the effects of input variables on internal states and aggressive behavior.

Impact of Individual Differences and Violent Video Games on Internal States

Following the GAM, individual differences and environmental cues found in violent video games may lead to changes to internal states. Specifically, researchers have posited that exposure to violent video games leads to numerous negative effects, including 1) increased state hostility, 2) decreased empathy and desensitization towards violence, and 3) increased arousal and interpersonal aggression (Arriaga, Esteves, Carneiro, & Monteiro, 2006). These correspond with changes in cognition, emotion, and physiological arousal discussed in the GAM.

Cognition. Exposure to aggressive cues increases accessibility of aggressive thoughts (Anderson, 1997; Anderson, Anderson, Dill, & Deuser, 1998; Anderson, Benjamin, & Bartholow, 1998; Bushman, 1998; Bushman & Geen, 1990). For example, research has shown that individuals exposed to television programming that normalizes hostile attitudes and aggressive behavior value others around them less (Anastasio, 2004/2005). This decrease in empathetic thoughts, and corresponding increase in hostile thoughts, is posited to facilitate aggressive behavior.

Exposure to violent media also affects the processing of information that may allow individuals to relate to others. For example, through the recognition and interpretation of facial expressions, humans are often able to ascertain the emotions/motivations of others. This leads to fewer misunderstandings and promotes greater cooperation. However, research has shown that relative to individuals who consume lesser amounts of violent media, individuals who consume a greater amount of violent media are slower to recognize happy expressions but more quickly recognize hostile expressions (Kirsh, Mounts, & Olczak, 2006). These findings tentatively suggest that chronic consumption of violent media interferes with the processing of socio-emotional cues. Consistent with this view, research suggests that individuals chronically exposed to violent media interpret ambiguous situations as being more hostile (Bartholow, Sestir, & Davis, 2005). Taken together, these data indicate that chronic viewers of violent media are more likely to interpret ambiguous interpersonal cues as being more threatening.

The literature on video game violence's effect on increasing aggression has drawn similar conclusions. Within a violent video game, the protagonist is oftentimes required to commit violent acts against others to accomplish a goal. In identifying with this character, the player may view this violence as more acceptable, and he or she may care less about others around him. Specifically, exposure to video game violence is associated with lower empathy and stronger aggression-promoting attitudes (Funk, Baldacci, Pasold, & Baumgardner, 2004). Since video games are more interactive than television, there is concern that players identify more with violent protagonists, making violent strategies seem more acceptable.

Accordingly, one's amount of chronic exposure over time to violent video games may determine the degree to which he or she experiences negative effects. For example, research has shown that chronic exposure to violent video games increases the accessibility of aggressive thoughts (Carnagey & Anderson, 2005). These effects were particularly salient for those games that rewarded violent actions within the game. Chronic players of violent video games have also been shown to have an attentional bias towards negative semantic stimuli during attention tasks (Kirsh, Olczak, & Mounts, 2005). This priming of negative thoughts causes individuals to respond more quickly to aggressive cues in the environment. With this heightened perception of hostile cues, the individual is more likely to recognize and respond in a hostile manner.

Similarly, research indicates that frequent players of violent video games, relative to infrequent or casual players of violent video games, reported higher levels of trait hostility and were more likely to make negative attributions for the actions of others in stories where the aggressor's motives were ambiguous (Lynch, Gentile, Olson, & van Brederode, 2001). Moreover, when asked to guess future actions of the protagonists after playing a violent video game, the individual expected the protagonists to act in a more hostile way (Bushman & Anderson, 2002). The observed increases in hostile cognition presumably reflected a mindset in which hostile thoughts are more salient.

Affect. Input variables also affect aggressive behavior by eliciting negative emotion. Research has shown that individuals, particularly children, who watched violent media (e.g., movies, television news) reported being more fearful of others and more concerned for their safety (Wilson, Martins & Marske, 2005). This finding is not limited to feature films or television news broadcasts, as violent dramatic programming also increases fear in heavy consumers of that genre (Romer, Jamieson, & Aday, 2003).

Some studies (Anderson & Dill, 2000; Anderson & Ford, 1986; Ballard & Wiest, 1996; Carnagey & Anderson, 2005) suggest that exposure to violence in video games increases negative affect as well. In addition, individuals who played violent games reported a greater increase in negative affect than individuals who played a non-violent game (Carnagey & Anderson, 2005). However, other studies (Calvert & Tan, 1994; Nelson & Carlson, 1985) failed to detect a significant relation between video game violence and negative affect.

One possible reason for this discrepancy is that many of these studies rely only on self-report measures of affect. Using additional measures of affect is one approach that may clarify this seemingly equivocal relationship. Additionally, personality traits and cues in the environment have been found to interact to increase or decrease negative affect, similar to the effect of increases in negative cognition. For example, individuals who are dispositionally prone to be angry report more state anger after exposure to violent video games than after exposure to non-violent games, whereas individuals not prone to anger were reported no differences in state anger after exposure to violent and nonviolent games (Giumetti & Markey, 2007). Thus, it is possible that studying individual differences will lead to a better understanding of the relation between exposure to violent video games and changes in affect.

Physiological responses/Arousal. Violent video game consumption can also affect physiological responses. For example, research indicates that after individuals have played a violent video game, they exhibit reduced amplitude of the P300 component of the event-related brain potential to subsequently viewed violent media (Bartholow, Bushman, & Sestir, 2006). Typically, higher amplitude is associated with a moving away from the stimuli, whereas the reduced amplitude of these findings suggests a less aversive reaction to violent fare. Additionally, this lowered brain response predicted increased aggressive behavior in a subsequent laboratory-based task. The authors suggest that with a dampened neurological response to the pain of others, individuals may be less likely to feel empathy and/or engage in helping behaviors. Thus, the use of aggression would be more likely to resolve an interpersonal conflict.

Moreover, when looking at the physiological effects of violent video games, researchers often compare the responses of those who have played a violent game versus those who have played a non-violent game. Ballard and Wiest (1996) found that individuals showed greater cardiovascular reactivity after playing a violent video game as compared to playing a non-violent game of billiards. Relative to players of pencil and paper games and non-violent video games, players of violent video games displayed significantly higher arousal as measured by heart rate and self-report (Fleming & Rickwood, 2001). Individuals who played a violent video game have also shown a significant increase in systolic blood pressure and reported increased state anxiety from pre-game levels as compared to individuals who played a non-violent video game (Baldaro, Tuozzi, Codispoti, et. al, 2004).

In one of the identified studies using both heart rate and electrodermal activity, participants who played a violent video game were then asked to watch a videotape of real-world violence. These individuals showed lower heart rate and electrodermal activity than individuals who played a non-violent video game before viewing the violent videotape (Carnagey, Anderson, & Bushman, 2007). Similar to the conclusions of Bartholow, Bushman, and Sestir (2006), the authors suggested that individuals show a physiological desensitization to violence after playing violent games and that this desensitization causes an individual to become less likely to help victims of violence.

Schneider, Lang, Shin, and Bradley (2004) found that participants who played a violent video game with a plot to follow showed increased physiological arousal and appeared to identify more with the protagonist of the game relative to participants who played a violent video game without a plot to follow. The authors concluded that as the story increased participants' physiological arousal, it also increased the participant's justification of the violence. Taken together, these studies suggest that individuals who play violent games tend to show an increase in physiological arousal, but also become less sensitive to the plight of others.

Summary. The cited literature collectively suggests that playing violent video games makes hostile cognitions more accessible, increases negative emotion, and heightens physiological arousal. These effects are especially salient among individuals who possess aggression-promoting traits or who frequently play violent video games.

Effects of Violent Video Games on Aggressive Behavior

Laboratory-based studies have shown that individuals who play violent, relative to non-violent, video games set higher levels of noise punishment for their competitor (Anderson & Murphy, 2003; Bartholow & Anderson, 2002). Outside of laboratory settings, students who reportedly spend a great deal of time playing violent video games are more likely to be involved in more physical fights (Gentile, Lynch, Linder, & Walsh, 2004; Lynch, Gentile & Olson, & van Brederode, 2001) and to argue with teachers than those who play violent video games less frequently (Gentile et al., 2004).

Finally, research suggests that violent video games prime behavioral characteristics already present in the individual, such as aggressive tendencies, and may promote the individual's use of aggression towards others (Cicchirillo & Chory-Assad, 2005). Overall, these findings highlight the importance of exploring how inputs (individual differences in trait aggression and extensive violent game play) interact with environmental cues (violent video games) to produce increases in negative internal states. Research in this area will elucidate the extent to which violent video games independently trigger future aggression as well as the degree to which antecedent conditions affect the degree to which violent games facilitate aggression.

Limitations of Previous Video game research

With the GAM as a guiding theoretical framework, the cited literature provides some support for the effects of violent video games on aggressive behavior. However, although numerous studies tout the negative effects of violent video games on aggression, it has been argued that there numerous methodological and theoretical problems that complicate the interpretation of this literature. These issues include low construct validity of the independent variable, lack of control for the strength and length of exposure to the violent video game, and the types of outcome measures used (Sherry, 2001).

First, previous laboratory-based studies have randomly assigned participants to play a "violent" or a "nonviolent" video game. Unfortunately, it is difficult to find games that are truly comparable in the types of emotions or patterns of physiological reactivity they elicit. Indeed, video games, especially from different genres, oftentimes elicit different patterns of physiological and emotional responses (e.g., a person playing a puzzle game compared to a person playing a violent fighting game would differ in their responses). As such, the construct validity of the typical independent variable (i.e., type of video game) in these studies is suspect.

Second, past research has not standardized the length of exposure to violent video games. This makes it difficult to compare results across different games. For example, a person may become frustrated or bored with a game if they are asked to play a game that is too short or too long, respectively. If the participant has had too little exposure to a violent game, they may become frustrated because they have not had enough time to master the game or at least become comfortable with the game. If the person plays a game for a much longer period of time, they may become bored with performing the same tasks repeatedly. As a result, differential patterns of frustration or boredom may represent a significant confound to these studies. In turn, this potential confound may obscure the true link, if one exists, between violent video games and aggressive behavior.

Finally, while most experimental studies do use self-report or behavioral outcome measures, such as administration of a noise blast (Bartholow & Anderson, 2002), rarely are two or more outcome measures used in the same study. Consequently, while a person may exhibit more aggression after playing a violent video game on a single measure, factors linking increased aggressive cognition (self-report) and aggressive behavior (behavioral measures) are not often explored.

Addressing the Limitations of Research on Violent Video games

In a recent laboratory-based study, Panee and Ballard (2002) addressed many of the frequently cited limitations of experimental research on violent video games. In their study, they evaluated undergraduate men's performance and arousal while playing a *single* game. Relative to previous studies, this methodological change avoided the comparison of effects across different video games and genres, since the game, *Metal Gear Solid,* allowed for players to reach the end of the game by using either stealth (i.e., avoiding enemies) or violence (i.e., shooting or choking the enemy). The researchers also addressed concerns about frustration due to unfamiliarity with controls, as the participants became familiar with the controls through a training session prior to experimental game play. In addition, participants were primed by receiving either aggressive or non-aggressive instructions during this training session, rather than using two games of different genres, as earlier studies have done. Participants in the aggressive prime condition were told that they "must kill" the guards in order to progress to the completion area, whereas those in the non-aggressive prime condition were told that they "do not have to kill the guards to complete the levels, but it is still an option (p. 2465)."

After the training session, the game was set to a particular level (mission) prior to game play and participants were given the objectives of that level. Those in the aggressive prime condition were given additional information that they did not have to kill the guards, but it was "still an option." This was done to reinforce the priming. Both sets of participants were given the same amount of time to complete five levels (5 minutes), and the process was the same for the five levels.

Rather than using a single measure of self-reported state hostility, which the authors did after the participant played the video game, the authors also developed an index of aggression. This index was computed by counting the frequency of aggressive acts displayed within game play. It was observed by videotaping the strategies participants used to progress through the game. Coders blind to the conditions later reviewed the tape and indicated the number and level of aggressive acts used by the participant.

Results indicated that participants who received an aggressive prime used more aggressive tactics while playing the game and reported higher levels of state hostility than participants who received the non-aggressive prime. A link between the receipt of an aggressive prime and physiological responses (e.g., heart rate and blood pressure) was not detected. However, participants' self-report of increased state hostility was significantly associated with increases in heart rate. Consistent with the GAM, the aggressive prime introduced changes in the player's internal state, including increased heart rate and an increase in hostile thoughts. This presumably caused these "primed" individuals to appraise the situation as requiring aggression, which, the authors theorized, ultimately led them to exhibit increased aggressive behavior during game play.

From a theoretical standpoint, findings from this study were consistent with the GAM and demonstrated its usefulness in tracing pathways to aggression within, and potentially following, violent video game play. These findings are particularly compelling given the methodological changes employed in this study. This investigation showed that increasing experimental control in the type of game used effectively avoids previous limitations that have threatened the validity and strength of findings. Additionally, the authors used physiological measures (e.g., heart rate and blood pressure), behavioral measures (i.e., videotaped activities during the game), and self-report measures. Given the complexity of aggressive behavior and its predictors, this methodology provided a more complete picture of potential factors that lead to aggressive behavior.

Expansion of Panee and Ballard (2002)

Despite these methodological advantages, there are also several limitations of Panee and Ballard's (2002) design that merit attention. First, they used a verbal "prime", which encouraged (or did not encourage) a particular style of play during training sessions. Panee and Ballard then used the "aggression index" as an outcome measure and found that participants in the aggressive prime condition used significantly more violence to progress through the game than individuals in the non-aggressive prime condition. It is possible that the prime introduced social desirability effects, in that the participants may have surmised the purpose of the study and acted accordingly. Second, consistent with previous studies in this area, Panee and Ballard (2002) assessed physiological arousal during game play via heart rate and blood pressure. While these indices are reliable and valid measures of arousal, additional measures, such as electrodermal activity, are available. Indeed, the use of multiple measures of arousal would increase the study's convergent validity, thus increasing confidence in results.

Finally, Panee and Ballard's (2002) study did not address the role of individual differences in the effects of violent media on future aggressive behavior. Specifically, it was not determined whether the typical amount of violent media consumed on a weekly basis or trait aggressiveness played a part in how violent media had an impact on the player. Indeed, research suggests that these individual difference variables are important to understanding the potential negative effects of violent video games.

The Present Study

The overarching aim of the present study was to examine the independent and joint effects of individual differences and situational factors on affective and physiological reactivity to playing a violent video game. Rather than assessing aggressive *behavior* after playing a violent video game, however, the present research sought to examine antecedent variables. Research has shown that many variables that affect real-world aggression also affect measures of aggression in a laboratory setting (Anderson & Bushman, 1997). To the extent that antecedent variables are linked to these hypothesized routes to aggressive behavior during game play, it is reasonable to conclude that these variables will also be linked to post-game play aggressive behavior.

Prior research suggests that playing violent video games increases the likelihood of real-world aggression. However, these findings have garnered significant criticism, primarily due to the techniques used by other researchers. As such, the present investigation also sought to address these methodological issues. Participants were randomly assigned to play one of two versions of the same game. The primary differences between these two versions was 1) an instruction to play the game using violent or nonviolent strategies, and 2) providing the participant's character with a gun or not providing the participant's character with a gun. It was assumed that this methodology would permit a highly valid comparison of violent and nonviolent games. In addition, relative to prior studies, the present research expanded the number and type of measured physiological responses. Specifically, heart rate and electrodermal activity (EDA) were assessed to reflect physiological arousal and facial electromyography (EMG) was assessed to reflect positive and negative affect. Since facial EMG activity and EDA (i.e., skin conductance) are automatic and unconscious, it was expected that adding them as additional measures would present a more complete picture of video game effects on affect and arousal.

Hypotheses

Theoretical and empirical work suggests that individuals with aggression-promoting traits experience heightened levels of arousal (Arriaga, Esteves, Carneiro & Monteiro, 2006) and negative affect (Anderson, Carnagey, & Flanagan, et. al., 2004; Bushman, 1995; Giumetti & Markey, 2007) following exposure to aggressive cues. Therefore, it was hypothesized that trait aggression would be positively related to increased arousal among participants in the violent, but not the non-violent game condition. It was also hypothesized that trait aggression would be positively related to negative affect among participants in the violent, but not the non-violent, video game condition.

Research suggests that individuals who frequently play video games show higher levels of arousal and negative affect after playing violent, relative to non-violent, video games (Baldaro, Tuozzi, Codispoti, et al, 2004). Related studies indicate that chronic players of violent video games evince higher levels of hostile cognition (Carnagey & Anderson, 2005), negative affect (Anderson & Dill, 2000; Ballard & Wiest, 1996), and physiological arousal (Fleming & Rickwood, 2001). Therefore, it was hypothesized that past exposure to violent video games would be positively related to arousal during exposure to a violent, but not to a non-violent, video game condition. Lastly, it was hypothesized that past exposure to violent video games with be positively related to negative affect during exposure to a violent, but not to a non-violent, video game condition.

CHAPTER 2: METHODS

Power Analysis

A power analysis (G-POWER 3; Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007) was utilized to determine the number of participants needed to detect an interaction in a regression model with two predictors. The effect size used to compute power is considered in the small to medium range (f^2= .18). The parameters for the power analysis were set at alpha = .05 and power = .80. It was determined that approximately 124 participants would be needed to have sufficient power for this study.

Participants and Recruitment

One hundred thirty-three male participants between 18-35 years of age were recruited from the Department of Psychology undergraduate research participation pool at Georgia State University in partial fulfillment of course requirements. However, 14 participants were removed due to bad physiological readings, 7 were removed for not completing all the questionnaires, and 6 pilot subjects were removed, leaving a final sample of 106. Of the individuals in the final sample, Caucasians (n = 45) and African Americans (n = 30) comprised of 71% of the sample. The remaining participants were Hispanic (n = 10), Asian (n = 11), or identified as from an unspecified racial background (n = 9). The mean age of the participants was 19.76 (SD = 2.35).

Participants responded to an online advertisement seeking volunteers for a "study on psychological and physiological responses to video games." This advertisement clearly indicated that the study would last approximately one hour, required participants to complete a series of questionnaires and play a video game while physiological measures were recorded, and afforded participants one research credit. Men in this age range were selected because they reflect the typical demographic of video game players (ESA, 2006). In addition, research has shown that men experience negative emotion more strongly than do women (Verona & Curtain, 2006). Given that this literature also shows that men respond more strongly to violent video game cues than women (Anderson & Dill, 2000; Bartholow & Anderson, 2002), recruitment was limited to healthy males ages 18 to 35.

Experimental Design

This study had three predictors: trait aggression (a continuous variable), history of exposure to violent video games (a continuous variable), and video game exposure (Aggressive instruction, Non-Aggressive instruction). Participants were randomly assigned to either the Aggressive instruction group (n = 66) or to the Non-Aggressive instruction group (n = 67).

Questionnaire Battery

Demographic form. This self-report form obtained information such as age, race, and pertinent medical history information that would prevent the participant from completing this study (e.g., uncorrected vision and hearing problems).

Buss-Perry Aggression Questionnaire (BAQ; Buss and Perry, 1992). This 29-item Likert-type scale measures an individual's disposition toward physical aggression, verbal aggression, anger, and hostility. For the present study, only the physical aggression subscale was analyzed (e.g., "Given enough provocation, I may hit another person"). Response options ranged from one (extremely uncharacteristic of me) to five (extremely characteristic of me). Higher scores indicated an increased tendency to engage in acts of physical aggression. Reliability for this subscale has been found to be good, with the authors reporting a coefficient alpha of .85. Alpha reliability for the present sample was .79. See Appendix A for the complete measure.

Video game questionnaire (VGQ; Anderson & Dill, 2000). This questionnaire was administered to measure participants' prior exposure to video game violence. On this measure, participants were asked to name their five favorite video games and then rate, on a scale from 1-7, how often they have played each game, and the level of violent content and graphics of each game. The authors reported good reliability for this measure ($\alpha = .86$). Alpha reliability for the present sample was .66. See Appendix B for the complete measure.

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegren, 1988). This self-report instrument was used to measure negative and positive affect both before and after individuals play the video game. The PANAS consists of 37 descriptors of feelings and emotions and asks respondents to indicate the degree to which each item describes how they are feeling *at that moment*. Responses range from 1 (very slightly) to 5 (extremely). While there are six subscales included on the PANAS (joviality, sadness, anger, fear, positive affect, and negative affect), only the positive and negative affect scales were examined for the present study. Adjectives included on the positive affect subscale included "interested", "excited", "strong", "enthusiastic", "proud", "alert", "inspired", "determined", "attentive", and "active". Adjectives on the negative affect scale included "distressed", "upset", "guilty", "scared", "hostile", "irritated", "ashamed", "nervous", "jittery", and "afraid". Adequate reliability has been reported for both the positive ($\alpha = .86$) and negative affect ($\alpha = .84$) subscales. Alpha reliability for both administrations of positive and negative affect subscales exceeded .74. See Appendix C for the complete measure.

Post-Game Questionnaire (PGQ; 2007). This self-report instrument was developed by the author to assess the participants' experience of the game after the experimental condition. It consisted of seven items asking respondents to indicate the degree to which they felt threatened during the game, prior experience with the game, how violent they felt their actions, the actions of guards in the game, and the game itself were violent, and how much control they felt they had over their actions. Responses range from 1 (not at all/none) to 5 (a great deal, very high). See Appendix D for the complete measure.

Physiological Measures

Facial electromyography (EMG). Participants' affective experience during a baseline period and during game play was assessed with 4 mm standard silver-silver chloride electrodes that recorded muscle activity over the *zygomaticus major* region on the left side of the face (positive affect) and over the *corrugator supercillia* area over the brow (negative affect). Greater activity over the *zygomaticus major* region has been demonstrated to be an indicator of positive feelings about stimuli, and greater activity over the *corrugator supercillia* region has been shown to measure more negative affect (Cacioppo, Petty, Losch & Kim, 1986, Larsen, Norris, & Cacioppo, 2003).

Heart rate. Heart rate, defined as the number of heartbeats per minute, is a widely accepted measurement of physiological arousal (Stern, Ray, & Quigley, 2001). Signals were recorded during a baseline period and during game play with a single 8 mm silver-silver chloride electrodes placed over each wrist.

Electrodermal activity (EDA). Electrodermal activity has frequently been used to measure arousal in conjunction with heart rate (Stern, Ray, & Quigley, 2001). A common measure of EDA, which was used in the present study, is skin conductance level, which measures the level of electrical activity on the surface of the skin. Readings were collected by two 8-mm silver-silver chloride electrodes attached to the second segment of the first and second fingers of the participant's left hand. Placement of electrodes in this area minimized movement artifacts that may occur, as the participant used his right hand primarily to play the video game and did not need to use these fingers. Placements for all of the physiological measures are consistent with the Edelberg guidelines (Fowles, Christie, Edelberg, et. al, 1981).

Video game software/Apparatus. The video game software used for the study, *Metal Gear Solid 2* (Konami, Redwood City, CA), is an action-adventure game in which players are able to use stealth tactics (e.g., hiding in dark corridors, avoiding detection) or aggression (e.g., punching, choking guards, using knives and guns) in order to progress in the game. In the present study, players were required to complete a "mission" by reaching a "completion cone." Upon completion of each mission, participants then proceeded to the next mission. A Sony Playstation 2 (Sony Computer Entertainment, Inc., China) was used to play the video game on a 19-inch color television. Game play of all participants was recorded with a videocassette recorder.

Procedure

Upon arrival to the laboratory, participants were greeted by the experimenter and seated in a recliner. Participants were informed that the purpose of the study was to assess psychological and physiological responses to playing video games. They were told that participation entailed answering several self-report questionnaires as well as playing a video game while physiological measures were taken. They were also informed verbally (and on their consent forms) that they had the right to refrain from answering any of the questions and to withdraw their participation at any time. Further, they were advised that their performance during the game would be recorded, but that the recording was solely of in-game action, and not of the participant.

Upon providing informed consent, all participants completed a battery of written questionnaires, including the BAQ, the VGQ, the PANAS, and a general demographic form.

Next, the researcher cleaned the participant's face, wrists, and fingers, with soap and water. In addition, these areas were lightly abraded with an abrasive pad. The researcher then attached electrodes to participants' face, wrists, and fingers to record facial EMG, heart rate, and EDA, respectively. Participants watched a five- minute travel video while wearing attached electrodes to establish baseline measures. Participants were then randomly assigned to one of two instructional sets (violent vs. nonviolent). Those in the violent instructional set were told, "The video game you are about to play is named Metal Gear Solid 2. The goal of the game is to reach the end of the board. However, there are guards patrolling the area who want to prevent you from reaching the end. While you can either avoid the guards or kill them, for this study, you are required to kill the guards to reach your goal." Instructions were identical for those in the nonviolent instructional set, with the exception that the statement "you are required to *kill* the guards to reach your goal" was replaced with the statement "you are required to *avoid* the guards to reach your goal". The researcher then set up the video game system, and demonstrated how to perform the different actions in the video game. The participant demonstrated that he has learned the controls of the game by performing each of the moves during a practice session. Next, the researcher advised the participant that he would have five minutes to complete the levels during the actual game play session.

Participants then played Metal Gear Solid 2 on a Playstation 2 while facial EMG, EDA, and heart rate were recorded. Performance in the game was also videotaped for later coding. At the end of the experiment, participants were administered the PANAS a second time to measure state affect after playing the video game, and given a post-game questionnaire to measure their feelings towards the game. Finally, participants were fully debriefed and dismissed.

CHAPTER 3: RESULTS

Overview of Data analysis

A review of the literature suggested that there were a number of strategies for calculating difference scores for physiological measures. For instance, some researchers subtract an average across the entire baseline period from the average of each physiological measure across the entire experimental period (Butler, Egloff, & Wilhelm, et al. 2003). Alternatively, other researchers recommend entering baseline physiological activity as a covariate (Mauss, Wilhelm, & Gross, 2003). Unfortunately, there is little agreement on the most appropriate method. Rottenberg, Ray, and Gross (2007) proposed that subtracting the average baseline response from the average experimental response may "wash out" effects of physiological or emotional data. To address this problem, they recommend an analysis of different time frames with the experimental time period. Unfortunately, it has not been determined whether these time intervals should be compared to an overall baseline period or to corresponding baseline time intervals.

In accordance with the recommendations of Rottenberg and colleagues (2007), the present study analyzed physiological responses within one-minute time intervals (i.e., rather than averaging physiological responses across a five minute period of game play). The rationale for this strategy is that it would maximize precision in the analysis of patterns of arousal or affect and better determine the direction of trends across the five-minute period. Unfortunately, as noted above, it remains unclear which strategy is most appropriate for computing interval-based difference scores. Thus, the present study utilized two methods. The first method compared experimental intervals to the corresponding baseline intervals (e.g., difference between minute 1 of game play and minute 1 of baseline). The second method compared experimental intervals to the average baseline response (e.g., difference between minute 1 of game play and the average of the five-minute baseline period). A description of this data reduction strategy is outlined below.

Data Reduction

Trait aggression. Trait aggression was the cumulative score on the Physical Aggression subscale of the Buss-Perry Aggression Questionnaire.

Past violent video game exposure. A violent video game exposure index was computed from participant responses on the VGQ in accordance with procedures set forth by Anderson and Dill (2000). Specifically, participants were asked to list their five favorite video games and rate how violent both the content and the graphics are for the game. These ratings were summed for each game. This value was then multiplied by the participants rating for how frequently he played each game. The resultant value indicated the level of exposure the participant has had to violent video games in the past.

Self-reported affect. Change in negative affect was computed by subtracting the score on the Negative Affect Subscale of the PANAS reported before playing the game from the score reported after playing the game. Likewise, change in positive affect was computed by subtracting the score on the Positive Affect Subscale of the PANAS reported before playing the game from the score reported after playing the game.

Physiological affect. Positive and negative affect were computed from recorded muscle activity over the *zygomaticus major* and *corrugator supercillia* regions, respectively. Recordings were collected during each minute of the five-minute baseline period and during each minute of the five-minute game play period. Average activity over each region was computed for five one-minute periods. This resulted in five positive affect and five negative affect readings at baseline, as well as five positive and negative affect readings during game play. Changes in positive affect were computed using two methods. The first method calculated the difference in affect by subtracting the five baseline readings of zygomaticus activity from the corresponding five game play readings of zygomaticus activity. The second method calculated the difference in affect by subtracting the average zygomaticus activity across the five-minute baseline period from each of the one-minute intervals of the game play period. Similarly, negative affect was computed by subtracting the five baseline readings of corrugator activity from the corresponding five game play readings of corrugator activity during game play and by subtracting the average corrugator activity across the five-minute baseline from each of the one-minute intervals of the game play period.

Skin conductance. Similar to readings of facial EMG, electrodermal activity readings were collected across a five-minute baseline period and across a five-minute gameplay period. Average skin conductance was recorded for each of the five one-minute periods. Changes in average skin conductance level were calculated using two methods. The first method calculated the difference in arousal by subtracting the five baseline readings of skin conductance from the corresponding five game play readings of skin conductance activity. The second calculated the difference in arousal by subtracting the average skin conductance across the five-minute baseline period from each of the one-minute intervals of the game play period.

Heart Rate. Heart rate was calculated by counting the number of beats per minute during the five-minute baseline period and during the five-minute game play session. Changes in heart rate were computed using two methods. The first method calculated the difference in heart rate by subtracting the five baseline readings of heart rate from the corresponding five game play readings of heart rate. The second calculated the difference in arousal by subtracting the average heart rate across the five-minute baseline period from each of the one-minute intervals of the game play period.

Data Screening

Facial EMG, EDA, and heart rate data were examined and edited for measurement values outside of normal ranges and analyzed using Biopac amplifiers (Biopac Systems, Inc., Santa Barbara, CA) where the signals were amplified. Signals were digitized then recorded and displayed on a laboratory computer. Data was then imported into SPSS for analysis. The means, standard deviations, and intercorrelations of demographic variables, video game consumption, and trait aggression were computed (See Table 1). Data were screened for missing data and outliers for which mean substitutions was made.

Preliminary Analysis

To evaluate group characteristics for demographic and dispositional variables, a series of one-way ANOVAs were conducted with condition as the independent variable and with age, trait aggression, and exposure to video game violence as dependent variables. In addition, a chi-square test was performed to see if the non-violent and violent groups differed by race. Analyses did not detect significant group differences for years of education, trait aggression, exposure to violent video games, and race. However, there was a difference between the groups in age, where individuals in the nonviolent group were older ($M = 20.21$, $SD = 2.85$) than individuals in the violent group ($M = 19.18$, $SD = 1.26$), $F(1,101) = 4.94$, $p < .05$. Therefore, age was added as a covariate in the first step of each regression model (see below).

In addition, a series of one-way ANOVAs were conducted to see if groups differed on their responses to the post-game questionnaire. This questionnaire assessed the participants' self-reported experiences of the game after the experimental condition. It consisted of seven

Table 1.

Intercorrelations Between Age, Trait Aggression, Past Exposure to Violent Video Games, and Self-Reported Affect

	1	2	3	4	5
1. Age	--	-.08	-.13	.21*	-.19
2. Trait Aggression		--	.14	.07	-.15
3. Past Exposure to Violent Games			--	.03	-.04
4. Positive Affect				--	.06
5. Negative Affect					--

* $p < .05$.

items asking respondents to indicate the degree to which they felt threatened during the game, prior experience with the game, how violent they felt their actions, the actions of guards in the game, and the game itself were violent, and how much control they felt they had over their actions. Responses range from 1 (not at all/none) to 5 (a great deal, very high). Analyses did not detect significant group differences for the degree of feeling threatened, their prior experience with the game, or how violent the actions of the guards were in the game. There was a significant difference between the groups in how violent they felt their own actions were in the game, where individuals in the violent group reported that they felt their actions were more violent ($M = 3.50$, $SD = 1.15$) then did individuals in the non-violent group ($M = 1.63$, $SD = .92$), F (1, 105) = 86.22, $p < .001$. There was also a significant difference between the groups in how violent they perceived the game to be overall, where individuals in the violent group reported that they perceived the game to be more violent ($M = 2.78$, $SD = .92$) than did individuals in the non-violent condition, ($M = 1.88$, $SD = .92$), F (1,105) = 24.88, $p < .001$). These findings were consistent with expectations that individuals in the violent condition would perceived their actions to be more violent, and that the game itself appear to be more violent to these individuals than to individuals in the non-violent condition (See Table 2).

Manipulation Check

For data to be valid, it was important to demonstrate that participants followed the instructions for the group (violent or non-violent strategies) to which they were assigned. An independent rater blind to conditions of the experiment watched a video recording of participants' performance and calculated an aggression index. This index consisted of summing the number of violent activities the individual utilized on a minute-by-minute basis in order to progress through the game. A *t*-test was performed to determine whether groups differed in the

Table 2.

Means and Standard Deviations of Participants in Violent and Non-Violent Condition on Post-Game Questionnaire Items

Item	Violent *M (SD)*	Non-Violent *M (SD)*
Previous experience with the game	2.02 (1.45)	2.00 (1.33)
How violent game overall	2.78 (1.45)*	1.88 (.92)
How violent rate guards' actions	1.65 (.95)	1.73 (.97)
How violent rate own actions	3.50 (1.15)*	1.63 (.92)
How much control felt over actions	3.75 (1.07)	3.90 (.93)
How threatened felt during game	2.15 (1.05)	2.23 (1.31)
How much control felt over outcome of game	3.65 (1.14)	3.66 (1.02)

* $p < .05$

number of violent acts performed. As expected, individuals in the violent strategy group used a significantly higher number of aggressive actions during game play ($M = 45.9$, $SD = 20.97$) than individuals in the non-violent strategy group ($M = 1.32$, $SD = 3.35$), $t\ (104) = 16.23$, $p < .001$. This analysis confirmed that participants in the Violent and Non-Violent groups engaged in violent and non-violent game play, respectively.

Multiple Regression Analyses

Raw scores for each of the continuous independent variables (i.e., trait aggression, history of exposure to violent video games) were first converted to *z*-scores. Standardizing these first-order variables automatically centers the values (i.e., deviation scores with a mean of zero) which reduces multicollinearity between interaction terms and their constituent lower-order terms (Aiken & West, 1991). Additionally, dummy coding was employed for the categorical variable of instructional set (violent or non-violent). Interaction terms were then calculated by obtaining cross-products of pertinent first-order variables. The parameter estimates for interaction terms are reported as unstandardized *b*s, whereas those for main effects and simple slopes are reported as standardized βs. According to the procedures put forth in Aiken and West (1991), significant interaction terms were interpreted by plotting the effect and testing to determine whether the slopes of the simple regression lines differed significantly from zero.

Data were analyzed by entering variables into a hierarchical regression model. Assumptions of multiple linear regression were checked before entering the variables by checking for multicolinearity, normality, and homoscedascity. Colinearity diagnostics indicated that tolerance was below 1 and VIF scores were below 2, suggesting that multicolinearity was not a problem.

Effects of Trait Aggression and Video Game Condition on Arousal and Affect

In order to determine the interactive effect of trait aggression and violent video game play on affect and arousal, a series of hierarchical regression models were computed. In all models, age (Step 1), trait aggression and video game condition (Step 2) and their interaction (Step 3) were entered as predictors. However, each model separately tested the effects of these variables on changes in corrugator activity, zygomaticus activity, heart rate, skin conductance, and self-reported negative and positive affect, respectively, from each minute at baseline to the corresponding minute of videogame play.

Facial EMG. In terms of corrugator activity, significant main effects of trait aggression or game condition on changes in facial muscle activity were not detected during any of the five one-minute intervals. In addition, the interaction between trait aggression and violent game condition on changes in corrugator activity was not significant during any of the five one-minute intervals.

In terms of zygomaticus activity, significant main effects of trait aggression or game condition on changes on zygomaticus activity were not detected during the first four minutes of game play. In addition, the interaction between past violent video game exposure and violent game condition on changes in zygomaticus activity was not significant during the first four one-minute intervals.

During the fifth minute of game play, significant main effects of trait aggression or game condition on zygomaticus activity were not detected. However, a marginally significant interaction between trait aggression and condition was found on zygomaticus activity ($b = -1.67$, $p < .07$). Explication of this interaction revealed a significant positive relationship between trait aggression and changes in zygomaticus activity for individuals who engaged in non-violent play

($\beta = .34$, $p < .05$), but not for individuals engaged in violent play ($\beta = -.30$, p = n.s.). This marginally significant interaction effect suggested that the pattern of covariation between trait aggression and increases in positive physiological affect was significantly more positive for individuals who engaged in non-violent, relative to violent, video game play.

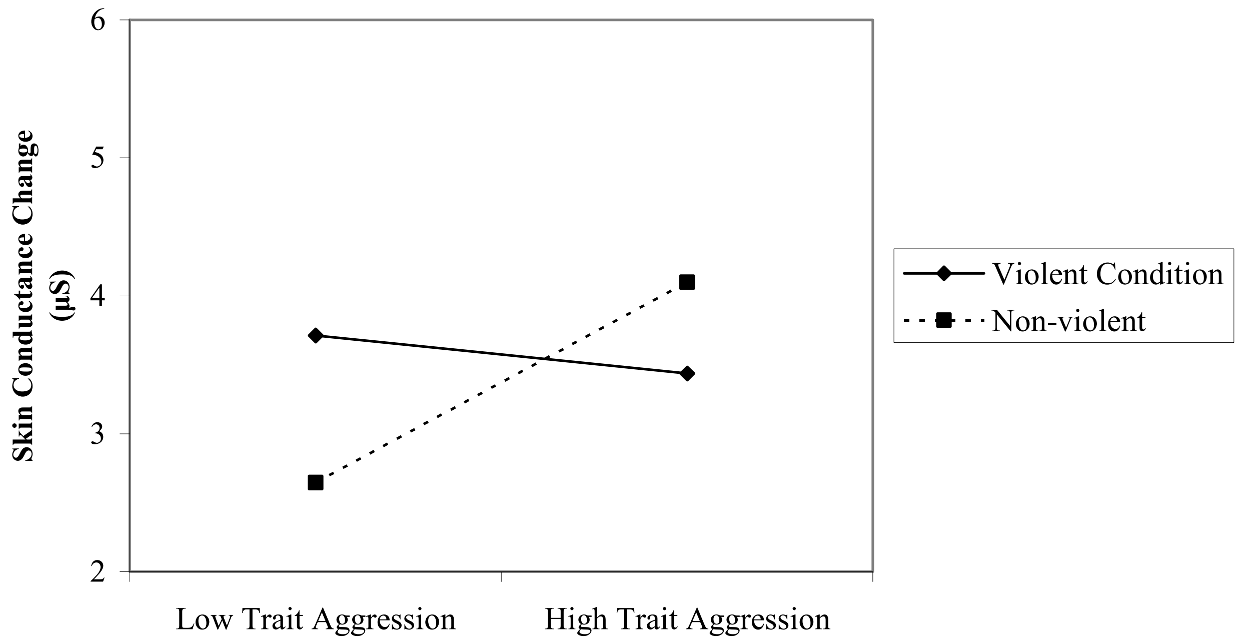
Heart rate. A significant main effect of trait aggression or violent video game condition on changes in heart rate was not detected during any of the five one-minute intervals. In addition, the interaction between trait aggression and violent game condition on changes in heart rate was not significant during any of the five one-minute intervals.

Skin conductance. A significant main effect of trait aggression or game condition on changes in skin conductance was not detected during the first minute of game play. In addition, the interaction between trait aggression and violent video game condition was not significant during the first minute of game play.

During the second minute of game play, a significant main effect was not found for trait aggression or game condition on skin conductance activity. However, a marginally significant interaction effect was found ($b = -.86$, $p < .09$). Explication of this interaction revealed a significant positive relationship between trait aggression and skin conductance activity for individuals who engaged in non-violent video game play ($\beta = .29$, $p < .05$), but not for individuals who engaged in violent video game play ($\beta = -.06$, p = n.s.). This finding suggested that higher levels of trait aggression were associated with increased arousal among individuals who used non-violent, but not violent, game play strategies (see Figure 1).

During the third minute of game play, a significant main effect was not found for trait aggression or game condition on skin conductance activity. However, a significant interaction effect was found ($b = -1.06$, $p < .05$). Explication of this interaction revealed a significant

Figure 1. Effect of trait aggression and video game condition on change in skin conductance (Minute 2).



positive relationship between trait aggression and skin conductance activity for individuals who engaged in non-violent video game play ($\beta = .29$, $p < .05$), but not for individuals who engaged in violent video game play ($\beta = -.12$, p = n.s.). This finding suggested that higher levels of trait aggression were associated with increased arousal among individuals who used non-violent, but not violent, game play strategies (see Figure 2).

During the fourth minute of game play, a significant main effect was not found for trait aggression or game condition on skin conductance activity. However, a significant interaction effect was found ($b = -1.25$, $p < .05$). Explication of this interaction revealed a significant positive relationship between trait aggression and skin conductance activity for individuals who engaged in non-violent video game play ($\beta = .28$, $p < .05$), but not for individuals who engaged in violent video game play ($\beta = -.15$, p = n.s.). Again, this finding suggested that higher levels of trait aggression were associated with increased arousal among individuals who used non-violent, but not violent, game play strategies (see Figure 3).

During the fifth minute of game play, a significant main effect was not found for trait aggression or game condition on skin conductance activity. However, a significant interaction effect was found ($b = -1.30$, $p < .05$). Explication of this interaction revealed a marginally significant positive relationship between trait aggression and skin conductance activity for individuals who engaged in non-violent video game play ($\beta = .27$, $p < .07$), but not for individuals who engaged in violent video game play ($\beta = -.17$, p = n.s.). Again, this finding suggested that higher levels of trait aggression were associated with increased arousal among individuals who used non-violent, but not violent, game play strategies (see Figure 4).

Self-reported affect. A significant main effect of trait aggression or violent video game condition on changes in self-reported positive affect was not found. Likewise, the interaction

Figure 2. Effect of trait aggression and video game condition on change in skin conductance (Minute 3).

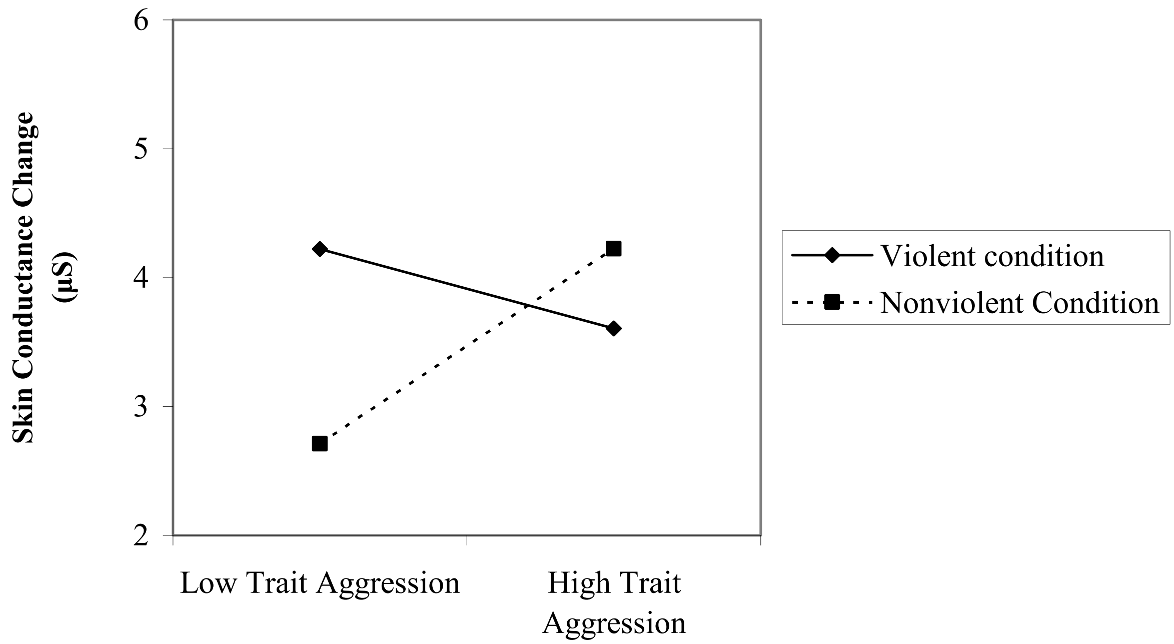


Figure 3. Effect of trait aggression and video game condition on change in skin conductance (Minute 4).

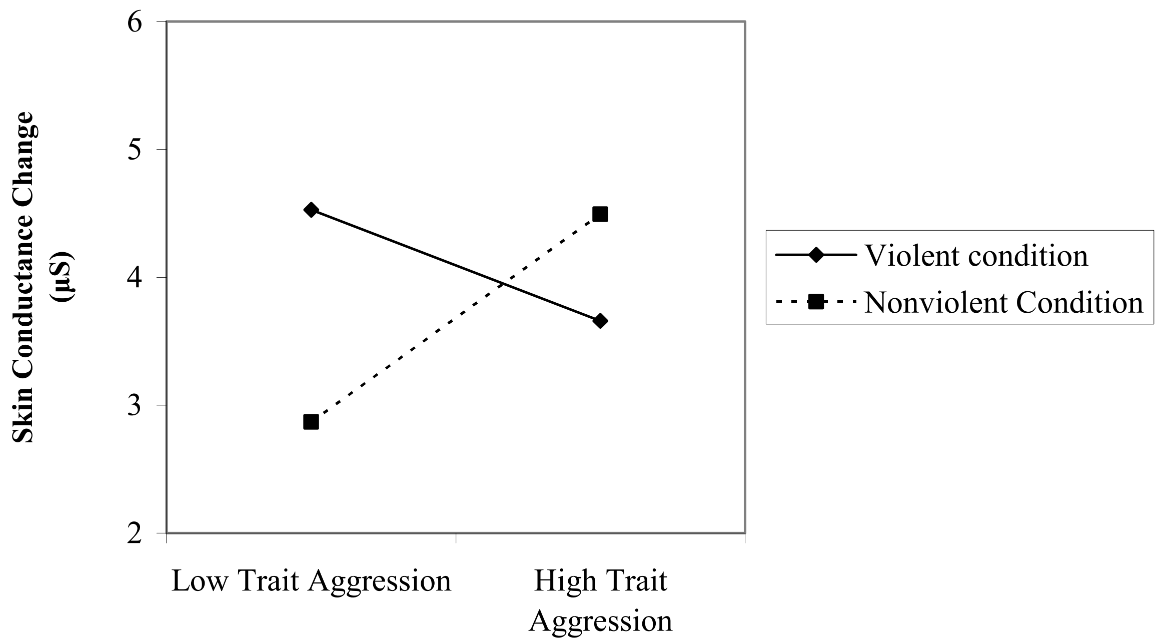
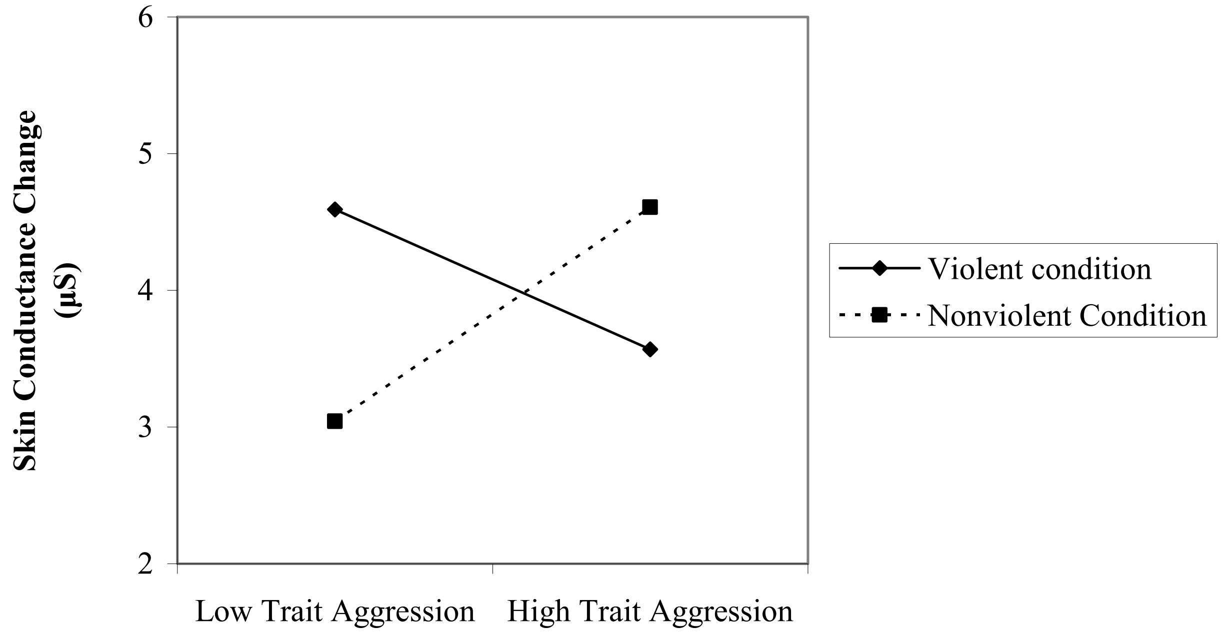


Figure 4. Effect of trait aggression and video game condition on change in skin conductance (Minute 5).



between trait aggression and violent video game condition on these indices was not significant. However, a marginally significant main effect of trait aggression was found for negative affect ($\beta = .19$, $p < .07$). This finding suggested that higher levels of trait aggression were associated with increased negative affect during game play.

Effects of Past Violent Video Game Exposure and Video Game Condition on Arousal and Affect

In order to determine the interactive effect of past violent video game exposure and violent video game play on affect and arousal, a series of hierarchical regression models were computed. In all models, age (Step 1), trait aggression and video game condition (Step 2) and their interaction (Step 3) were entered as predictors. However, each model separately tested the effects of these variables on changes in corrugator activity, zygomaticus activity, heart rate, skin conductance, and self-reported negative and positive affect from each minute at baseline to the corresponding minute of video game play.

Facial EMG. In terms of corrugator activity, significant main effects of past violent video game exposure or game condition on changes in corrugator activity were not detected during the first two minutes of the five one-minute intervals. In addition, the interaction between past violent video game exposure and video game condition on changes in corrugator activity was not significant during the first two minutes.

During the third minute of game play, a significant main effect of past violent game exposure on corrugator activity was detected ($\beta = .20$, $p < .05$), such that higher exposure to violent video games was associated with higher corrugator activity during game play. However, a significant interaction effect between past game exposure and video game condition on corrugator activity was not detected.

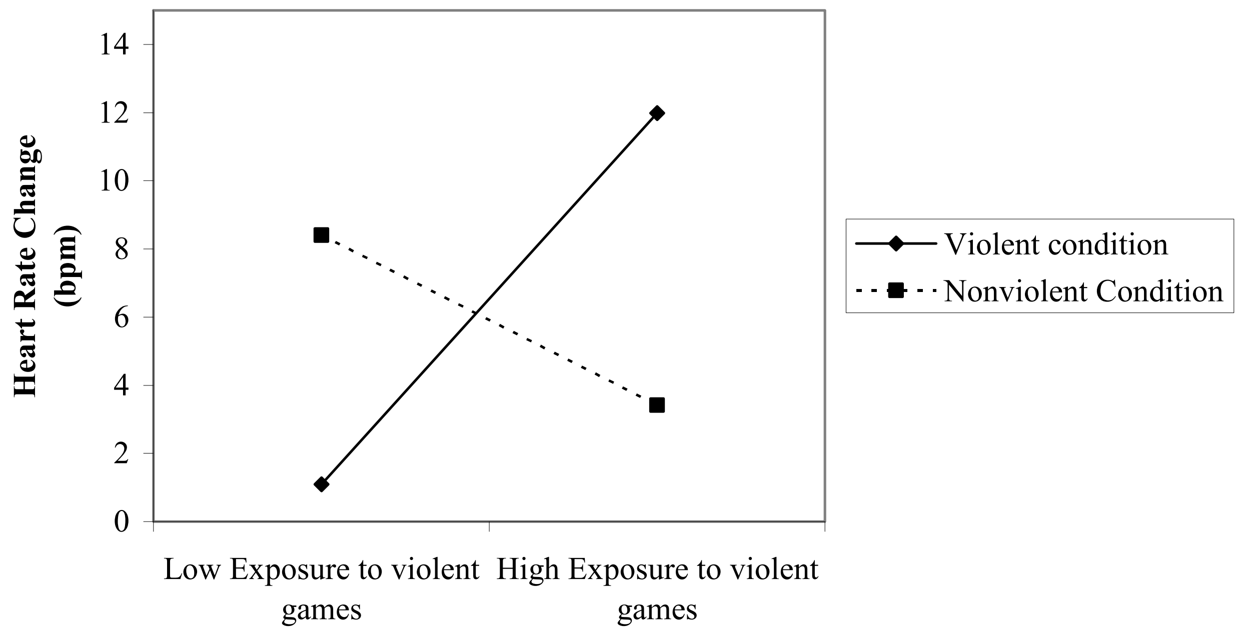
During the fourth and fifth minutes of game play, significant main effects of past violent video game exposure on corrugator activity were not detected. In addition, the interaction between past violent video game exposure and violent video game condition on corrugator activity was not significant.

In terms of zygomaticus activity, significant main effects of past violent video game exposure or game condition on changes in zygomaticus activity were not detected during any of the five one-minute intervals. In addition, the interaction between past violent video game exposure and violent game condition on changes in zygomaticus activity was not significant.

Heart rate. During the first minute of game play, a significant main effect of past violent video game exposure or violent video game condition on changes in heart rate was not detected. In addition, the interaction between past violent video game exposure and violent game condition on changes in heart rate was not significant.

During the second minute of game play, a significant main effect of past violent video game exposure or violent video game condition on changes in heart rate was not detected. However, a marginally significant interaction between past violent video game exposure and violent video game condition on changes in heart rate was found ($b = 7.94$, $p < .06$). Explication of this interaction revealed a positive association approaching significance between past violent game exposure and increases in heart rate for participants who engaged in violent video game play ($\beta = .26$, $p < .10$) but not for participants who engaged in non-violent video game play ($\beta = -.12$, $p =$ n.s.). This marginally significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in heart rate was more positive for individuals who engaged in violent, relative to non-violent, video game play (see Figure 5).

Figure 5. Effect of violent video game exposure and video game condition on change in heart rate (Minute 2).



During the third minute of game play, significant main effects of past violent video game exposure or violent video game condition on changes in heart rate were not detected. However, a significant interaction effect was found ($b = 11.47, p < .05$). Decomposing this interaction revealed a significant positive association between past violent game exposure and increases in heart rate for participants who engaged in violent video game play ($\beta = .44, p < .01$) but not for participants who engaged in non-violent video game play ($\beta = -.08$, p = n.s.). This finding indicated that greater past exposure to violent video games was positively associated with increased heart rate for individuals who engaged in violent, relative to non-violent, video game play (see Figure 6).

During the fourth minute of game play, there was a significant main effect of video game exposure on heart rate ($\beta = .25, p < .05$), such that more exposure to violent video games was associated with a higher heart rate during game play. A significant interaction was also found ($b = 8.75, p < .05$). Explication of this interaction revealed a significant positive association between past violent game exposure and increases in heart rate for participants who engaged in violent video game play ($\beta = .54, p < .001$) but not for participants who engaged in non-violent video game play ($\beta = .02$, p = n.s.). This finding indicated that greater past exposure to violent video games was positively associated with increased heart rate for individuals who engaged in violent, relative to non-violent, video game play (see Figure 7)

During the fifth minute of game play, there was a significant main effect of video game exposure on heart rate ($\beta = .20, p < .05$), such that more exposure to violent video games was associated with higher heart rates during game play. However, the interaction between past violent video game exposure and violent game condition on changes in heart rate was not significant.

Figure 6. Effect of violent video game exposure and video game condition on change in heart rate (Minute 3).

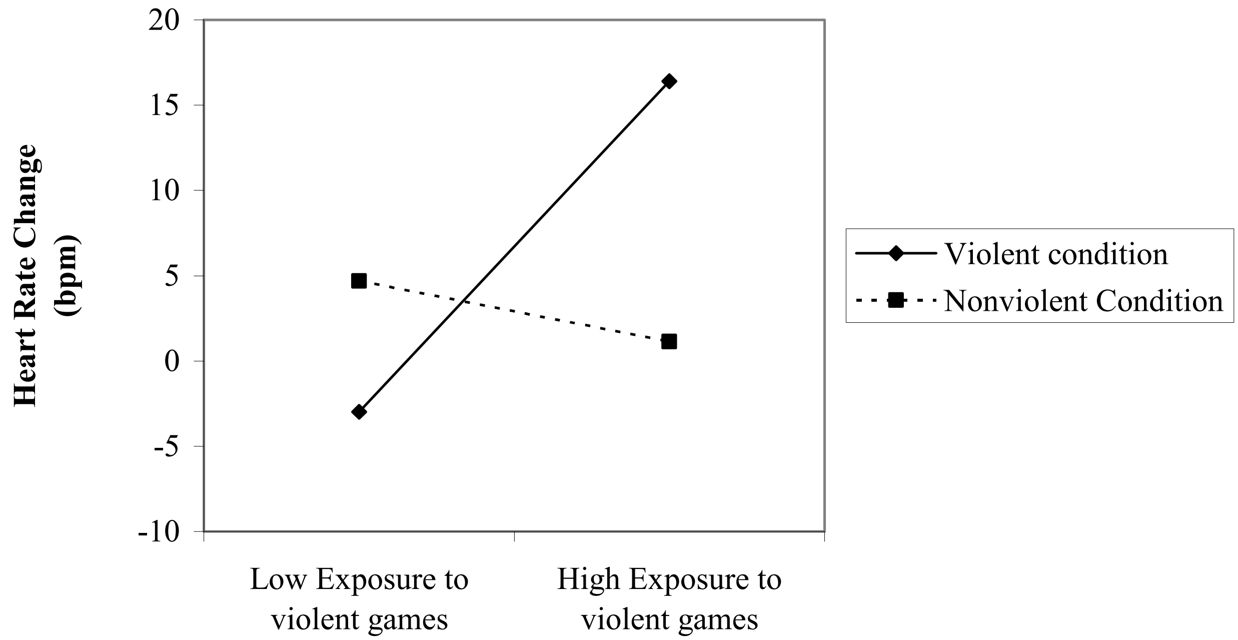
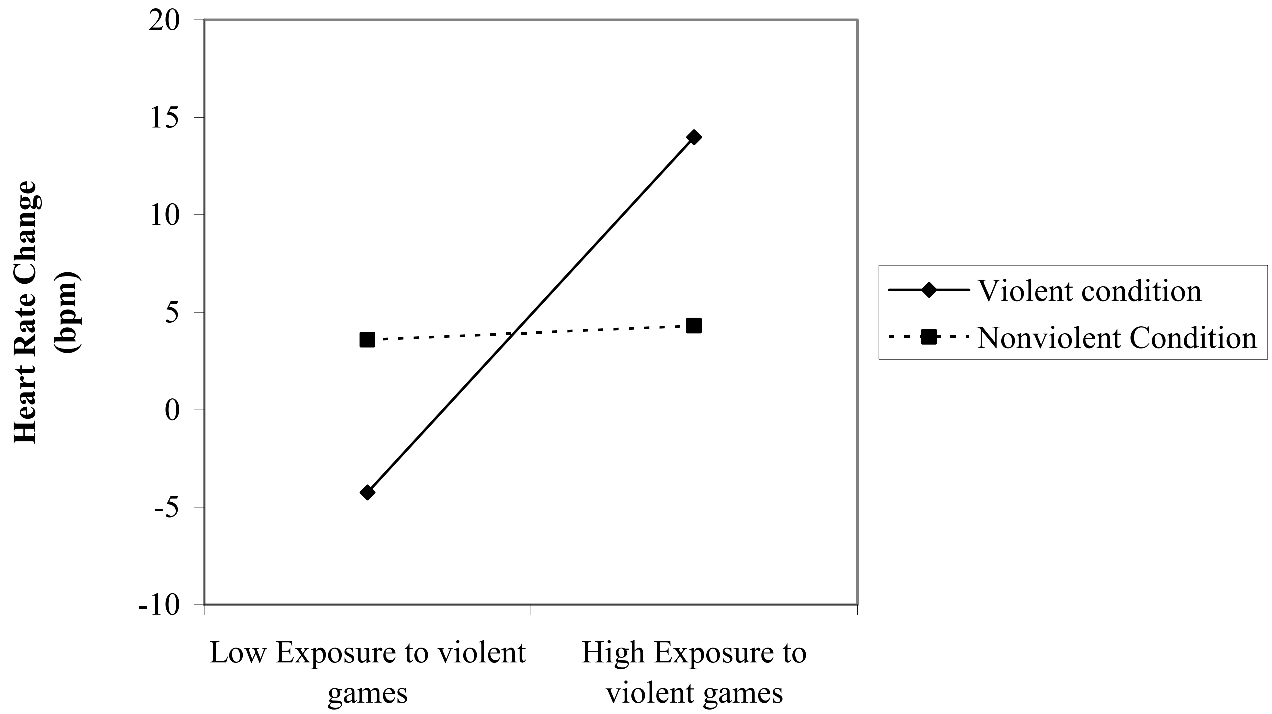


Figure 7. Effect of violent video game exposure and video game condition on change in heart rate (Minute 4).

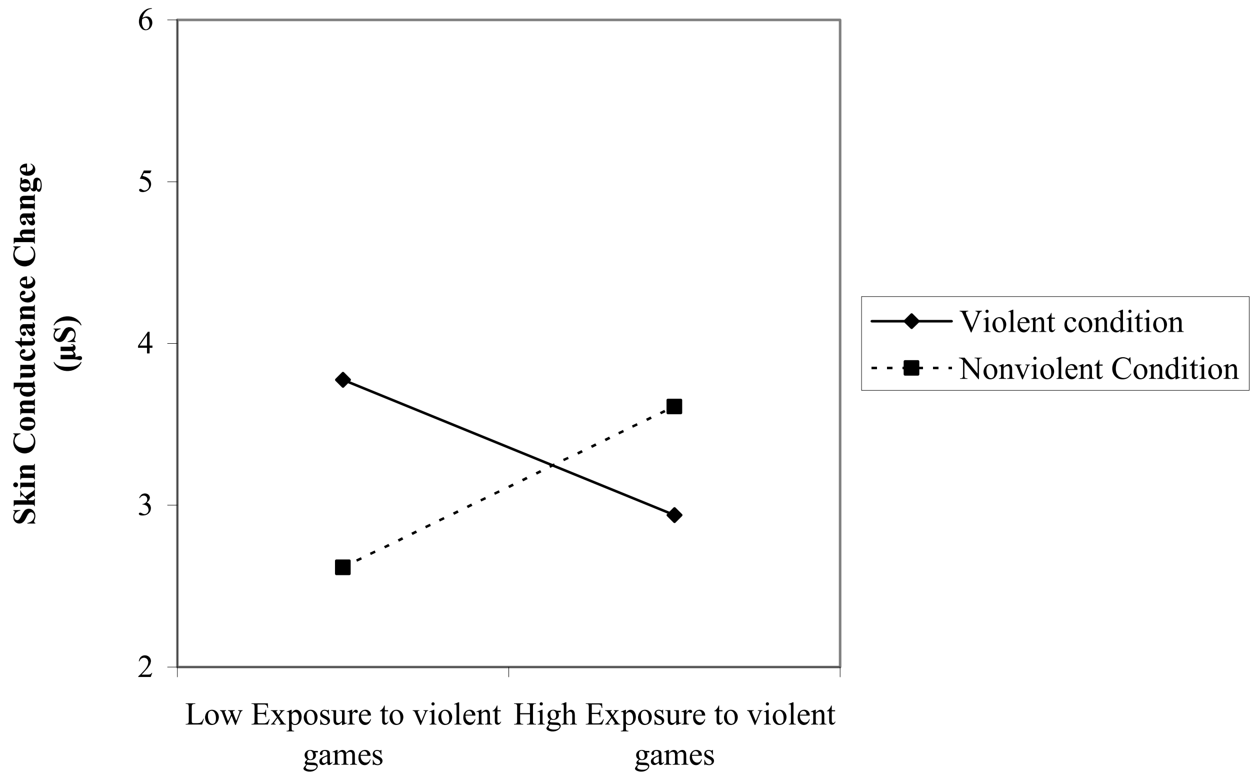


Self-reported affect. A significant main effect of video game exposure or violent video game condition on changes in self-reported negative or positive affect was not found. Likewise,the interaction between video game exposure and violent video game condition was not significant.

Skin conductance. Significant main effects of video game exposure and video game condition on changes in skin conductance were not found during the first minute of game play. However, a marginally significant interaction was found ($b = -.92$, $p < .07$). Explication of this interaction revealed a positive but non-significant association between past violent game exposure and increases in skin conductance for participants who engaged in non-violent video game play ($\beta = .21$, p = n.s.) and a negative but non-significant association between past violent video game exposure and increases in skin conductance for participants who engaged in violent video game play ($\beta = -.18$, p = n.s.). Nevertheless, this marginally significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in skin conductance was more positive for individuals who engaged in non-violent, relative to violent, video game play (see Figure 8).

During the second minute of game play, significant main effects of video game exposure and video game condition on skin conductance were not found. However, a significant interaction between video game exposure and violent video game condition was detected ($b = -1.05$, $p < .05$). Explication of this interaction revealed a positive but non-significant association between past violent game exposure and increases in skin conductance for participants who engaged in non-violent video game play ($\beta = .22$, p = n.s.) and a negative but non-significant association between past violent video game exposure and increases in skin conductance for

Figure 8. Effect of violent video game exposure and video game condition on change in skin conductance (Minute 1).



participants who engaged in violent video game play (β = -.20, p = n.s.). Nevertheless, this significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in skin conductance was more positive for individuals who engaged in non-violent, relative to violent, video game play (see Figure 9).

During the third minute of game play, significant main effects of video game exposure or video game condition on skin conductance were not found. However, a significant interaction between video game exposure and violent video game condition was found (b = 1.08, $p < .05$). Explication of this interaction revealed a positive but non-significant association between past violent game exposure and increases in skin conductance for participants who engaged in non-violent video game play (β = .19, p = n.s.) and a negative but non-significant association between past violent video game exposure and increases in skin conductance for participants who engaged in violent video game play (β = -.22, p = n.s.). Nevertheless, this significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in skin conductance was more positive for individuals who engaged in non-violent, relative to violent, video game play (see Figure 10).

During the fourth minute of game play, significant main effects of video game exposure or video game condition on skin conductance were not found. However, a significant interaction between video game exposure and violent video game condition was found (b = -1.08, $p < .05$). Explication of this interaction revealed a positive but non-significant association between past violent game exposure and increases in skin conductance for participants who engaged in non-violent video game play (β = .21, p = n.s.) and a negative but non-significant association between past violent video game exposure and increases in skin conductance for participants who engaged in violent video game play (β = -23, p = n.s.).

Figure 9. Effect of violent video game exposure and video game condition on change in skin conductance (Minute 2).

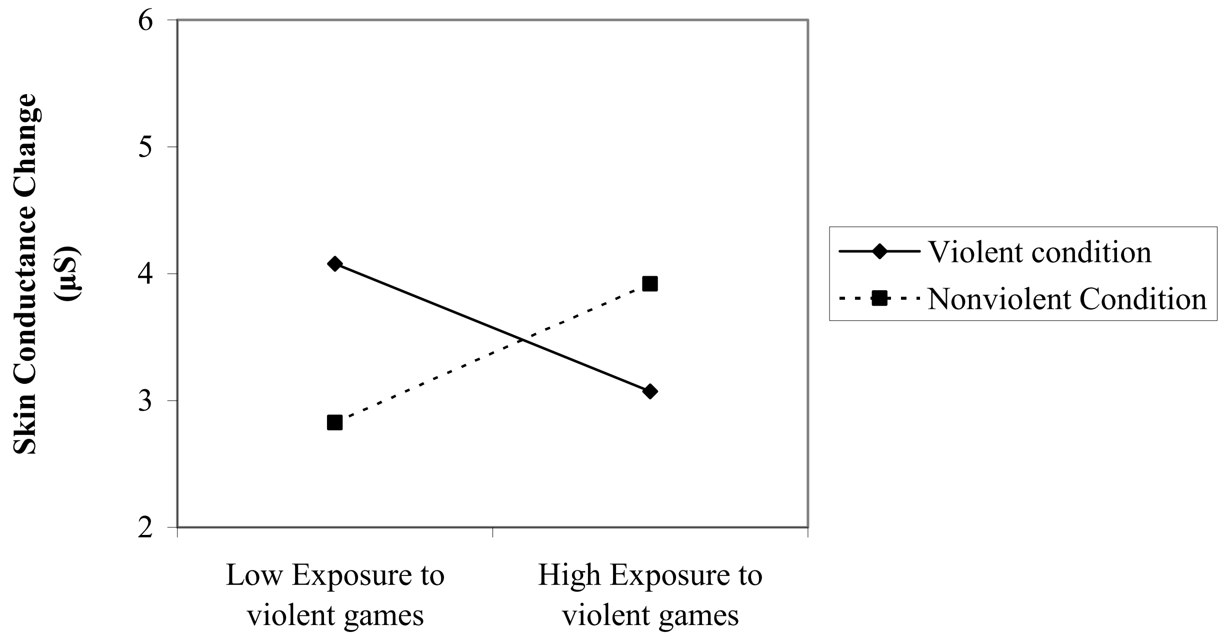


Figure 10. Effect of violent video game exposure and video game condition on change in skin conductance (Minute 3).

Nevertheless, this marginally significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in skin conductance was more positive for individuals who engaged in non-violent, relative to violent, video game play (see Figure 11).

During the fifth minute of game play, significant main effects of video game exposure or video game condition on skin conductance were not found. However, a significant interaction between video game exposure and violent video game condition was found (b = -1.39, $p < .05$). Explication of this interaction revealed a positive but non-significant association between past violent game exposure and increases in skin conductance for participants who engaged in non-violent video game play (β = .25, p = n.s.) and a negative but non-significant association between past violent video game exposure and increases in skin conductance for participants who engaged in violent video game play (β = -.22, p = n.s.). Nevertheless, this marginally significant interaction effect suggested that the pattern of covariation between past violent videogame exposure and increases in skin conductance was more positive for individuals who engaged in non-violent, relative to violent, video game play (see Figure 12).

Alternative Data Analysis.

The preceding analysis of physiological responses compared experimental intervals to the corresponding baseline interval (e.g., difference between minute 1 of game play and minute 1 of baseline). However, as previously discussed, it could be argued that differences scores should be computed by comparing experimental intervals to the average physiological reading (e.g. heart rate, skin conductance, facial EMG) of the *entire* baseline period (i.e., across the five-minute baseline period). Pertinent analyses were repeated with using this approach. Thus, the average physiological response during the entire baseline period was subtracted from each one-minute

Figure 11. Effect of violent video game exposure and video game condition on change in skin conductance (Minute 4).

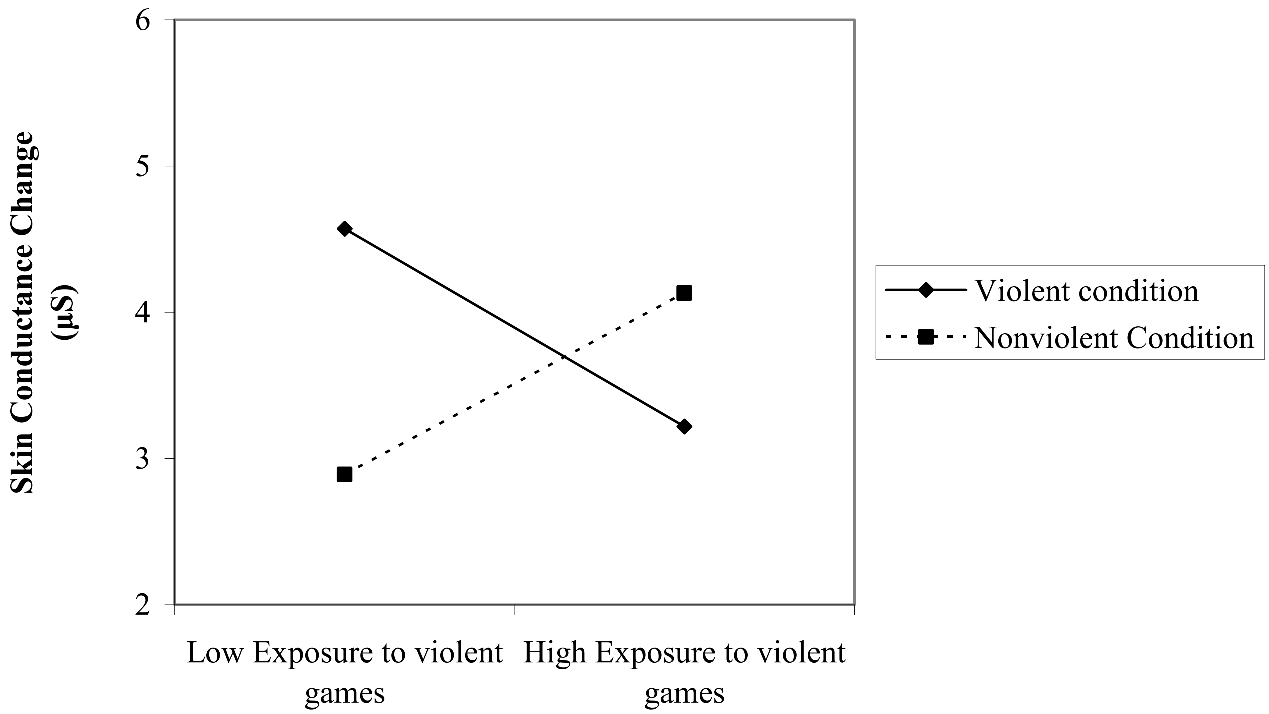
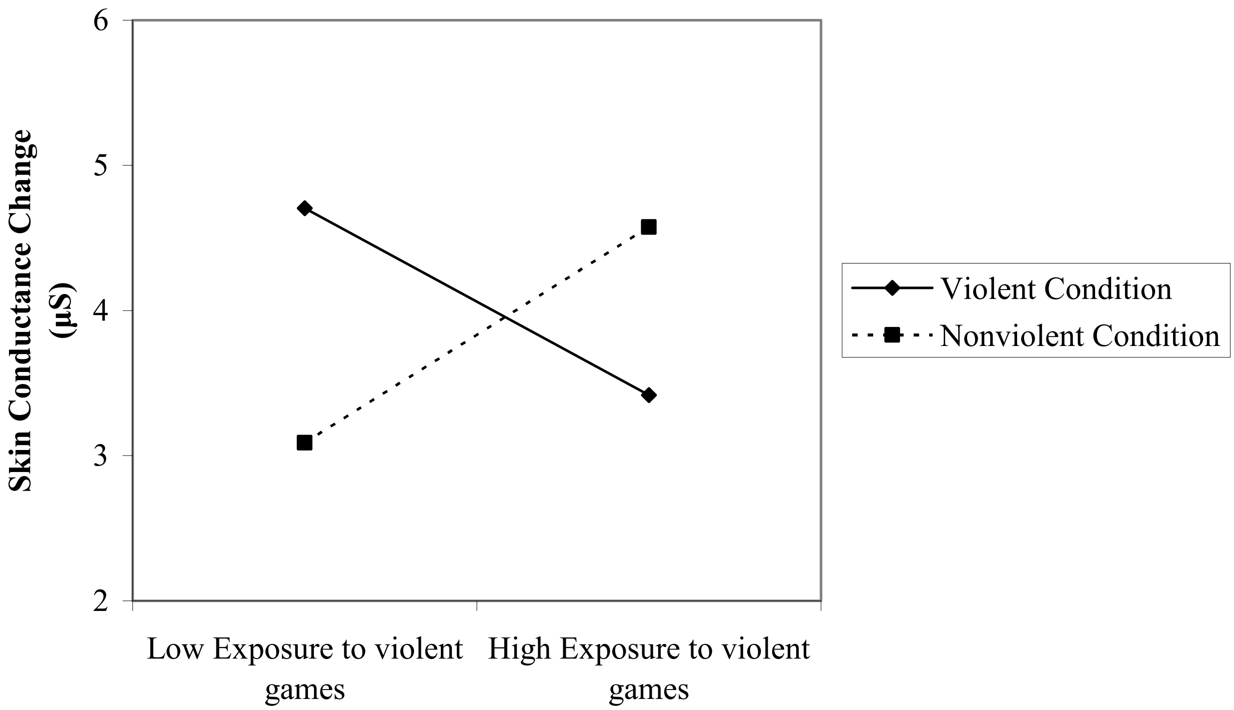


Figure 12. Effect of violent video game exposure and video game condition on change in skin conductance (Minute 5).



interval during game play. Using this alternate approach, the same pattern of findings emerged. Indeed, there was no instance where the alternate strategy produced a marked difference in results. Therefore, it was determined that the present findings were not dependent upon the strategy used for calculating difference scores.

CHAPTER 4: DISCUSSION

The purpose of the present study was to examine the independent and joint effects of individual differences and situational factors on affective and physiological reactivity to playing a violent video game. Following the GAM, this study sought to examine the effects of trait aggression and past exposure to violent video games (which correspond to the individual inputs in the GAM) and violent or nonviolent game condition (which correspond to situation inputs) on the elicitation of arousal and affect (i.e., changes in present internal state). The following hypotheses were advanced: 1) Trait aggression would be positively related to increased arousal among participants in the violent, but not the non-violent game condition, 2) Trait aggression would be positively related to negative affect among participants in the violent, but not the non-violent, video game condition, 3) Past exposure to violent video games would be positively related to arousal among participants in the violent, but not the non-violent game condition, and 4) Past exposure to violent video games with be positively related to negative affect among participants in the violent, but not the non-violent game condition.

Trait Aggression and Violent Game Condition

Arousal. The hypothesis that trait aggression would be positively related to increased arousal among participants in the violent condition was not supported. Specifically, analyses failed to detect a significant positive association between trait aggression and increased arousal (i.e., heart rate, skin conductance) among individuals in the violent video game condition. However, contrary to this hypothesis, trait aggression was positively associated with increased skin conductance activity among individuals in the *nonviolent* video game condition. This pattern persisted from the second through the fifth minute of game play.

A possible explanation for these findings is that trait aggressive individuals became frustrated because they were instructed to play the game in a way (i.e., using non-violent tactics) that differs from what they would prefer (i.e., using violent tactics). Indeed, several studies across a variety of settings (Berkowitz, 1981; Anderson, Deuser, Deneve, 1995; Mahood, 2007) have demonstrated increased arousal due to frustration. In the present study, all participants were informed during the pre-game training session that there was the option to shoot, punch, or kick the guards. Participants in the violent game condition were then told to avoid detection by the guards and kill all the guards in order to progress to the next level. In contrast, participants in the non-violent game condition were then told to avoid the guards *without* killing the guards. Although not formally measured in this study, during debriefing, many participants in the non-violent video game condition expressed disappointment that they were unable to attack the guards. Considering these factors, it is possible that individuals who reported higher levels of trait aggression became frustrated at being unable to attack the guards. This increased frustration, in turn, potentially led to higher levels of arousal.

Although trait aggression was counterintuitively associated with increased skin conductance during nonviolent game play, this finding is still consistent with the GAM. Specifically, it is plausible that the inputs of trait aggression and video game condition interacted to cause a change in internal state, in this case, frustration. Inasmuch as the internal states of affect and arousal are associatively linked, participants' frustration subsequently mediated the effects of game play arousal. In future studies, it would be helpful to distinguish between arousal caused by the game condition and arousal created by frustration. Work has already begun in this area of research. Anderson, Gentile and Buckley (2007) measured frustration among men and women who played violent and non-violent games. Results indicated that the non-violent game was rated as being more frustrating than the violent game and that men expressed more frustration than women. These findings support the possibility that frustration increased arousal in the present sample of men. To account for this confound, future research could statistically control for frustration in pertinent analyses (Anderson et al., 2007). In addition, game play condition might be treated as a repeated measure, such that participants play *both* violent and non-violent video games with a "washout" period in between. Because participants would presumably be less frustrated while playing the non-violent game, this design may permit a better comparison of changes in arousal for both conditions. Using either or both of these techniques, future researchers could then better determine the effect of trait aggression on arousal during violent and nonviolent game play and whether frustration is influencing this relationship.

There was no association between trait aggression and increased heart rate in either the violent or the nonviolent conditions. This pattern remained consistent throughout the five-minute game play period. This finding was contrary to expected results for the present study, as well as past video game research (Ballard & Wiest, 1996; Fleming & Rickwood, 2001). Interestingly, however, a similar pattern was reported by Panee and Ballard (2002), who employed methodology similar to the present research. This difference may be explained by a primary methodological difference between previous studies and the present research (including Panee and Ballard's study). Previous research compared either dissimilar game *types* (e.g., paper and pencil vs. violent video games) or dissimilar game *genres* (e.g., Doom vs. Tetris). In contrast, the present research, like Panee and Ballard (2002), used a single game with either violent or non-violent instructions. These differences suggest that previous research may have confounded video game play with game action that tends to elicit arousal. Thus, because "non-violent" video games (e.g., Tetris) were devoid of action comparable to "violent" video games (e.g., Doom), individuals who played non-violent games evinced significantly less arousal than individuals who played violent games. In contrast, the present research and that of Panee and Ballard (2002) required participants to engage in game action that varied in violent content but not in game action. Future research should consider how this methodological difference might influence participants' patterns of arousal in response to violent video games.

Affect. Results did not support the hypothesis pertinent to the effects of trait aggression on affect during violent video game play. A marginally significant positive association between trait aggression and self-reported negative affect was found. However, this main effect indicated that higher levels of trait aggression were associated with increased self-reported negative affect regardless of video game condition. This finding suggests that whether one is playing a violent or a nonviolent video game does not matter as much as one's level of trait aggression when determining whether they would display an increase in negative affect after playing a video game. The explanation of one's trait aggression being an important consideration when measuring the effects of violent video games on increases in negative affect is consistent with prior research on violent video games (Bushman, 1995). Further, this finding suggests that the individual input of trait aggression may be more important than the situational input of game condition in describing the effect of video games on affect. As such, it may be necessary to control for or include trait aggression as a moderator in a model when making predictions about a variable's impact on changes in negative affect.

Analyses did not detect an effect of trait aggression on changes in facial EMG. As reported by Hubbard and colleagues (2004), one explanation for this finding is that emotion may be manifested differently across different response systems (e.g., self-report and physiological measurements). Although individuals high in trait aggression reported increased negative affect, a comparable increase in negative affect was not manifested in facial EMG. Prior video game research (Anderson & Dill, 2000; Anderson & Ford, 1986; Ballard & Wiest, 1996; Carnagey & Anderson, 2005) has relied on self-report measures to assess increases in negative affect, but only one other study (Ravaja, Turpeinen, Saari, Puttonen, & Keltikangas-Jarvinen , 2008) was identified that used corrugator activity as a measure of negative affect in response to playing a violent video game. Although facial EMG activity is a reliable, unconscious physiological measure of affect (Cacioppo, Petty, Losch & Kim, 1986; Larsen, Norris, & Cacioppo, 2003), other research has shown that other factors, such as intensity of the stimuli, may also affect the degree to which an individual shows physiological reactivity in terms of positive and negative affect (Bernatt, Patrick, Benning, & Tellegren, 2006). In their study, Bernatt and colleagues (2006), defined intensity as being the level of arousal a stimulus evokes combined with the level of positive or negative valence of that stimulus. They observed that while corrugator activity was shown to decrease as stimuli intensity increased, zygomaticus activity was shown to increase with increases in stimuli intensity. They concluded that intensity can influence one's level of positive or negative affect. It is possible that the game used in the present study was not sufficiently intense (particularly in terms of valence), and so while increased arousal was detected with other measures, changes in affect were not. Taken together, these findings illustrate the benefit of using physiological measures in conjunction with self-report measures to obtain a more comprehensive picture of how affect is (or is not) influenced by trait aggression and violent video games. Given this, future studies may benefit from further exploring the difference between the effects of trait aggression and violent video games on self-reported affect and the effects of trait aggression and violent video games on physiological measures of affect.

The present study did not find a relationship between trait aggression or video game condition and self-reported positive affect. However, during the fifth minute of the five-minute video game play, a marginally significant interaction between trait aggression and condition was found for zygomaticus activity. In this final minute, higher levels of trait aggression were associated with more positive affect among individuals who engaged in non-violent, but not violent, game play. This finding suggests that trait aggression leads to increased positive affect as non-violent game play persists. However, this result is not consistent with the aforementioned interpretation that high trait aggressive individuals who were instructed to use non-violent strategies became more frustrated as game play persisted. Thus, it is possible that the finding for positive affect is spurious. Nevertheless, as previously mentioned, it would be useful for future studies to utilize both self-report and physiological measures of affect to better understand how trait aggression and violent video games influence changes in an individual's affect.

It is worth considering these null results within the context of the GAM. Specifically, in the present study, this particular combination of inputs (trait aggression and game condition) did not change a person's internal state (i.e., affect). According to the GAM, affect, cognition, and emotion may co-occur in any combination, but changes in all three do not always happen. It is possible that the violent and non-violent conditions were not sufficiently different enough to cause a change in affect. Further manipulating the environmental input (i.e., making the violent condition more violent, reducing the feeling of threat or frustration, etc.) may change this relationship. In addition, there was wide variability among those individuals in the violent group in terms of how violent they viewed the game as being. It would be worthwhile in future studies to further divide groups into those who viewed the game as being more violent and those viewed it as less violent. Exploring these group differences may show a different pattern of changes in affect.

Past exposure to violent video games and game condition

Arousal. The hypothesis that past exposure to violent video games would be positively related to increased arousal in the violent, but not the non-violent video game condition received mixed support. Contrary to the second hypothesis of this study, past exposure was positively associated with increased skin conductance activity in the *nonviolent* video game condition, but not in the violent game condition. This pattern was evident throughout the five minutes of game play. As with trait aggression, increased arousal during the non-violent condition may be explained by participants becoming frustrated. Indeed, individuals with greater exposure to violent video games may been particularly eager to use violent strategies during video game play. However, after receiving pre-game training (e.g., how to punch, kick, and shoot), some of these individuals were instructed to *not* use any of these tactics.

It is also possible that participants with an extensive history of playing violent video games had an aggressive “script” in mind of how they would play the game. According to the GAM, those individuals with greater exposure to violent games have a greater network of cognitive associations with aggressive acts (Anderson & Bushman, 2002). Studies (Bartholow, Sestir, & Davis, 2005; Kirsh, Mounts, & Olczak, 2006) have proposed that priming individuals with aggression may cause them to view even non-violent cues in a more aggressive way. Inasmuch as these hostile cognitions are linked to arousal, this may explain why these individuals exhibited higher arousal in a non-violent game.

Interestingly, when in the violent condition, although the finding was not significant, those higher in trait aggression show lower skin conductance that those lower in trait aggression.

It is possible that individuals who are accustomed to violent video game play were also desensitized to violence. They may actually feel more comfortable in the more violent condition. This interpretation might explain why a relation between past video game exposure and skin conductance was not found among individuals in the violent video game condition. Indeed, greater familiarity with violent video games might explain why some studies have found that individuals are desensitized to violence (Carnagey, Anderson, & Bushman, 2006; Funk, Baldacci, Pasold, & Baumgardner, 2004), while others show increases in arousal (Baldaro, Tuozzi, Codispoti, et. al, 2004; Fleming & Rickwood, 2001; Schneider, Lang, Shin, and Bradley, 2004). If researchers account for past exposure to violent video games, it is possible that they will be better able to detect changes in arousal associated with playing violent video games. Indeed, future studies need to examine past exposure to violent video games so that they can obtain a clearer understanding of how playing violent video games influences arousal.

In contrast to analyses for skin conductance, the hypothesis that past exposure to violent video games would be positively related to increased arousal in the violent, but not the non-violent video game condition, was partially supported by analyses for heart rate. During the second, third and fourth minutes of violent game play (but not non-violent game play), a significant positive association was found between past exposure to violent video games and heart rate. This association was marginally significant in the second minute of violent game play and not significant during the first and fifth minutes of game play. In the fifth minute of game play, greater past exposure to violent video games was positively associated to increases in heart rate for participants in both the violent and the non- violent condition. Importantly, this pattern of findings did not emerge during any of the five time intervals among participants who played a nonviolent videogame. Interestingly, this effect lasted for only a short period of time (i.e., about

2-3 minutes). These data suggest that, after "acclimating" to playing a video game (i.e., during the first minute), individuals who reported higher levels of exposure to violent video games evinced greater increases in heart rate during the early stages of violent game play. This finding is consistent with other literature that use the GAM as a model to explain video game effects on arousal (Anderson & Dill, 2000; Anderson, Gentile, & Buckley, 2007), in that individuals with greater past exposure to violent video games show higher arousal when playing violent video games. Collectively, these data suggest that individual inputs play a role in how individuals respond physiologically to the type of game (e.g. violent or non-violent) they play. It appears that those higher in past exposure to violent video games show greater increases in heart rate in response to violent video games than those lower in past exposure to violent video games, but this effect does not last long. Future studies can study these phenomena for longer periods and see if these effects persist.

On the surface, it would appear that these findings are at odds with the findings that individuals higher in trait aggression demonstrated more arousal (e.g., skin conductance activity) during the non-violent video game, but not the violent video game condition. A plausible explanation for these divergent findings exists. Research on the relationship between skin conductance and heart rate (Lazurus, Spiesman, & Mordkoff, 1961) has indicated that while changes in skin conductance and heart rate are both indicators of autonomic response, the type of stimuli used may differentially influence responses. Additionally, relative to measures of heart rate, skin conductance has been demonstrated to be a somewhat more "pure" measure of emotional arousal (Hubbard, Parker, & Ramsden, et. al (2004), meaning that while skin conductance is primarily used for arousal, heart-rate may also may also measure attention. Therefore, participants with higher past exposure to violent video games are experiencing increased arousal in both conditions, but this arousal is manifested differently, based on how the player is playing the game, and possibly how much the individual is concentrating on the task. This finding has interesting implications for future research. To capture the full range of responses individuals have to video games, it is important for researchers to use multiple physiological measures, so that they can fully capture the patterns of physiological responses associated with both violent and non-violent video game play.

Affect. The hypothesis that past exposure to violent video games would be positively related to increased negative affect in the violent, but not the non-violent, video game condition was not supported. During the third minute of game play, there was a main effect of past violent video game exposure on corrugator activity. This finding indicated that more exposure to violent video games was associated with increased corrugator activity during game play (regardless of game play condition). If those with greater exposure to violent video games are rehearsing aggressive scripts, it is possible that they are also going to experience increased negative affect. Further, since this occurs in both violent and non-violent conditions, it suggests that affective responding was influenced more by individuals' exposure to violent video games than by the type of game condition (violent or non-violent). However, since this only corresponded to the third minute of game play, there is not enough support to definitively state that greater past exposure to violent video games increased negative affect.

It is worth considering these null results within the context of the GAM. Specifically, the inputs of past exposure to violent video games and video game condition do not lead to an increase in negative affect. One likely explanation is the individuals enjoy playing the game, so they are experiencing both negative and positive affect. This enjoyment of the video game may moderate the relationship between the inputs and changes in the internal state of affect. Future studies should include video game enjoyment as a covariate and see if controlling for this enjoyment may change the influence of violent video games on increases in negative affect.

In terms of self-reported positive affect and positive affect as measured by zygomaticus activity, no significant relationship was found between past exposure to violent video games and positive affect. This is consistent with previous findings. Again, citing Bernatt and colleagues (2006), there was likely not enough game intensity to increase positive affect significantly. One way that may increase the intensity of the game is to vary the level of gore in the game. The predictor variable under investigation, past violent video game exposure, was created in part by having participants rate how violent and how realistic their favorite video games are. If a person has greater past exposure to violent video games, we may find that it may actually *increase* the person's positive affect, as they may be more accustomed to games that contain more gore. Future research should continue to study the relationship between exposures to violent games and affect to see if this pattern persists.

Strengths of the present study design

Past video game research has sought to determine the effects of violent video games on future aggression. However, it has been argued that there are numerous methodological and theoretical problems that complicate the interpretation of this literature. The present study was designed to both explore the relationships of trait aggression and exposure to violent video games on arousal and affect, as well as to address many of the limitations of previous video game studies. These limitations include reliance on self-report, limited training on the game, and comparison of dissimilar game types/genres.

One of the strengths of the present study's design is the use of both physiological and self-reported affect. This differs from previous video games studies (Anderson & Dill, 2000;

Anderson & Ford, 1986; Ballard & Wiest, 1996; Carnagey & Anderson, 2005), which often relied primarily on self-reported affect. Results of the present study demonstrated the importance of having multiple measures, as one measure may detect changes in affect or arousal, while the other might not. By using physiological measures in conjunction with self-report measures, this study was able to observe both conscious and unconscious measures of affect, thus being more inclusive of affect responses to violent video games.

Another strength of the present study's design is the fact that the study included a training session to familiarize the player with the game controls. By allowing participants to demonstrate that they could perform the controls, and by allowing participants to play at their own pace for five minutes during the game play trials, the potential for participant frustration due to not knowing how to perform the task was minimized. This procedure also limited the boredom of the participants, which could have occurred with longer trials.

The greatest strength of the present study design was having individuals in both conditions play the same game, rather than two different games. Unlike other video game studies, which typically used games of different genres, this study used two very similar versions of the same game. By using two versions of the same game, which differed primarily on the inclusion of a weapon only in the violence condition, this study arguably had a more internally valid contrast between violent and nonviolent video games. There are some potential drawbacks to this approach. One concern on the onset of the study was that the violent and non-violent conditions would not be sufficiently different enough to elicit different patterns of arousal and negative affect. To a certain extent, this concern was realized, in that individuals did not show significantly different patterns of facial EMG activity between the two conditions. Additionally, individuals in both conditions were not given a great deal of choice of techniques they could use to progress in the game. For example, participants in the nonviolent condition could not progress to next board if they attacked the guards, and those in the violent condition could not go to the next board until they killed all of the guards on that board. Nevertheless, this design allowed for much more experimental control than the use of two separate violent and non-violent video games.

Given these strengths, there are some interesting implications raised by this study for future video game research. Although past video game studies and the present study based their models on the GAM, they have very different patterns of results. For example, the divergent patterns of arousal suggest that future researchers need to consider multiple measures of arousal, as different measures may reflect aspects of arousal. The findings also indicate the importance of study design and how it might have influenced the patterns of findings for past research (e.g., higher arousal caused by violent, but not nonviolent, games). More importantly, null findings of this study call into question the conclusions drawn by past researchers about how violent video game play increases arousal and, in turn, potential increases the likelihood of future aggressive acts. A suggested line of future research would be for researchers to conduct studies using the methods used in the present study and see if the patterns of earlier findings are replicated.

Limitations to the present study design

Although there were several areas in which the present study improved upon past violent video game research, there are some limitations that should be considered. First, the present sample was comprised exclusively of male participants because men reflect the typical demographic of video game players (ESA, 2006). Although this sampling strategy controlled for possible gender effects, it also limited the external validity of the findings. Indeed, some research suggests that women are affected differently than men by violent games (Chory &

Cicchirillo, 2007). Future studies may explore if women show a similar pattern of physiological changes due to trait aggression or past exposure to violent video games. In addition, the age of the study participants may have influenced the findings. While this study focused on 18-35 year olds, research has suggested the children and adults are affected differently by exposure to violent games (Gentile, Lynch, Linder, & Walsh, 2004; Bushman & Huesmann, 2006). Since much of the concern of how violent video games affect people is centered on children, future research may need to sample from a younger population. In this line of research, it will be necessary to utilize video games that include violence, yet can be played by individuals younger than 18 years old (e.g., games rated to be acceptable for teens to play, rather than adults).

Future Directions

Despite its limitations, the present study demonstrated that changes in study design could influence the direction of findings in violent video game research. Future research can expand these findings in a variety of ways. For instance, participants could be required to engage in violent or non-violent game play for different periods of time (e.g., five minutes, ten minutes, etc.). This would enable researchers to see how long these effects last as well as how the pattern of results change after a longer period of game play.

Another direction for future research involves investigating how other individual difference variables may mitigate the effects of violent video game play on aggression. It is possible that other personality differences moderate the effects of violent video games on changes in affect or arousal. An important component of this is *how* they play the game, in terms of playing alone, with friends, online, etc. Research in this area (Eastin & Griffiths, 2006) suggests that people are affected differently by games, based on whom the person plays with, and whether they play the game online or not.

In addition, for children, results from Anderson, Gentile and Buckley (2007) are promising in the exploration of parental involvement with media violence exposure as a moderator. In this line of research, exposure to media violence was positively related to self-reported violent behavior when their parents were not involved in media selection, but this effect disappeared when parents were involved. It is possible that parental involvement in media choices, parents' and peers own usage of violent media, and the child's overall level of access to violent games may play a role in how aggressive they become after playing violent video games.

Another way to extend findings is to utilize a longitudinal design for this study. Often, video game studies focus on the short-term effects of violent video game, but neglect the long-term effects. It is possible that people are more (or less) affected by exposure to violent video games over time, and this can influence whether they act more aggressively or if they learn other techniques for dealing with this aggression. Finally, as suggested by Sherry (2001), future research can focus on different *elements* of the game itself. This can include looking at how graphics, game challenge, and enjoyment of the game can ultimately influence their responses to the game. It is possible that these elements can be added, adjusted, or removed to reduce the likelihood of future aggression occurring. For example, if it found that introducing more "save points", which saves the player's progress, could reduce the frustration (and possible future aggression) they may feel from having to constantly restart a board, game designers may take this under consideration, and improve these elements. Overall, there are numerous ways in which the present study's design can be expanded to increase knowledge of how violent video games influence video game players.

Conclusion

Although patterns of the effects of violent video games and arousal were somewhat different from expected findings for the present study, it demonstrates the flexibility of the General Aggression Model in studying these effects. It is apparent that by expanding the measures and the methodology of video game research, interesting and different patterns of arousal and affect emerge. This is not to say that one should use multiple physiological or self-report measures in the hopes of simply “finding something”; rather it illustrates that there are different components of arousal and affect (i.e. attention, valence, etc.), and that one cannot fully establish the effects of video games on emotional reactivity without the use of multiple measures. Moreover, the findings of the present study reinforce that research on the effects of violent video games is a relatively young field, and that there are various routes researchers can explore before a definitive statement can be made about these effects.

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Appendix A

Buss-Perry Aggression scale (BAQ; Buss and Perry, 1992)

Instructions: For each of the following below, please circle a number that best indicates how the statement applies to you. Answer according to the following scale:

1 - Extremely uncharacteristic of me
2 -
3 - Moderately characteristic of me
4 -
5- Extremely characteristic of me

1. Once in a while I can't control the urge to strike another person	1	2	3	4	5
2. I tell my friends openly when I disagree with them	1	2	3	4	5
3. I flare up quickly but get over it quickly	1	2	3	4	5
4. I am sometimes eaten up with jealously	1	2	3	4	5
5. Given enough provocation, I may hit another person	1	2	3	4	5
6. I often find myself disagreeing with people	1	2	3	4	5
7. When frustrated, I let my irritation show	1	2	3	4	5
8. At times I feel I have gotten a raw deal out of life	1	2	3	4	5
9. If somebody hits me, I hit back	1	2	3	4	5
10. When people annoy me, I may tell them what I think of them	1	2	3	4	5
11. I sometimes feel like a powder keg ready to explode	1	2	3	4	5
12. Other people always seem to get the breaks	1	2	3	4	5
13. I get into fights a little more than the average person	1	2	3	4	5
14. I can't help getting into arguments when people disagree with me	1	2	3	4	5

15. I am an even-tempered person	1	2	3	4	5
16. I wonder why sometimes I feel so bitter about things	1	2	3	4	5
17. If I have to resort to violence to protect my rights, I will	1	2	3	4	5
18. My friends say that I'm somewhat argumentative	1	2	3	4	5
19. Some of my friends think I'm a hothead	1	2	3	4	5
20. I know that "friends" talk about me behind my back	1	2	3	4	5
21. There are people who pushed me so far that we came to blows	1	2	3	4	5
22. Sometimes I fly off the handle for no good reason	1	2	3	4	5
23. I am suspicious of overly friendly strangers	1	2	3	4	5
24. I can think of no good reason for ever hitting a person	1	2	3	4	5
25. I have trouble controlling my temper	1	2	3	4	5
26. I sometimes feel that people are laughing at me behind my back	1	2	3	4	5
27. I have threatened people I know	1	2	3	4	5
28. When people are especially nice, I wonder what they want	1	2	3	4	5
29. I have become so mad that I have broken things	1	2	3	4	5

Appendix B

Video game questionnaire (VGQ; Anderson & Dill, 2000)

How much do you like video games? Below are a few questions so that we can get a good idea of the type of video games you like to play and how often you play them. There are *two* sets of questions. Please follow the instructions for each section.

Instructions: In the numbered spaces under the column "Name of Game", please list your FIVE (5) favorite video games. For the spaces under "Game-Type", please list ONE of the six game-types listed below that *best* describes the game you listed in the "Name of Game" column. For the last three columns, please rate how often you play the game, how violent the content of the game is, and how violent the graphics of the game are. These items are to be rated on a scale from 1-7. Please circle the response that *best* describes that item. If you have *never* played a video game before, please check the space by that item. The scale for the last three columns is as follows:

1 = Rarely play the game/little or no violent content/little or no violent graphics
2
3
4 = Occasionally play the game/somewhat violent content/ somewhat violent graphics
5
6
7 = Often play the game/extremely violent content/extremely violent graphics

Name of Game	Game-Type Education Fighting-Hands Fighting-Weapons Sports Fantasy Skill	How often do you play?	How violent is the content?	How violent are the graphics?
1.		1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
2.		1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
3.		1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4.		1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
5.		1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7

_______I have *never* played a video game before today.

Instructions: In the spaces beside each question, please estimate the number of hours *per week* you have played video games in the time frame listed.

1. Please estimate the number of hours *per week* you have played video games in *recent months*____________________

2. Please estimate the number of hours *per week* you have played video games in *during the 11th and 12th grade*___________________

3. Please estimate the number of hours *per week* you have played video games *during the 9th and 10th grade*___________________

4. Please estimate the number of hours *per week* you have played video games *during the 7th and 8th grade*_____________________

Appendix C

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegren, 1988).

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what you *feel* this way right now, that is, at the present moment. Use the following scale to record your answers.

1	2	3	4	5
Very slightly	A little	Moderately	Quite a bit	Extremely

_______________ Interested

_______________ Distressed

_______________ Excited

_______________ Downhearted

_______________ Upset

_______________ Strong

_______________ Delighted

_______________ Scornful

_______________ Frightened

_______________ Guilty

_______________ Cheerful

_______________ Scared

_______________ Hostile

_______________ Sad

_______________ Enthusiastic

_______________ Angry

_______________ Lively

_______________ Lonely

_______________ Proud

_______________ Inspired

_______________ Blue

_______________ Joyful

_______________ Happy

_______________ Irritable

_______________ Alone

_______________ Shaky

_______________ Alert

_______________ Energetic

_______________ Nervous

_______________ Determined

_______________ Loathing

_______________ Attentive

_______________ Jittery

_______________ Active

_______________ Afraid

_______________ Disgusted

_______________ Ashamed

Appendix D

Post-Game Questionnaire

Instructions: Thank you for your participation and for playing the video game! This survey will ask you a few questions about your experiences playing this game. Please circle the answer that BEST describes how you felt using the following scale:

1= Not at all/None
2= Slightly/Very Little
3= Average
4= Above Average/High
5= A Great Deal/Very High

1. How much experience did you have with the game before today? 1 2 3 4 5

2. How violent would you rate the **game** overall? 1 2 3 4 5

3. How violent would you rate **the guards' actions** during the game? 1 2 3 4 5

4. How violent would you rate **your own actions** during the game? 1 2 3 4 5

5. How much control did you feel you had over your actions? 1 2 3 4 5

6. How threatened did you feel during the game? 1 2 3 4 5

7. How much control did you feel you had over the outcome of the game? 1 2 3 4 5