The Influence of Media Violence on the Neural Correlates of Empathic Emotional Response

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LOYOLA UNIVERSITY CHICAGO

THE INFLUENCE OF MEDIA VIOLENCE ON THE NEURAL CORRELATES OF

EMPATHIC EMOTIONAL RESPONSE

A DISSERTATION SUBMITTED TO

THE FACULTY OF THE GRADUATE SCHOOL

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

PROGRAM IN DEVELOPMENTAL PSYCHOLOGY

BY

LAURA A. STOCKDALE

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Deepest thanks to my committee. Noni, the first time I heard you speak was at the orientation to graduate school and I instantly thought, “This woman is amazing.” Every interaction since has only confirmed my original thoughts. You are amazing. Bob and Becky, thank you for allowing me to join the “island of misfit toys”. Knowing both of you has changed my entire career trajectory. Thank you for believing in me and my work and spending countless hours teaching me the EEG/ERP methodology. You both mean more to me than you will ever know. Jim, thank you for supporting me and always being on my team. Thank you for letting me run in your office and providing perspective and warmth when I was very overwhelmed. I could not have imagined a more perfect advisor. Thank you!

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Decades of research on the effects of media violence have shown that exposure to violence in the media is related to increased aggression, decreased prosocial behavior, and decreased empathy. Video games, which contain some of the most graphic, realistic, justified, and rewarded aggression have been shown to increase aggressive behavior and decrease prosocial behavior. Researchers suggest that emotional face processing and inhibitory control may be important factors associated with aggressive behavior and empathy; however, few researchers have examined these variables in chronic and nonchronic violent video game players. Therefore, the goal of the current study was to understand differences in gamers and nongamers in emotional face processing and inhibitory control at baseline and after exposure to a violent video game.

Electroencephalography (EEG) methods were employed to examine the neural correlates of emotion face processing and inhibitory control in these populations, specifically the N170 and N200 ERP components were examined while participants completed a stop-signal task using emotional faces. At baseline, gamers and nongamers performed equally well at a gender discrimination task and at inhibiting behavior, but gamers had significant reductions in their ACC generated N200 component, reflective of decreased cognitive resources being allocated to inhibition. Likewise, gamers and nongamers displayed more negative N170 amplitude in response to threat-related faces; however, after playing a violent video game, gamers no longer distinguished between happy and threat-related faces in their N170 amplitude. Implications are discussed.
CHAPTER ONE
INTRODUCTION

On January 19, 2013, Nehemiah Griego, a 15-year old boy, murdered his parents and three younger siblings because he was frustrated with his mother. Griego was heavily involved with violent video games (such as *Call of Duty*) and had elaborate plans to carry out more acts of terror and violence across the community when he was arrested (Bryan, 2013). Sadly, Griego’s story is not unique, and several individuals who have committed horrific acts of violence (including the perpetrators of the Sandy Hook and Columbine shootings) were heavily involved with violent media (Edelman, 2013; Smith, 1999).

Decades of research studying the effects of media violence on aggression have shown clear causal relationships among violent media exposure, increased aggressive behavior, and decreased empathy (Anderson et al., 2010; Bushman & Anderson, 2002a). Empathy is an important protective factor against aggression and violence (Rose & Rudolph, 2006), and decreased empathy in a society has profound implications for how humans interact with one another and respond to violence. As large scale acts of violence continue to be common in American society, it is important to understand the risk and protective factors that are related to violence and aggression. Media violence exposure is a risk factor for aggressive behavior, but empathy serves as a protective factor (Garbarino, 2006; Gentile & Bushman, 2012). Aggression and empathy are emotional experiences that can influence interpersonal behavior, and have a significant impact on
interactions within a community (Garbarino, 2008). Researchers have argued that exposure to media violence leads to decreased empathy and increased aggressive behavior, and the "numbing" of society to violence (Bushman & Anderson, 2009). A society lacking empathy is numb to the pain and suffering of others, and is a society that places people at high risk for violence and aggression (Garbarino, 1995).

The media is saturated with violence and aggression (Coyne, Stockdale, & Nelson, 2012; Linder & Gentile, 2009), yet few researchers have examined the cognitive and neural processes associated with empathic behavior and how they are influenced by exposure to violent media. A few studies have reported changes in cognitive and neural processes associated with empathy following violent media exposure (Weber, Ritterfeld, & Mathiak, 2006), but more research is needed to understand better what aspects of violent media exposure cause these changes. The proposed project will employ methods from psychology and neuroscience in order to investigate the multifaceted processes that contribute to decreased empathy following violent media exposure. Understanding the effect of media violence exposure on cognitive and neural function could help media creators, community members, and policy makers develop strategies to prevent decreased empathy after exposure to violent media. Understanding changes in brain function that result from violent media exposure might motivate policy makers to reevaluate the societal cost of media violence. For example, one possibility might be to persuade media creators to make artistic choices designed to limit aggressive behavior following media use, such as making violence less realistic, punished, or with more consequences. Community members working with children (i.e., teachers and clinicians) may use
methods similar to those utilized in this project to identify children most at risk for aggressive behavior, and subsequently monitor their media habits to moderate this risk. With these societal implications in mind, this project strives to promote a safer and more peaceful society by decreasing the negative effect of media violence exposure on empathy, and thus aggression, in communities.

**Media Violence and Aggression**

Decades of research, including experimental and longitudinal studies, have shown a causal relationship between violent media exposure and increased aggressive behavior (Bushman & Anderson 2001, 2002a). Violent media can be defined as any type of media, including movies, television, and video games, which portray acts of aggression or violence. This includes less extreme behaviors such as hitting, kicking, and punching, and more extreme acts of violence such as stabbing, shooting, and raping. Before the average American child graduates from elementary school, he/she will be exposed to over 8,000 murders and over 10,000 other acts of violence through television media alone (Federman, 1998). Researchers have shown that violent behavior in media is frequently glamorized, glorified, and rewarded (Coyne & Archer, 2005; Coyne, Stockdale, & Nelson, 2012; Linder & Gentile, 2009). This violence is often depicted by "super hero" characters that portray aggression and violence as necessary, justified, rewarding, and an essential part of being a "hero" (Coyne & Archer, 2005). Violence portrayed in this rewarded and justified fashion is the most likely to cause increased aggression (Huesmann, 2007). In fact, the strength of the association between media violence exposure and aggressive behavior is as strong as the association between smoking and
lung cancer (Bushman & Anderson, 2001). For example, people who were exposed to a violent video game for ten minutes were more likely to administer noise blasts known to cause physical pain and potentially long-term hearing damage to a confederate of the study (Anderson & Murphy, 2003). Similarly, people exposed to violent media were more likely to accept aggression and violence in society (Huesmann, 2007), and have more pro-violence beliefs (Bushman & Huesmann, 2006). Researchers have repeatedly shown that exposure to violent media for as little as 20 minutes results in decreased arousal to images of real life violence (Carnagey, Anderson, & Bushman, 2007; Staude-Müller, Bliesener, & Luthman, 2008), less compassion for the pain and suffering of others (Fanti, Vanman, Henrich, & Avraamides, 2009; Krahé & Möller, 2010), and less intervening in violent situations (Bushman & Anderson, 2009).

Video games, which contain some of the most graphic, rewarded, and justified violence of any type of media (Haninger & Thompson, 2004), have become increasingly popular since the 1980s (Weis & Cerankosky, 2010). In fact, the military uses violent first-person shooter video games to prepare soldiers for active duty and to desensitize them to the emotional and psychological consequences of killing (Grossman, 2009).

Previous researchers observed that roughly ten percent of adolescents spend fifteen hours per week or more playing video games (Gentile et al., 2011). Males between the ages of 18 to 25 are the most likely to play video games for fifteen hours a week or more (Padilla-Walker, Nelson, Carroll, & Jensen, 2010). Individuals who play video games for more than fifteen hours a week are referred to as “chronic video gamers.” However, very little is known about these chronic video gamers, and how they compare with their non-
gaming peers (i.e., those who do not play video games; Olson et al., 2007). Likewise, while it is assumed that these chronic gamers are spending exorbitant amounts of time playing violent video games, research has not yet thoroughly examined how the amount and the content of game play might foster aggressive behavior in chronic gamers. Finally, researchers have shown that chronic gamers who are more immersed in the gaming experience strongly identify with their avatars, and feel more connected to their video games. These factors are thought to increase the effect of media violence on aggression and empathic responding (Konijn, Bijvank, & Bushman, 2007). Media violence experts have highlighted the need for novel developmental research, which takes into account individual differences in biology and personality, to characterize how violent media exposure can increase aggressive behavior and decrease empathy in individuals who are highly susceptible to the impact of chronic violent media exposure (Gentile & Bushman, 2012). However, very little systematic and experimental research has been conducted with this high exposure, at-risk population. The proposed study seeks to fill this research gap by examining the effects of media violence on emotional face processing in chronic gamers.

Cognitive, Emotional, and Neural Mechanisms Related to Media Violence Exposure

The General Aggression Model explains the influence of media violence exposure on aggression and decreased empathy through changes in cognitive schemas regarding aggression (Anderson & Bushman, 2002). According to this theory, exposure to media violence activates cognitive schemas that are shaped by chronic exposure to violence. These schemas shape the development of attentional and interpretation biases that may
trigger aggressive behavior. Attentional biases toward negative stimuli result from vigilantly monitoring the environment for negatively valenced or threatening stimuli. These attentional biases often lead to the development of interpretive biases, meaning that individuals mistakenly interpret neutral stimuli or situations as hostile or negative. Supporting the General Aggression Model, participants who played a violent video game were slower at identifying happy faces than people who played a nonviolent video game (Kirsh & Mounts, 2007). Similarly, the amount of violent media consumption was significantly related to the speed of recognition of angry faces, with people exposed to a heavier diet of violent media recognizing angry faces faster than people who less frequently partake of violent media (Kirsh, Mounts, & Olczak, 2006). In the general population this bias towards negatively valenced information in ambiguous or neutral social situations may be problematic, however for soldiers or people in highly violent communities these changes in processing may be beneficial. In a related study, post-combat veterans were found to have less physiological response to fearful and sad faces than non-combat veterans, yet show no difference in happy faces (Anaki, Brezniak, & Shalmon, 2012; Simmons et al., 2011). Children with a history of physical victimization more quickly and accurately identify distorted angry faces than non-abused children, and have difficulty identifying happy faces (Leist & Dadds, 2009; Pollak & Sinah, 2002). Together, these studies indicate an attentional bias that results from violent media, such that attention is quickly oriented toward threatening stimuli and not captured by positive stimuli. This interpretation bias leads people to act more aggressively and with less empathy. For example, people exposed to violence in the media were more likely to
claim hostile intentions behind ambiguous social situations (Gentile, Coyne, & Walsh, 2011). The presence of these damaging cognitive biases has lead researchers to assert that exposure to media violence directs people to see the world through "blood-red tinted lenses" (Hasan, Bègue, & Bushman, 2012).

The ability to discriminate, process, and accurately interpret facial expressions is essential for social interaction, and even for survival. Research has shown a clear association between emotional face processing and aggression. A range of psychological disorders associated with aggressive behavior such as schizophrenia (Caharel et al., 2007; Williams et al., 2008) and conduct disorder (Hileman, Henderson, Mundy, Newell, & Jaime, 2011), are related to abnormal emotional face processing. Previous neuroimaging studies demonstrated that highly aggressive people display abnormal brain activity in response to emotional faces (Coccaro, McCloskey, Fitzgerald, & Phan, 2007). In particular, abnormal processing of fearful faces may be particularly important for human empathic responding and decreased aggression (Lamm, Batson, & Decety, 2007).

Abnormal emotional face processing likely influences an individual’s interpersonal behavior, resulting in decreased empathy for others. Research is needed to understand how exposure to violent media, particularly highly immersive and active violent video games affects emotional face processing, and determine what aspects of processing are affected. In this study we propose to use neurocognitive electroencephalography (EEG) methods that will allow us to examine how media violence influences the time course of the neurocognitive processes underlying empathy. Unlike other common neuroimaging methods like functional Magnetic Resonance Imaging (fMRI) or Positron Emission
Tomography (PET), EEG is a noninvasive and inexpensive method that is widely available to both medical professionals and psychological scientists. Specifically, we hypothesize that engagement with violent video games will result in changes in the time course of the neural processes underlying emotional face processing. These changes are expected to result from an attentional bias toward negative and threatening facial emotions that will be reflected by increased attention to negative stimuli, and decreased attention to positive stimuli. Such a detailed neurocognitive EEG investigation will be effective in helping us to understand how violent gaming experiences could be shaped better to lessen their negative impact on interpersonal aggression and violence.

Neural Measures of Face Processing and Emotion Regulation

Neural Measures of Facial Processing

In order to study the time course of the neural correlates of emotional face processing, the proposed study will use event related potentials (ERPs), an EEG analysis method frequently used to study face processing in time, allowing researchers to examine what is happening in the brain after exposure to a face stimuli, but before a physical response. ERPs allow researchers to measure precisely how the brain responds to a specific stimulus and characterize the types of processing occurring. The N170 ERP is a negative waveform believed to originate from the posterior area of the brain responsible for face processing in humans (Grill-Spector, Knouf, & Kanwisher, 2004). The N170 is so named because it occurs approximately 170 milliseconds after exposure to a face and reflects very early face processing (Eimer, Kiss, & Nicholas, 2010). The N170 also measures attention towards a face (Carlson & Reinke, 2010). Differences in the N170
ERP have been identified in individuals with developmental disorders associated with increased aggression (Caharel et al., 2007; Hileman, Henderson, Mundy, Newell, & Jaime, 2011; Williams et al., 2008), yet no known research has examined the influence of media violence exposure on the N170.

While behavioral research supports that exposure to media violence leads to an attentional bias toward emotionally salient stimuli (particularly negatively valenced faces), the proposed study will examine the underlying neural mechanisms that are hypothesized to change in response to chronic media violence exposure. The N170 will be measured in response to emotional faces. It is hypothesized that exposure to media violence will result in increased N170 amplitude (reflecting increased cognitive resources being recruited during emotion regulation) in response to fearful faces, but decreased amplitude in response to happy faces. In the future, the N170 could be used as a biomarker to identify individuals at risk for aggressive behavior and to evaluate the potential influence of violent video games prior to public distribution.

**Neural Measures of Emotion Regulation**

Emotion is known to affect cognitive processes, and vice versa (Mohanty et al., 2007). Negative emotional experiences interfere with the ability to employ top-down attentional control processes associated with prefrontal brain regions efficiently (Silton et al., 2011), whereas positive emotion or mood facilitates attentional control (Fredrickson & Branigan, 2005; Ochsner & Gross, 2005; Pessoa, Kastner, & Ungerleider, 2002). For example, the N170 has also been shown to be sensitive to emotion. Researchers have shown that exposure to fearful faces evokes increased brain activity
(reflected by a larger amplitude), suggesting the need to recruit increased attentional processing (Blau, Maurer, Tottenham, & McCandliss, 2007; Krombholz, Schaefer, & Boucsein, 2007). Supporting the notion that positive emotions facilitate attentional control, happy faces evoke earlier processing (reflected by a shorter N170 latency; Batty & Taylor, 2003). Experiencing intense negative or positive emotions influences the ability to use top down control processes to regulate internal affective states (Gross, 2002; Ochsner & Gross, 2008). Researchers have shown that the ability to regulate and manage emotions is extremely important for minimizing aggressive behavior. People with poor emotion regulation abilities show decreased empathy (Liew et al., 2011) and increased aggression (Wanless et al., 2013). For example, children who were rated as poor emotional regulators by their teachers were also rated by their peers as highly aggressive (Eisenberg et al., 2001). Therefore, to understand the influence of media violence exposure on aggressive behavior, it is also important to understand the effect of media violence on emotion regulation and related top down attentional control processes.

ERP researchers have shown that asking people to regulate their emotions results in a negative brain wave approximately 200 milliseconds after the regulation (Enriquez-Geppert, Konrad, Pantev, & Huster, 2010). This negative wave is referred to as the N200 and it is evoked by tasks that require processing conflicting information (Silton et al., 2010; 2011). Previous research showed that individuals who were high in aggression showed a larger N200 to negative stimuli when they were asked to ignore these stimuli in order to attend to the task at hand (Stewart et al., 2010). These N200 results suggest that that individuals with high levels of aggression need to exert extra attentional control to
override their automatic attentional bias toward negative information. Similarly, other researchers have shown that people high in aggression also display N200 differences when asked to process conflicting information (Fisher, Ceballos, Matthews, & Fisher, 2011), and this seems to be particularly true when the conflict is emotionally salient (Sellbom & Verona, 2007). For example, psychopaths (people who are known to display decreased empathy and increased aggression) do not display deficits in behavioral regulation unless the regulation task uses emotional stimuli (Kiehl, Smith, Hare, & Liddle, 2000), suggesting that it is regulation in the context of emotion that is difficult for psychopaths. The proposed study hypothesizes that exposure to media violence will result in increased attentional demands for emotion regulation. This emotion regulation deficit is likely related to an increased likelihood of aggressive behavior and a decreased likelihood of empathic responding. The proposed study hypothesizes that exposure to media violence will result in increased N200 amplitude (reflecting increased cognitive resources being recruited during emotion regulation). However, no known research has examined the influence of media violence exposure on the N200.

**Rationale for the Proposed Study**

The research reviewed above demonstrates the complex relationship among emotional processing, media violence exposure, empathy, and aggressive behavior. The experiments described in this proposal will be the first to assess systematically how the neural correlates of emotional face processing interact with the social environment to lead to aggressive behavior. Understanding the influence of media violence exposure on both the processing and regulation of emotions will help researchers, parents, and policy
makers develop a better understanding of the cognitive processes underlying aggressive behavior, and how exposure to violent media mitigates those processes. A deeper understanding of the cognitive processes underlying aggressive behavior can help parents and policy makers create targeted interventions that will decrease the negative impact of media violence on society. For example, decreasing the effects of media violence on people at risk for heightened aggression will lead to less people who are at risk for aggression. Similarly, understanding the cognitive processes behind aggressive behavior will help researchers, clinicians, and medical personal provide better interventions and treatments, and will help decrease violence and aggression in society and increase empathy.

**Specific Aims and Hypotheses**

The proposed study aims to investigate the influence of media violence exposure on the neurocognitive processes underlying aggression in chronic violent video gamers and a non-gamer sample. Cognitive and affective neuroscience methods will be used to investigate face processing and emotion regulation in these two samples. Specifically, EEG methods will be used to investigate the N170, an ERP associated with face processing (Rossion & Jacques, 2011) and the N200, an ERP associated with attentional control and emotion regulation (Kanske & Kotz, 2010). Chronic violent video gamers (≥ 30 hours per week of violent video game play), and an age and gender matched population of non-gamers will be brought into the lab and randomly assigned to violent video game play or nonviolent video game play. Emotional face processing and emotion regulation will be measured before (baseline) and after (post-test) game play in both of
these samples using an emotional face stop-signal task while EEG data are collected. This will result in a 2X2X4 experimental design. Violent video game exposure is hypothesized to result in an attentional bias to negative stimuli and increased difficulties effectively regulating emotion (requiring more top-down attentional control), resulting in abnormal N170 and N200 amplitudes. Exposure to nonviolent media is not expected to modulate facial processing or emotion regulation.

**Specific Aim and Hypothesis #1**

To understand the influence of violent media exposure on emotional face processing in a non-gamer sample.

**Hypothesis 1a:** It is anticipated that exposure to violent media will result in larger N170 amplitude to fearful faces (reflecting attentional bias to negative stimuli) and a smaller N170 amplitude to happy faces.

**Hypothesis 1b:** It is hypothesized that exposure to nonviolent media will not change the N170 amplitude to fearful or happy faces.

**Specific Aim and Hypothesis #2**

To understand the influence of media violence exposure on emotional facial processing in chronic violent video gamers.

**Hypothesis 2a:** Chronic violent video gamers are expected to display larger N170 amplitude in response to fearful faces and smaller amplitude to happy faces at baseline compared to non-gamers.

**Hypothesis 2b:** It is anticipated that exposure to violent media will exacerbate the above effects, and will result in a larger N170 amplitude in response to fearful faces and even
smaller N170 amplitude to happy faces after media violence exposure compared to
baseline in the chronic video gamers.

Specific Aim and Hypothesis #3

To understand the influence of media violence exposure on emotion regulation in
a non-gamer sample.

Hypothesis 3a: It is anticipated that exposure to violent media will result in larger N200
mean amplitude (reflective of increased top-down attentional control).

Hypothesis 3b: It is anticipated that exposure to nonviolent media will not change the
N200 amplitude.

Specific Aim and Hypothesis #4

To understand the influence of media violence exposure on emotion regulation in
chronic violent video gamers.

Hypothesis 4a: Chronic violent video gamers are expected to display larger N200
amplitude at baseline during an emotion regulation task compared to non-gamers.

Hypothesis 4b: It is anticipated that exposure to violent media will exacerbate the above
effects, and will result in an increased N200 amplitude relative to baseline in the chronic
violent video gamers.
CHAPTER TWO

METHODS

Participants

All participants were right handed, full-time, male undergraduate students between the ages of 18 and 25 ($M = 20$ years, $SD = 1.35$ years), recruited from an urban Midwestern university. Because the vast majority of chronic violent video gamers between the ages of 18 and 25 are males (Padilla-Walker et al., 2010), only males were recruited for this study. The majority of the participants in this study identified their ethnicity as Caucasian (approximately 51%), approximately 23% indentified as Asian, approximately 13% identified as Hispanic or Latino, 3% identified as multiracial or biracial, and approximately 3% identified as African American. All participants had no known history of neurological disorders.

Sixty-nine male undergraduate students participated in the experiment. In terms of chronic violent video gamers, one participant was dropped due to poor behavioral performance (accuracy below 50%) on either go or stop-trials, and three were dropped due to poor EEG data (more than 20% rejected trials) and one was dropped due to experimenter error. This resulted in a final sample of thirty-one chronic violent video gamers for baseline measures. Thirty-four non-gamers were brought into the lab for testing. Two participants were dropped due to poor behavioral data and one participant was dropped due to poor EEG data resulting in a final sample of thirty-one non-gamers at
baseline. For the chronic violent video gamers and the non-gamers four participants from each category were dropped from within subject comparisons due to either poor behavioral data, poor EEG data, or not returning for day two of the study. This resulted in a final sample of twenty-seven chronic violent video gamers and twenty-six non-gamers for within subject analysis.

**Procedures**

Chronic violent video gamers and non-chronic gamers were recruited through email announcements and phone calls to participate in the study for pay ($15 an hour for approximately 2, 2.5 hour sessions). Participants were brought into the lab, provided informed consent, and completed several questionnaires to assess mood, aggression, prosocial behavior, and empathy. After completing the questionnaires, participants were fitted with a 64-channel nylon mesh cap and electrode sensors were placed in the cap in order to record electrical activity on the scalp. After capping, participants completed a 30 minute stop-signal task while their EEG was recorded on a 64-channel biosemi Active electrode system. Following completing the stop-signal task, participants were randomly assigned to play either a violent or a nonviolent video game for twenty minutes. Subsequent to playing a video game for twenty minutes, participants completed the Positive and Negative Affective Schedule (PANAS; Bradley & Lang, 1994) questionnaire. Participants then completed the same stop-signal task while their EEG was recorded and after all EEG tasks completed several more questionnaires to measure aggression, prosocial behavior, and empathy.
Measures

Group Selection Criteria

**Chronic violent video gamers and non-chronic gamers.** Participants completed a series of self-report questionnaires. Participants were asked to self-report the number of hours they spend playing video games on a typical day. For example, participants were asked, "On an average weekday, between the hours of 6 am and noon, how many hours do you spend playing video games.” Installments were created to cover the 24 hours of each day. These numbers were then summed and multiplied by five to create an overall weekday average for hours of video game play. These same questions were asked for a typical weekend, and composites were created and multiplied by two. Finally, weekday and weekend totals were summed to create an overall average weekly video game play. In instances where participants identified a range of average hours they spent playing video games (e.g. 2-3 hours) an average was created. Previous research has shown that this is a valid and reliable way to measure time and content of the media in 18-25 year olds (Gentile et al., 2011; Stockdale, Coyne, Nelson, & Padilla-Walker, in press).

**Violent or nonviolent content in video game play.** The goal of this research question is to identify differences in facial and emotional processing between chronic *violent* gamers and non-gamers. Therefore it was not only important to establish the frequency of video game play, but also the content of the video games played by participants. During the initial screening survey participants were asked to identify the three video games they played most frequently from a list of the ten best-selling video games for the last ten years. This resulted in a list of 57 video games (several video
games were best sellers for multiple years). Participants were also given the option to name video games they frequently played that were not on the list. Identified video games were compared to content analyses examining the frequency of violence and aggression in video games (Dill, Gentile, Richter, & Dill, 2005; Haninger & Thompson, 2004). When content analyses were not available for the game, two raters of media violence coded the games for violence (α > .85). Based on these content analyses and expert ratings, video games were classified as violent, moderately violent, or not violent. Participants who identified a violent video game for at least two of their three most frequently played video games were classified as violent video gamers. A participant who identified two of the three games they played most frequently as nonviolent were classified as nonviolent gamers.

**Chronic Violent Video Gamers**

Chronic violent video gamers were required to meet two conditions: (1) participants had to report playing video games, on average, 30 hours per week or more, and (2) two of the three games they reported playing most frequently had to be violent. Previous researchers have used similar criteria to study media effects (Gentile et al., 2011). Undergraduate college students are considered full-time if they spend approximately twelve hours a week or more in the classroom. Therefore, chronic gamers in this study are spending, on average, more time playing video games than they spend in the classroom. Similarly, undergraduate students are strongly encouraged not to work more than 15-20 hours a week while taking a full undergraduate course load (Kalenkoski & Pabilonia, 2010). Therefore, these students spend as much or more time playing video
games than they are counseled to work. Similar criteria have been used in to identify chronic gamers in previous video game research (Olson et al., 2007).

**Non-gamers**

Non-gamers were participants who reported playing video game, on average, less than five hours per week, but more than never, and two of the three games they reported playing were nonviolent.

**Media Violence Exposure**

Participants were asked to play either a violent or nonviolent video game for twenty minutes, on either an Xbox 360 or a PlayStation 3 (the two most popular gaming systems, excluding more casual gaming systems such as the Wii; Durvee, 2013). Previous researchers have argued that not letting participants play on gaming systems that they are accustomed to could increase frustration, and therefore skew results (Ferguson & Rueda, 2010). The violent video game was the first-person shooter, *Call of Duty: Modern Warfare 3*. The primary objective of this game is to kill other humans or humanoids, and players are rewarded for killing. Second, when humans or humanoids are killed they create vocalizations of pain or anguish. And, third, when humans or humanoids are killed, blood is shown on the screen coming from the victim. The nonviolent video game was a racing game, *Need for Speed*. The primary objective of this game did not include killing humans, humanoids, or other living beings (2), no blood or gore is presented in the video game (3) players are rewarded for completing tasks unrelated to violence against other living begins.
Before testing, games were pilot tested using the Self-Assessment Manikin (SAM) to make sure they were equally arousing (Bradley & Lang, 1994). The SAM is a self-report measure of arousal that also measures valance. To measure valance, participants were given a range of cartoon figures displaying a range of emotions from happy to unhappy and told to select one figure that represents how the stimuli made them feel. To measure arousal, participants were given a range of cartoon figures displaying calm to excited emotions. Scales range from 1 through 9, with 9 being the most arousing and the angriest (Lang, 1980). The SAM has been shown to be a reliable and valid self-report measure of arousal and has been used repeatedly to measure the valance and arousal of emotional stimuli (Bradley, Greenwald, Petry, & Lang, 1992; Morris, 1995; \( \alpha = .93 \)).

Forty independent undergraduate male students were brought into the lab and completed the SAM before and after playing the violent or the nonviolent video game for course credit. Participants were randomly allocated across video game conditions. There were no significant differences across the video games in self-reported arousal \( (t(40) = -1.34, p = 0.19, M_{violent} = 3.45, SD_{violent} = 2.01, M_{nonviolent} = 4.23, SD_{nonviolent} = 1.74) \), positive affect \( (t(40) = -0.02, p = 0.98, M_{violent} = 3.23, SD_{violent} = 0.76, M_{nonviolent} = 3.24, SD_{nonviolent} = 0.67) \), negative affect \( (t(40) = -0.98, p = 0.98, M_{violent} = 1.41, SD_{violent} = 0.39, M_{nonviolent} = 1.54, SD_{nonviolent} = 0.46) \), engagement with the video game \( (t(40) = 0.95, p = 0.35, M_{violent} = 5.65, SD_{violent} = 1.14, M_{nonviolent} = 5.32, SD_{nonviolent} = 1.13) \), excitement of the game \( (t(40) = 1.25, p = 0.22, M_{violent} = 5.40, SD_{violent} = 1.27, M \)
nonviolent = 4.91 $SD_{\text{nonviolent}} = 1.27$), or frustration level after playing the games ($t(40) = -0.93, p = 0.36, M_{\text{violent}} = 3.10, SD_{\text{violent}} = 1.74, M_{\text{nonviolent}} = 3.55, SD_{\text{nonviolent}} = 1.37$).

**Chronic Violent Video Gamers**

Participants completed a stop-signal task using faces (Sagaspe, Schwartz, & Vuilleumier, 2011). In this task, participants were shown a series of grayscale photographs of human faces from the NimStim database of emotional faces (Tottenham et al., 2009). Half of the faces presented had a fearful expression, and the other half had a happy expression. The selected fearful and happy faces have been previously shown to be equally arousing (Tottenham et al., 2009). Participants are asked to identify the gender of the face (male or female) by pressing one of two buttons as quickly and accurately as possible. The faces were normed to ensure easy identification of gender and that fearful and happy faces did not differ in difficulty. The Stop-signal Task is an implicit bias emotion regulation task that involves using top-down attentional control to inhibit an automatic response (see Figure 1). Previous research suggests that there were no sex differences in ability to discriminate male and female faces (Stockdale et al., under review), but all faces were counter-balanced to include an equal number of male and female faces conveying an equal number of afraid and happy facial expressions.

On half of the trials, a rectangular mask surrounds the photo 100 to 300 milliseconds after the face was presented. On these trials, the participant was instructed to withhold their button press. Thus, half of trials were “go” trials and the other half were “stop” trials. In order to adjust the task to correct for test-retest biases, the lag of the stop signal varied according to participant reaction time, (i.e. the delay between the
presentation of the face and the stop-signal became longer the better participants were at inhibiting their behavior and the worse participants were at inhibiting their behavior the shorter the delay between the presentation of the face and the stop-signal became). Each trial condition was equally divided between the two facial expressions. Each participant completed sixty trials per block with twelve blocks for a total of 720 trials (360 male faces and 360 female faces). Each block was followed by a 20 second break and only correct trials were used for analyses. Such facial processing tasks are a reliable and valid measure of the N170 in response to faces (Caharel, Jacques, d'Arripe, Ramon, & Rossion, 2011; Jacques & Rossion, 2010; Sun, Gao, Han, 2010). Stop-signal tasks have been repeatedly in ERP studies and are known to produce a reliable N200 ERP (Verbruggen & Logan, 2008).

Figure 1. Stop-Signal Task Paradigm.

a). Go-trials begin with a fixation screen followed by the presentation of the face for 1s while the participants indicate the gender of the face by pressing one of two buttons on an electronic response box. b). On Stop-trials, a stop-signal was displayed for 100 ms after a 200-500 ms delay. The stop-signal delay was adjusted based on participant performance so that better withholding of responses on the previous two trials resulted in an increased delay between the presentation of the face and the stop-signal, thereby making the task more difficult. The Go-trial ERP was time locked to face-onset, while the stop-trial ERP was time locked to the stop-stop signal onset.
**Empathy**

After completing the stop-signal task, participants completed the Interpersonal Reactivity Index (IRI; Davis, 1983). The IRI is a 28 question, self-report questionnaire that measures four subscales of empathy (7 questions each) including fantasy, perspective taking, cognitive empathy, and personal distress. The IRI was developed by taking several well-established self-report measures of empathy (e.g. Mehrabian & Epstein Emotional Empathy Scale; Stotland’s Fantasy-Empathy Scale) and newly developed questions, and statistically selecting the best and most reliable questions to measure empathy. Therefore, the IRI is a multidimensional measure of empathic responding. Example items include "When I watch a good movie, I can very easily put myself in the place of a leading character" (fantasy), "Before criticizing somebody, I try to imagine how I would feel if I were in their place" (perspective taking), "I often have tender, concerned feelings for people less fortunate than me" (cognitive empathy), and "Being in a tense emotional situation scares me" (personal distress). The IRI has been found to be a reliable and valid self-report measure of empathy (fantasy $\alpha = 0.73$, perspective taking $\alpha = 0.71$, cognitive empathy $\alpha = 0.76$, and personal distress $\alpha = 0.76$).

**Aggression**

After completing the IRI, participants completed the Buss and Perry Aggression Questionnaire (AQ; Buss & Perry, 1992). The AQ is a 29-question self-report measure of aggression that includes four subscales that measure physical and verbal aggression, anger, and hostility. Participants answer questions on a scale of one to five, with one being extremely uncharacteristic of me and five being extremely characteristic of me.
Example questions include, "If somebody hits me, I hit back" (physical aggression) and "Some of my friends think I am a hot-head" (anger). The AQ has been extensively tested for validity and has been shown to be an excellent measure of aggressive behavior across ages and cultures (Santisteban, Alvarado, & Recio, 2007). The internal consistency for physical aggression is 0.85, verbal aggression is 0.72, anger is 0.83, and hostility is 0.77 (Buss & Perry, 1992). See Figure 2 for a visual of the recruitment and study procedures.

Figure 2. Study Procedure.

Procedure for recruitment and lab activities of chronic violent video gamers and non-gamers. Sample size and time of each task are also included.
**EEG Equipment and Data Reduction**

Participant’s brain waves were recorded using a 72-channel Biosemi Active2 EEG system. 64 electrodes were located at equidistant locations in a nylon cap. To expand the coverage of EEG monitoring we placed two electrodes on the inferior edge of the orbit of each eye. Participants were excluded from the study if they meet the following criteria, which is known to alter EEG recording: 1.) colorblindness, 2.) has a known neurological medical condition, 3.) had a visual, hearing, voice, or motor impairment that would prevent completion of study procedures, 4.) were taking any medication known to change patterns of brain activity (including antidepressant medications). Raw EEG was digitally re-referenced offline to a common average reference of all 64 electrodes and then high-pass filtered at 0.01 Hz. The signal was then be band-stop filtered from 59 to 61 Hz to remove any AC electrical contamination. EEG signal was corrected for ocular artifacts using a spatial PCA filter, a method available in EMSE (Source Signal Imaging, San Diego CA). Signal was further cleaned via a ±100μV rejection criterion. Included participants had fewer than 20% of trials rejected. The mean amplitude and latency of the N170 and N200 ERPs were calculated for each condition for each participant, following methods used in Silton et al., 2010. Separate grand average ERPs were calculated for correct trials (“stop” and “go”) for each emotion condition (fearful and happy). This resulted in four different ERP grand averages (stop/fearful, stop/happy, go/fearful, go/happy) for each group (non-gamers and chronic gamers) and each condition (non-violent media exposure and violent media exposure).
CHAPTER THREE

RESULTS

Questionnaire Measures

Baseline Physical Aggression

In order to examine potential differences between chronic violent video gamers and non-gamers at baseline an independent means t-test was conducted to examine self-report measures of physical aggression. There was a significant difference between chronic violent video gamers and non-gamers in regards to physical aggression ($t (58) = 2.10, p = .04$), with chronic violent video gamers reporting being more physically aggressive than non-gamers (gamers $M = 2.12, SE = 0.11$, non-gamers $M = 1.81, SE = 0.10$).

Baseline Empathy

In order to examine potential differences between chronic violent video gamers and non-gamers at baseline an independent means t-test was conducted to examine self-report measures of empathy. There was a significant difference between chronic violent video gamers and non-gamers in regards to overall empathy ($t (55) = -2.17, p = .03$), with chronic violent video gamers reporting being less empathic than non-gamers (gamers $M = 12.95, SE = 0.37$, non-gamers $M = 13.86, SE = 0.22$).
**Baseline State Anger**

In order to examine potential differences between chronic violent video gamers and non-gamers at baseline an independent means t-test was conducted examining state anger. There was a trending difference between chronic violent video gamers and non-gamers in regards to state anger ($t (54) = 1.78, p = .08$), with chronic violent video gamers reporting being more angry at baseline than non-gamers (gamers $M = 17.58, SE = 0.71$, non-gamers $M = 16.20, SE = 0.37$). See Figure 3 for a visual representation of all baseline survey measures.

Figure 3. Baseline Measures of Aggression, Empathy, and Anger Between Gamers and Non-gamers.

a.) Baseline means and standard deviations for self-reported physical aggression. b.) Baseline means and standard deviations for self-reported empathy. c.) Baseline means and standard deviations for self-reported anger. Error bars represent ±1 SEM.
Behavioral

Baseline Go Trials Accuracy and Response Time

In order to access baseline differences in chronic violent video gamers and non-gamers regarding accuracy for go trials, a factorial repeated measures analysis of variance (ANOVA) was conducted examining group (gamer or non-gamer) and face valence (happy or afraid faces). For go trials, there was no significant effect of group ($F(1, 30) = 0.12, p = 0.73, \eta^2 = 0.01$), gamers $M = 0.80, SE = 0.02$, non-gamers $M = 0.78, SE = 0.02$), a significant effect of face valence ($F(1, 30) = 18.20, p = .001, \eta^2 = 0.23$), happy faces $M = 0.81, SE = 0.02$ and afraid faces $M = 0.78, SE = 0.02$), and no significant interaction ($F(1, 30) = 1.14, p = 0.29, \eta^2 = 0.02$) on overall accuracy. These results suggest that regardless of group, participants were less accurate at identifying the gender of afraid faces as compared to happy faces.

In order to access baseline differences in chronic violent video gamers and non-gamers regarding response time for go trials, a factorial repeated measures ANOVA was completed examining group (gamers or non-gamers) and face valence (happy or afraid faces). For go trials, there was no significant effect of group ($F(1, 30) = 0.00, p = 1.0, \eta^2 = 0.00$), gamers $M = 773.95, SE = 11.57$ non-gamers $M = 773.72, SE = 11.57$), no significant effect of face valence ($F(1, 30) = 1.77, p = 0.19, \eta^2 = 0.03$), happy faces $M = 772.62, SE = 8.02$ and afraid faces $M = 775.05, SE = 8.45$), and no significant interaction ($F(1, 30) = 0.04, p = 0.83, \eta^2 = 0.00$) on response times for go trials. These results suggest that participants were equally fast at identifying the gender of faces.
regardless of being a chronic violent video gamer or non-gamer and regardless of if the face was expressing happiness or fear.

**Baseline Stop Trials Accuracy and Average Stop Signal Delay**

In order to access baseline differences in chronic violent video gamers and non-gamers regarding accuracy for stop trials, a factorial repeated measures analysis of variance (ANOVA) was conducted examining group (gamer or non-gamer) and face valence (happy or afraid faces). For stop trials, there was no significant effect of group \((F (1, 30) = 0.01, p = 0.94, \eta^2 = 0.00, \text{gamers } M = 0.86, SE = 0.02, \text{non-gamers } M = 0.86, SE = 0.02)\), no significant effect of face valence \((F (1, 30) = 2.26, p = 0.95, \eta^2 = 0.04, \text{happy faces } M = 0.88, SE = 0.02 \text{ and afraid faces } M = 0.87, SE = 0.02)\), and no significant interaction \((F (1, 30) = 0.00, p = 0.95, \eta^2 = 0.00)\) on overall accuracy. These results suggest that participants are equally able to inhibit behavior regardless of if they were a chronic violent video gamer or non-gamer or face if they were shown happy or afraid faces.

In lieu of reaction time for stop trials, the average stop signal delay was examined at baseline. The staircase between presentation of the face and the stop signal was jittered based on performance of the two previous trials, and faces were randomly presented, therefore, there was no way to examine the influence of face valence on average stop signal delay for baseline stop trials. As a result, an independent samples t-test was conducted to examine the influence of group (gamers or non-gamers) on average stop signal delay at baseline. There was no significant effect of group of average stop signal delay \((t (60) = 0.29, p = 0.77, \text{gamers } M = 491.90, SE = 2.92 \text{ and non-gamers } M =\)
490.49, SE = 3.92). These results suggest that regardless of being a chronic violent video gamer or a non-gamer, participants were equally able to inhibit behavior. See Figure 4 for a visual representation of the baseline behavioral data.

Figure 4. Baseline Accuracy and Response Time for Gamers and Non-gamers.

a.) Proportion correct for baseline Go-trials. b.) Reaction time in milliseconds for baseline Go-trials. c.) Average proportion correct for baseline Stop-trials. d.) Average Stop-Signal Delay for baseline Stop-trials. Error bars represent ±1 SEM.

**Non-gamers Go Trials Accuracy and Response Time After Media Violence Exposure**

In order to assess the effects of media violence exposure and face valence on face on accuracy in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces). For go trials, there was no significant effect of condition (F (1,26)
= 1.09, \( p = 0.31, \eta^2 = 0.04 \), violent \( M = 0.82, SE = 0.02 \), nonviolent \( M = 0.84, SE = 0.02 \), a significant effect of face valence \( (F(1, 26) = 38.43, p < .001, \eta^2 = 0.60 \), happy faces \( M = 0.85, SE = 0.02 \) and afraid faces \( M = 0.81, SE = 0.02 \), and no significant interaction \( (F(1, 26) = 2.41, p = 0.13, \eta^2 = 0.09) \) on overall accuracy. These results suggest that regardless of video game condition, non-gamers participants were less accurate at identifying the gender of afraid faces as compared to happy faces.

In order to access the effects of media violence exposure and face valence on response time in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces). For go trials, there was no significant effect of condition \( (F(1,26) = 0.08, p = 0.79, \eta^2 = 0.003 \), violent \( M = 756.48, SE = 12.05 \), nonviolent \( M = 765.28, SE = 11.80 \)), a significant effect of face valence \( (F(1, 26) = 29.90, p < .001, \eta^2 = 0.54 \), happy faces \( M = 756.48, SE = 12.05 \) and afraid faces \( M = 765.28, SE = 11.71 \), and no significant interaction \( (F(1, 26) = 0.05, p = 0.82, \eta^2 = 0.002) \) on overall response time. These results suggest that regardless of video game condition, non-gamer participants were slower at identifying the gender of afraid faces as compared to happy faces.

**Non-gamers Stop Trials Accuracy and Average Stop Signal Delay After Media Violence Exposure**

In order to access the effects of media violence exposure and face valence on inhibitory control accuracy in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces) for the stop trials. For stop trials, there was no
significant effect of condition \(F (1, 26) = 0.68, p = 0.42, \eta^2 = 0.03\), violent \(M = 0.82, SE = 0.02\), nonviolent \(M = 0.84, SE = 0.02\), no significant effect of face valence \(F (1, 26) = 1.82, p = .19, \eta^2 = 0.07\), happy faces \(M = 0.85, SE = 0.02\) and afraid faces \(M = 0.81, SE = 0.02\), and no significant interaction \(F (1, 26) = 0.05, p = 0.83, \eta^2 = 0.002\) on overall stop accuracy. These results suggest that video game condition and face valence did not significantly influence non-gamers ability to inhibit behavior.

In lieu of reaction time for stop trials, the average stop signal delay was examined after exposure to a violent or a nonviolent video game. Because the staircase between presentation of the face and the stop signal was jittered based on performance of the two previous trials, and because faces were randomly presented, there was no way to examine the influence of face valence on average stop signal delay. As a result, a dependent means t-test was conducted to examine the influence of condition (violent video game or nonviolent video game) on average stop signal delay. There was no significant effect of video game condition on average stop signal delay \((t (26) = -0.40, p = 0.69, violent M = 487.65, SE = 5.13\) and nonviolent \(M = 489.78, SE = 4.40\)). These results suggest that regardless of video game exposure, non-gamers were equally able to inhibit behavior. See Figure 5 for a visual representation of the baseline behavioral data.
Figure 5. Non-gamers Accuracy and Response Time After Exposure to a Violent or Nonviolent Video Game.

Non-gamers comparisons between Stop-Signal Task performance after playing a violent or a nonviolent video game. a.) Proportion correct for Go-trials. b.) Reaction time in milliseconds for Go-trials. c.) Average proportion correct for Stop-trials. d.) Average Stop-Signal Delay for Stop-trials. Error bars represent ±1 SEM.

Chronic Violent Video Gamers Go Trials Accuracy and Response Time After Media Violence Exposure

In order to access the effects of media violence exposure and face valence on face on accuracy in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces). For go trials, there was no significant effect of condition ($F(1, 26) = 0.001, p = 0.99, \eta^2 = 0.001$, violent $M = 0.81, SE = 0.02$, nonviolent $M = 0.81, SE = 0.02$), a significant effect of face valence ($F(1, 26) = 8.67, p = .007, \eta^2 = 0.25$, happy faces $M = 0.82, SE = 0.02$ and afraid faces $M = 0.80, SE = 0.02$),
and a trending interaction \( F (1, 26) = 3.93, p = 0.06, \eta^2 = 0.13 \) on overall accuracy (gamers violent happy \( M = 0.81, SE = 0.02 \), gamers violent afraid \( M = 0.81, SE = 0.02 \), gamers nonviolent happy \( M = 0.83, SE = 0.02 \), gamers nonviolent afraid \( M = 0.79, SE = 0.03 \)). These results suggest that regardless of video game condition, chronic violent video gamers were significantly less accurate at identifying the gender of afraid faces as compared to happy faces. However, after playing a violent video game chronic violent video gamers were equally accurate in identifying the gender of happy and afraid faces.

In order to access the effects of media violence exposure and face valence on response time in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces). For go trials, there was no significant effect of condition \( F (1,26) = 0.04, p = 0.85, \eta^2 = 0.001 \), violent \( M = 769.72, SE = 9.35 \), nonviolent \( M = 771.10, SE = 10.23 \), a significant effect of face valence \( F (1, 26) = 18.10, p < .001, \eta^2 = 0.41 \), happy faces \( M = 766.78, SE = 9.32 \) and afraid faces \( M = 774.03, SE = 8.98 \), and a significant interaction \( F (1, 26) = 7.87, p = 0.009, \eta^2 = 0.23 \) on overall response time (gamers violent happy \( M = 763.69, SE = 9.66 \), gamers violent afraid \( M = 775.74, SE = 9.24 \), gamers nonviolent happy \( M = 763.69, SE = 10.56 \), gamers nonviolent afraid \( M = 772.32, SE = 10.00 \)). These results suggest that regardless of video game condition, chronic violent video gamers were slower at identifying the gender of afraid faces as compared to happy faces. However, after playing a violent video game chronic violent video gamers lost this distinction between happy and afraid faces.
Chronic Violent Video Gamers Stop Trials Accuracy and Average Stop Signal Delay After Media Violence Exposure

In order to access the effects of media violence exposure and face valence on inhibitory control accuracy in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game play) and face valence (happy or afraid faces) for the stop trials. For stop trials, there was no significant effect of condition ($F(1, 26) = 0.42, p = 0.52, \eta^2 = 0.02$), violent $M = 0.88, SE = 0.02$, nonviolent $M = 0.87, SE = 0.02$), no significant effect of face valence ($F(1, 26) = 0.38, p = 0.54, \eta^2 = 0.01$), happy faces $M = 0.87, SE = 0.02$ and afraid faces $M = 0.87, SE = 0.02$), and no significant interaction ($F(1, 26) = 0.57, p = 0.47, \eta^2 = 0.02$) on overall stop accuracy. These results suggest that video game condition and face valence did not significantly influence chronic violent video gamers ability to inhibit behavior.

In lieu of reaction time for stop trials, the average stop signal delay was examined after exposure to a violent or a nonviolent video game. Because the staircase between presentation of the face and the stop signal was jittered based on performance of the two previous trials, and because faces were randomly presented, there was no way to examine the influence of face valence on average stop signal delay. As a result, a dependent means t-test was conducted to examine the influence of condition (violent video game or nonviolent video game) on average stop signal delay. There was no significant effect of video game condition on average stop signal delay ($t(26) = 0.16, p = 0.87$, violent $M = 494.84, SE = 1.55$ and nonviolent $M = 494.57, SE = 1.63$). These results suggest that
regardless of video game exposure, chronic violent video gamers were equally able to inhibit behavior. See Figure 6 for a visual representation of the baseline behavioral data.

Figure 6. Chronic Violent Video Gamers’ Accuracy and Response Time After Exposure to a Violent or Nonviolent Video Game.

Non-gamers Chronic violent video gamers comparisons between Stop-Signal Task performance after playing a violent or a nonviolent video game. a.) Proportion correct for Go-trials. b.) Reaction time in milliseconds for Go-trials. c.) Average proportion correct for Stop-trials. d.) Average Stop-Signal Delay for Stop-trials. Error bars represent ±1 SEM.

EEG

Baseline Go Trials N170 Amplitude and Latency

In order to access baseline differences between chronic violent video gamers and non-gamers regarding face processing, a factorial repeated measures analysis of variance (ANOVA) was conducted examining group (gamer or non-gamer) and face valence (happy or afraid faces) on the N170 component mean amplitude. The window for
selecting N170 peaks was based on previous literature (Eimer, Kiss, & Nicholas, 2010) and visual inspection of the data (135-200 ms). A cluster of four right, posterior electrodes were averaged for all N170 analyzes. For N170 amplitudes, there was no significant effect of group ($F(1, 60) = 1.11, p = 0.30, \eta^2 = 0.02$, gamers $M = -3.08, SE = 0.44$, non-gamers $M = -2.4, SE = 0.44$), a significant effect of face valence ($F(1, 60) = 7.74, p = .007, \eta^2 = 0.11$, happy faces $M = -2.63, SE = 0.31$ and afraid faces $M = -2.87, SE = 0.32$), and no significant interaction ($F(1, 60) = 0.01, p = 0.92, \eta^2 = 0.001$). These results suggest that regardless of group, participants have less negative N170 amplitudes in response to happy faces as compared to afraid faces.

In order to access baseline differences in chronic violent video gamers and non-gamers regarding face processing, a factorial repeated measures analysis of variance (ANOVA) was conducted examining group (gamer or non-gamer) and face valence (happy or afraid faces) on the N170 50% fractional area latency. For N170 latencies, there was no significant effect of group ($F(1, 60) = 1.40, p = 0.24, \eta^2 = 0.02$, gamers $M = 161.29, SE = 1.38$, non-gamers $M = 163.60, SE = 1.38$), no significant effect of face valence ($F(1, 60) = 0.08, p = 0.78, \eta^2 = 0.001$, happy faces $M = 162.34, SE = 1.06$ and afraid faces $M = 162.55, SE = 1.03$), and a significant interaction ($F(1, 60) = 5.48, p = 0.02, \eta^2 = 0.08$ gamer happy $M = 160.33, SE = 1.50$ gamer afraid $M = 162.24, SE = 1.45$, non-gamer happy $M = 164.35, SE = 1.50$, non-gamer afraid $M = 162.85, SE = 1.45$). These results suggest that there was no different in the timing of facial processing between gamers and non-gamers or happy and afraid faces at baseline. However, gamers
had significantly faster latencies to happy faces as compared non-gamers at baseline. See Figure 7 for a visual representation.

**Figure 7. Baseline N170 ERPs Between Chronic Violent Video Gamers and Non-gamers.**

![Graph showing N170 ERP amplitudes and latencies for gamers and non-gamers.](image)

a) N170 (135-200 ms post face onset) mean amplitude scalp topography for the average of all four experimental conditions at baseline. b) Grand average ERPs (time-locked to the presentation of the face) for correct trials averaged across four right posterior electrodes indicated in black on topographic map. c) N170 mean amplitude (135-200 ms post face onset) across conditions. d) N170 50% fractional area latency (135-200 ms post face presentation). Error bars represent ±1 SEM.

**Non-gamers Go Trials N170 Amplitude and Latency**

In order to examine the effect of media violence exposure on face processing in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or
afraid faces) on the N170 component mean amplitude. For N170 amplitudes, there was no significant effect of condition ($F (1, 26) = 0.06, p = 0.81$, $\eta^2 = 0.002$, violent $M = -2.92$, $SE = 0.54$, nonviolent $M = -2.87$, $SE = 0.51$), a trending significant effect of face valence ($F (1, 26) = 3.93, p = .06$, $\eta^2 = 0.13$, happy faces $M = -2.76$, $SE = 0.51$ and afraid faces $M = -3.03$, $SE = 0.54$), and no significant interaction ($F (1, 26) = 1.52, p = 0.23$, $\eta^2 = 0.06$). These results suggest that regardless of exposure to a violent or nonviolent video game, non-gamers have less negative N170 amplitudes in response to happy faces as compared to afraid faces.

In order to examine the effect of media violence exposure on facial processing in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or afraid faces) on the N170 component latency. For N170 latencies, there was no significant effect of condition ($F (1, 26) = 1.34, p = 0.26$, $\eta^2 = 0.05$, violent $M = 162.64$, $SE = 1.68$, nonviolent $M = 163.67$, $SE = 1.61$), no significant effect of face valence ($F (1, 26) = 0.18, p = 0.67$, $\eta^2 = 0.007$, happy faces $M = 163.310$, $SE = 1.54$ and afraid faces $M = 163.00$, $SE = 1.71$), and no significant interaction ($F (1, 26) = 0.001, p = 0.98$, $\eta^2 = 0.001$). These results suggest that exposure to a violent or nonviolent video game and happy and afraid faces did not modulate the timing of face processing in non-gamers. See Figure 8 for a visual representation of the data.
Figure 8. N170 ERPs For Non-gamers After Exposure to a Violent and Nonviolent Video Game.

a.) N170 (135-200 ms) grand average ERPs (time-locked to the presentation of the face) for correct trials averaged across four right posterior electrodes for non-gamers. b.) N170 mean amplitude (135-200 ms post face onset) across conditions for non-gamers. c.) N170 50% fractional area latency (135-200 ms post face presentation) for non-gamers. Error bars represent ±1 SEM.

**Chronic Violent Video Gamers Go Trials N170 Amplitude and Latency**

In order to examine the effect of media violence exposure on face processing in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or afraid faces) on the N170 component mean amplitude. For N170 amplitudes,
there was no significant effect of condition \((F(1, 26) = 0.03, p = 0.86, \eta^2 = 0.001, \) violent \(M = -3.40, SE = 0.52,\) nonviolent \(M = -3.34, SE = 0.42,\) a significant effect of face valence \((F(1, 26) = 22.17, p < .001, \eta^2 = 0.46,\) happy faces \(M = -3.19, SE = 0.46\) and afraid faces \(M = -3.55, SE = 0.44,\) and a trending interaction \((F(1, 26) = 3.18, p = 0.09, \eta^2 = 0.11,\) violent happy \(M = -3.31, SE = 0.52,\) violent afraid \(M = -3.49, SE = 0.52,\) nonviolent happy \(M = -3.07, SE = 0.45,\) nonviolent afraid \(M = -3.62, SE = 0.40).\) These results suggest that regardless of exposure to a violent or nonviolent video game, chronic violent video gamers have less negative N170 amplitudes in response to happy faces as compared to afraid faces. However, after exposure to a violent video game chronic violent video gamers show less distinction in their N170 mean amplitudes between happy and afraid faces.

In order to examine the effect of media violence exposure on face processing in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or afraid faces) on the N170 component latency. For N170 latencies, there was no significant effect of condition \((F(1, 26) = 0.94, p = 0.34, \eta^2 = 0.04,\) violent \(M = 163.60, SE = 1.52,\) nonviolent \(M = 164.89, SE = 1.57,\) a significant effect of face valence \((F(1, 26) = 5.61, p = 0.06, \eta^2 = 0.18,\) happy faces \(M = 163.45, SE = 1.33\) and afraid faces \(M = 164.89, SE = 1.57,\) and no significant interaction \((F(1, 26) = 0.13, p = 0.73, \eta^2 = 0.005).\) These results suggest that regardless of video game exposure, chronic violent video gamers were slower to process afraid faces as opposed to happy faces. See Figure 9 for a visual representation of the data.
Figure 9. N170 ERPs For Chronic Violent Video Gamers After Exposure to a Violent and Nonviolent Video Game.

a.) N170 (135-200 ms) grand average ERPs (time-locked to the presentation of the face) for correct trials averaged across four right posterior electrodes for chronic violent video gamers. b.) N170 mean amplitude (135-200 ms post face onset) across conditions for chronic violent video gamers. c.) N170 50% fractional area latency (135-200 ms post face presentation) for chronic violent video gamers. Error bars represent ±1 SEM.

Baseline Stop Trials N200 Amplitude

In order to access baseline differences in chronic violent video gamers and non-gamers regarding the neural correlates of inhibitory control, a factorial repeated measures analysis of variance (ANOVA) was conducted examining group (gamer or non-gamer) and face valence (happy or afraid faces) on the N200 component mean amplitude for stop trials. The window for selecting N200 peaks was based on previous literature (Silton et
al., 2010) and visual inspection of the data (200-450 ms). A cluster of four central electrodes were averaged for all N200 analyzes. For N170 amplitudes, there was a trending effect of group ($F (1,60) = 1.11, p = 0.06, \eta^2 = 0.02$, gamers $M = 3.61, SE = 0.33$, nongamers $M = 4.52, SE = 0.33$), no significant effect of face valence ($F (1, 60) = 0.27, p = 0.60, \eta^2 = 0.005$, happy faces $M = 4.01, SE = 0.26$ and afraid faces $M = 4.12, SE = 0.25$), and no significant interaction ($F (1, 60) = 0.01, p = 0.97, \eta^2 = 0.001$).

These results suggest that regardless of face valence, chronic violent video gamers had decreased N200 amplitudes in response to inhibiting behavior. See Figure 10 for a visual representation of the data.

Figure 10. Baseline N200 ERPs Between Chronic Violent Video Gamers and Non-gamers.

a.) N200 (200-400 ms post stop-signal onset) mean amplitude scalp topography for the average of all four experimental conditions at baseline b.) N200 (200-400 ms) grand average ERPs (time-locked to the presentation of the stop-signal) for correct trials
averaged across four central electrodes for chronic violent video gamers and non-gamers at baseline. c.) N200 mean amplitude (200-400 ms post stop-signal onset) across conditions for chronic violent video gamers and non-gamers at baseline. Error bars represent ±1 SEM.

Non-gamers Stop Trials N200 Amplitude

In order to examine the effect of media violence exposure on inhibitory control in non-gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or afraid faces) on the N200 component mean amplitude. For N200 amplitudes, there was no significant effect of condition \((F (1, 26) = 2.12, p = 0.16, \eta^2 = 0.08, \text{violent } M = -2.92, \text{SE} = 0.54, \text{nonviolent } M = -2.87, \text{SE} = 0.51)\), no significant effect of face valence \((F (1, 26) = 1.57, p = 0.22, \eta^2 = 0.06, \text{happy faces } M = -2.76, \text{SE} = 0.51 \text{ and afraid faces } M = -3.03, \text{SE} = 0.54)\), and no significant interaction \((F (1, 26) = 0.28, p = 0.60, \eta^2 = 0.01)\). These results suggest that exposure to a violent video game or happy and afraid faces did not modulate the brains response to inhibition in non-gamers.

Chronic Violent Video Gamers Stop Trials N200 Amplitude

In order to examine the effect of media violence exposure on inhibitory control in chronic violent video gamers, a repeated measures analysis of variance (ANOVA) was conducted examining condition (violent or nonviolent video game) and face valence (happy or afraid faces) on the N200 component mean amplitude. For N200 amplitudes, there was no significant effect of condition \((F (1, 26) = 1.66, p = 0.21, \eta^2 = 0.06, \text{violent } M = 4.63, \text{SE} = 0.36, \text{nonviolent } M = 4.99, \text{SE} = 0.43)\), no significant effect of face valence \((F (1, 26) = 1.70, p = 0.20, \eta^2 = 0.06, \text{happy faces } M = 4.76, \text{SE} = 0.38 \text{ and afraid faces } M = 4.99, \text{SE} = 0.37)\), and a trending interaction \((F (1, 26) = 3.51, p = 0.07, \eta^2 = 0.13)\).
$\eta^2 = 0.12$, violent happy $M = 4.48, SE = 0.37$, violent afraid $M = 4.78, SE = 0.37$, nonviolent happy $M = 5.03, SE = 0.45$ nonviolent afraid $M = 4.94, SE = 0.42$). These results suggest that playing a violent video game can modulate how chronic violent video gamers inhibit behavior in the presence of afraid and happy faces. See Figures 11 and 12 for visual presentation.

Figure 11. N200 ERPs for Chronic Violent Video Gamers and Non-gamers After Exposure to a Violent and Nonviolent Video Game.

a.) N200 (200-400 ms) grand average ERPs (time-locked to the presentation of the stop-signal) for correct trials averaged across four central electrodes for non-gamers after exposure to a violent and a nonviolent video game. b.) N200 (200-400 ms) grand average ERPs (time-locked to the presentation of the stop-signal) for correct trials averaged across four central electrodes for chronic violent video gamers after exposure to a violent and a nonviolent video game.
Figure 12. N200 Amplitudes for Chronic Violent Video Gamers and Non-gamers After Exposure to a Violent and Nonviolent Video Game.

a.) Non-gamers N200 mean amplitude (200-400 ms post stop-signal onset) after playing a violent and a nonviolent video game. b.) Chronic violent video gamers N200 mean amplitude (200-400 ms post stop-signal onset) after playing a violent and a nonviolent video game. Error bars represent ±1 SEM. Error bars represent ±1 SEM.
CHAPTER FOUR
DISCUSSION

Summary of Findings

At baseline, chronic violent video gamers were more physically aggressive, less empathetic, and angrier than non-gamers. Also at baseline, regardless of categorization as a chronic violent video gamer or a non-gamer, participants were less accurate at identifying the gender of afraid faces. There was no effect of group (chronic violent video gamer or non-gamer) or valence on reaction time for go trials or stop trials at baseline. For non-gamers, there was no effect of playing a violent or a nonviolent video game on overall accuracy in inhibiting behavior or the average delay between the presentation of the face and the stop-signal. Consistent with baseline measures, non-gamers were less accurate and slower at identifying the gender of afraid faces as compared to happy faces.

Chronic violent video gamers were also less accurate at identifying the gender of afraid faces, however after exposure to a violent video game this distinction between happy and afraid faces in terms of accuracy disappeared. In line with accuracy results, chronic violent video gamers were slower at identifying the gender of afraid faces, however after playing a violent video game chronic violent video gamers were slower at identifying the gender of happy faces and faster at identifying the gender of afraid faces. In terms of the stop trials, there was no effect of playing a violent or a nonviolent video game in overall ability to inhibit behavior regardless of face valence for gamers.
With regard to the neural correlates of facial processing, regardless of group (chronic violent video gamer or a non-gamer), participants displayed more negative amplitudes in response to afraid faces as compared to happy faces. After playing a nonviolent or a violent video game for twenty minutes, non-gamers still displayed a more negative N170 to afraid faces as compared to happy faces. Chronic violent video gamers displayed more negative N170 amplitudes and delayed latencies to afraid faces, however after playing a violent video game this distinction between happy and afraid faces in the N170 was lost.

At baseline, chronic violent video gamers displayed decreased amplitudes in the N200 when inhibiting behavior as opposed to non-gamers. There was no effect of face valence on the N200 in response to inhibition. Non-gamers did not display changes in their N200 amplitude in response to inhibition after playing a violent or nonviolent video game and showed no distinction in the neural correlates of inhibitory control between happy and afraid faces. Chronic violent video gamers did not display changes in the amplitude of neural correlates of inhibitory control after playing a violent or a nonviolent video game and they did not distinguish in the N200 between happy and afraid faces. However, after playing a violent video game habitual gamers displayed modulations in their N200 amplitude in response to emotional faces.

**Behavioral Findings**

Longitudinal and meta-analytic studies have repeatedly found that repeated exposure to violence in the media is related to increased physical aggression and decreased empathy for others (Anderson et al., 2010; Huesmann, Moise-Titus, Podolski,
& Eron, 2003). In line with past research, chronic violent video gamers were found to be more physically aggressive and less empathic than non-gamers. These results lend support to decades of previous research which have shown a causal relationship between exposure to violence in multiple forms of media and increased aggression (Bushman & Anderson, 2001) and decreased empathy (Bushman & Anderson, 2009). The relationship between exposure to violence in the media and increased aggression and decreased empathy seems to be circular. People with aggressive personalities are more likely to seek out aggressive media and partaking of this media further increases their aggressive behavior (Bartholow, Sestir, & Davis, 2005). However, nonaggressive people still show an increase in aggressive behavior after exposure to media violence (Anderson et al., 2010). In line of this past work, it is likely that chronic violent video gamers had more aggressive personalities and that these differences in personality lead them to seek out more violent media. It is also likely that this violent media reinforced scripts and schemes related to physical aggression and decreased empathy (Anderson & Bushman, 2002), and thus at baseline chronic violent video gamers were more aggressive and less empathic than non-gamers.

Also consistent with past research is the finding in the current study that regardless of categorization as a chronic violent video gamer or non-gamer, participants were less accurate at identifying the gender of afraid faces. Threat-related stimuli (such as angry or afraid faces) are extremely attention grabbing (Vuilleumier, Armony, Driver, & Dolan, 2001) and for evolutionary reasons based on survival are given processing preference and are very difficult to disengage from (Fox, Russo, & Dutton, 2002). The
gender discrimination task used in this study is emotion irrelevant and thus participants have to disengage from the irrelevant information of emotion in order to quickly and accurately identify the gender of the face. This is much more difficult to do in the presence of threat-related stimuli, such as fearful faces, and thus participants are less accurate at this gender discrimination task in the presence of afraid faces. In contrast, participants, regardless of categorization as a chronic violent video gamer or non-gamer, were equally able to inhibit their behavior on the stop-trials. Likewise, face valence did not influence participants’ ability to inhibit behavior.

After playing a violent or a nonviolent video game, non-gamers still displayed this difficulty in disengaging from threat-related stimuli by having a reduction in accuracy and a delay in response time in the gender discrimination task for afraid faces. However, after exposure to a violent video game, chronic violent video gamers lost the distinction between happy and afraid faces in terms of reaction time and accuracy in the gender discrimination task. This is in line with past research which suggests that exposure to media violence results in desensitization to the emotional experiences of others (Anderson & Bushman, 2002). Researchers have argued that exposure to violence in the media can leave people "emotionally anesthetized" (Stockdale et al., under review). The lack of a distinction between happy and afraid faces in terms of reaction time and accuracy after exposure to a violent video game in gamers add support to the empirical research which shows the ability of media violence to numb viewers to the emotional experiences of others.
Behaviorally, there were no differences between chronic violent video gamer and non-gamers in their ability to inhibit behavior. Previous research has found mixed results regarding the effect of media violence on inhibitory control (Gentile et al., 2011; Ferguson, 2007). The results of the current study suggest that continuous exposure to violent video games does not result in decreased ability to inhibit behavior in the long or the short-term.

**Neural Findings**

At baseline, regardless of categorization as a chronic violent video gamer or a non-gamer, participants had more negative N170 amplitudes in response to afraid faces as compared to happy faces. This is consistent with past research that has found that the attention given to threat-related stimuli can be seen in the right posterior N170 component (Batty & Taylor, 2003), with threat-related faces producing more negative N170 amplitudes (Leppänen, Moulson, Vogel-Farley, & Nelson, 2007). This effect of afraid faces producing more negative N170 amplitudes as compared to non-threat-related faces was found at baseline, in non-gamers regardless of condition, and in non-gamers after exposure to a nonviolent video game. Likewise, chronic violent video gamers displayed delayed N170 latencies to afraid faces. This effect of afraid faces on delayed N170 latencies has some support in the literature, with a few studies finding afraid faces resulting in delayed N170 latencies as opposed to non-threat-related faces (Batty & Taylor, 2003; Leppänen, Kauppinen, Peltola, & Hietanen, 2007). However, after playing a violent video game, chronic violent video gamers did not differentiate between happy and afraid faces in their N170 amplitudes or latencies. This again supports the behavioral
results which suggest that exposure to violence in the media can result in desensitization to the emotional experiences of others, and can leave violent media consumers numb to emotion (Stockdale et al., under review).

In regards to the N200 component, reflective of the cognitive resources necessary to inhibit behavior (Silton et al., 2010; 2011), there were baseline differences between chronic violent video gamers and non-gamers. Chronic violent video gamers displayed decreased N200 amplitudes in response to inhibition as compares to non-gamers, regardless of face valence. This suggests that even though chronic violent video gamers and non-gamers behaviorally are equally able to inhibit behavior, chronic violent video gamers have to spend less cognitive energy and resources to perform equally well. This lends support to past research which suggests that playing violent video gamers can improve inhibitory control (Ferguson, 2007), due to the requirements of such games. When playing a first-person shooter video game, for example, players are rewarded only for shooting the "enemy" and are punished for shooting other teammates or civilians. This ability to inhibit behavior in order to only shoot the appropriate targets could lead to increase ability to inhibit behavior in other environments. The nature of the computerized and button press paradigm used in this experiment maybe particularly salient to chronic violent video gamers, as they are engaging in a similar environment as playing a video game. Thus, the cognitive resources necessary to equally inhibit behavior for chronic violent video gamers was less than non-gamers in this study at baseline. Exposure to a violent or a nonviolent video game did not modulate the N200 component amplitude for non-gamers. However, there was a trending modulation in N200 amplitudes in chronic
violent video gamers after exposure to a violent video game. This may be as result of chronic violent video gamers becoming particularly numb to valenced information after playing a violent video game, and thus they do not have to work as hard to overcome the emotion conveyed in the face in order to inhibit behavior.

Previous researchers have shown that top-down and bottom-up processing may not be as distinct as previously believed (Sarter, Givens, & Bruno, 2001). In particular, emotional information can enhance or interfere with top-down attentional control processes (Mechelli, Price, Friston, & Ishai, 2004). Previous researchers have shown that exposure to a violent video game can modulate the processing of happy faces (Kirsh & Mounts, 2005). Perhaps this desensitization to emotion after playing a violent video game in chronic violent video gamers is the behavioral mechanism underlying this modulation in N200 amplitude after exposure to a violent video game.

**Why Do Chronic Violent Video Gamers Have Stronger Effects Than Non-gamers?**

The effects of media violence on behavior and neural activity in this study were only evident in chronic violent video gamers, which leaves this question: "if media violence really effects behavior, why were these effects not seen in non-gamers?" There are several reasons why the effects of media violence exposure were only seen in chronic violent gamers in the current study. First, media effects research has shown that the stronger the identification with the character (Konijn, Bijvank, & Bushman, 2007), the more immersed and engaged with the media (Gentile, Lynch, Linder, & Walsh, 2004), and the more time spent with the violent media (Huesmann et al., 2001), the stronger the effect. Chronic violent video gamers, who were able to play on a system they were spend
30+ hours a week engaging with, undoubtedly felt more identification and engagement with the video games than did non-gamers. This would lead to stronger effects that are more likely to be seen in these lab based measures.

The non-gamers in this study played five or less hours a video games a week, but at least some. These non-gamers are spending significantly less time playing video games than the average male college student (Padilla-Walker et al., 2010). Research has shown that people who critically think about the content of what they are seeing in the media, and evaluate the content of the media they are viewing, do not show effects to their behavior after being exposed to media violence (Scharrer, 2006). This ability to evaluate and critique the content in the media engaged with is referred to as "media literacy", and is being implemented in schools across the United States in order to decrease the effect of media violence on aggressive behavior (Byrne, 2009). It is possible, that because these non-gamers spend so much less time with violent video games (less than even the average male college student), that they more deeply analyzes, evaluate, and critique the content of the video games they were asked to play in the lab. This critical evaluation would lead to no effect of media violence on behavior. The intense engagement of chronic violent gamers with the video games played in the lab and the potential for critical evaluation by the non-gamers in this study may help explain why the chronic violent video gamers in this study showed effects of violent video game exposure while the non-gamers did not.
Limitations

While the current study adds to the existing literature regarding media effects, it is not without limitations. The current study did not take into account previous life experiences, such as trauma, abuse, and community violence exposure, all of which are known to influence emotional face processing. Definitive conclusions regarding the long-term effects of chronically playing violent video games on behavior and face processing cannot be drawn from the current study because the researchers did not experimentally control who became a chronic violent gamer and a non-gamer. Future researchers should longitudinally examine what characteristics correlate with someone becoming a chronic violent video gamer versus a non-gamer in order to help understand the trajectories to these categorizations. Information regarding parenting, personality, academic achievement, and community support and environment would provide depth to the trajectories that lead to chronic violent video gaming versus non-gamers. Likewise, these results should be replicated with average gamers to help understand if there is an effect of violent video game play on face processing and inhibitory control in an average population.

Similarly, the current study was based on lab based measures in a controlled environment. No measures of aggressive behavior or empathy were taken after exposure to the violent or the nonviolent video game. Future researchers should examine the short-term and long-term effects of media violence exposure on aggression and empathy in chronic violent gamers and non-gamers. These relationships should also be examined in naturalistic observations, so correlations can be drawn between behaviors in the lab and
in the real world. Likewise, the current study only examined male college students. Future researchers should examine these behaviors in a more diverse sample of ages, educational backgrounds, and in female chronic violent gamers.

**Conclusions**

The current study provides evidence that exposure to violent video games in the short and the long-term can alter emotional face processing and inhibitory control. The results of the current study suggest that exposure to violent media can leave people numb to the emotional experiences of others. This desensitization to the pain and suffering of others can lead to increased aggression (Anderson & Bushman, 2002) and decreased empathy (Bushman & Anderson, 2009). Parents, policy makers, media consumers, and media makers should seriously evaluate the cost of media violence on society in order to promote a more peaceful and less aggressive world.
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VITA

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