Effects of Playing Violent Video Games

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Introduction

Video games are extremely popular among children, teens and adults. A wide spectrum of games is available on consoles (such as the Wii, XBox, and PlayStation), handheld players (such as Nintendo DS or an iPod) and cell phones. A recent study of media use among American youth done on a sample of more than 2000 children and teens showed that there has been a significant increase in video gaming over the past five years (Rideout, Foehr & Roberts, 2010). On any given day, 60% of young people play video games, spending an average of about 1 hour at the controller. Video game playing peaks among 11 to 14-year-olds who average one and a half hours per day. Boys continue to play more than girls (1:37 hours compared to 49 minutes).

Ten years ago, over 85% of games contained some violence, and about half included serious violent actions (Children Now, 2001). Violence in video games is often portrayed as justified, fun, and without negative consequences (Funk, Baldacci, Pasold & Baumgardner, 2004). A majority of children prefer playing violent games over non-violent ones (Funk et al., 2004).

It is a worrying fact that only 30% of children and teens report that their parents have rules about which video games they can play and how much time they can spend playing (Rideout, Foehr & Roberts, 2010). Research shows that parents often aren't familiar with the content of their children's favorite video games and underestimate their child's exposure to violence while playing (Funk, Hagan, & Schimming, 1999).

In response to congressional pressure, the Entertainment Software Rating Board (ESRB) was founded in 1994 by the game industry in order to aid consumers in determining a game's content and suitability for children and adolescents. The ESRB rates video games with age-basted rating symbols and content descriptors displayed on the game box. The rating system should, in theory, aid parents in controlling the kind of video game content to which their children are exposed.

However, despite some improvements over the years, the existing rating system is flawed in multiple ways (Gentile, 2008). For example, almost 50% of T-rated games ("Teen", appropriate for persons of 13 years or older) include potentially objectionable content that was not described on the box (Haninger & Thompson, 2004). Many parents don't understand the ratings. Only 19% of adolescents report that their parents have ever used the ratings to keep them from getting a game (Gentile et al., 2004). Most adolescents play games rated as inappropriate for their age.

Furthermore, a recent analysis of ESRB ratings found that 31% of E games (Everyone), 91% of E10+ games (Everyone 10 and older), 91% of T games (Teens ages 13 and over), and 89% of M games (Mature, ages 17 and older) contained violence (Gentile, 2008). Because such a large number of children, teens and adults play video games and because such a large proportion of games include violent content, it is important to understand the short term and long term effects that violent video games have on players.

This chapter describes a theoretical framework for understanding effects of playing violent video games, gives a short explanation of research designs and scientific causality and then describes the current knowledge of violent video game effects. Effects of violent video games on aggression and related variables are described in detail. Effects of violent video games on prosocial behavior are briefly described, as are effects of video games on attention and cognitive control, school performance and video game addiction.

Theoretical Frameworks

Several early and recent social cognitive models can provide useful contexts for understanding effects of exposure to violent media. Bandura's Social Learning Theory and Social Cognitive Theory (Bandura, 1973; 1983) propose that children can learn behavioral responses by observing behaviors of others and by observing the outcomes of those behaviors.

Classical experiments by Bandura and his colleagues using the Bobo doll paradigm showed that children can learn aggressive behavior through observation of both actual and filmed aggression (Bandura, Ross & Ross, 1961, 1963a). Children are more likely to imitate a witnessed behavior if that behavior was rewarded, and less likely to imitate the behavior if it was punished (e.g. Bandura, 1965; Bandura, Ross & Ross, 1963b).

Huesmann (1986, 1998) proposed that people's behavior is guided by the acquisition, internalization and application of behavioral scripts. Scripts are sets of highly associated concepts that guide perception of social events and enactment of social behavior. Children who are exposed a lot of media violence are more likely to acquire behavioral scripts that contain aggression and violence. An aggressive script can become chronically accessible through repeated rehearsal. Numerous aspects of script theory have been empirically confirmed, both within the aggression domain as well as in other domains. For example, playing a violent video game increases the amount of aggressive content in a story completion task (Bushman & Anderson, 2002).

Two recent relevant models are the General Aggression Model (GAM; e.g. Anderson & Bushman, 2002; Anderson & Huesmann, 2003, Anderson & Carnagey, 2004; Barlett & Anderson, 2010) and the General Learning Model (GLM; Buckley & Anderson, 2006; Gentile et al., 2009; Swing & Anderson, 2008). GAM integrates Social learning theory, Script theory and a host of other models including cognitive-neoassociation theory (Berkowitz, 1984), cultivation theory (Comstock & Scharrer, 2007), desensitization theory (Carnagey, Anderson, & Bushman, 2007), and social information processing theory (Crick & Dodge, 1994). GLM extends the basic processes underlying GAM to other domains of social behavior.

An overview of the General Aggression Model is shown in *Figure 1.* GAM is a bio-social-developmental model that describes the personal and situational factors and processes that influence an individual's aggressive behavior in a social episode. It also provides a way to understand how biological factors interact with environmental factors to yield behavior in context (Raine, Brennen, Farrington, & Mednick, 1997).

GAM describes two sets of processes that influence the probability that a person will respond aggressively in a particular social encounter – distal factors and proximal factors. Distal factors (displayed in the upper part of *Figure 1*) are developmental factors that have helped shape an individual's personality. Distal factors operate by increasing proximate factors that facilitate aggression or by decreasing proximate factors that inhibit aggression. Distal factors that influence aggression include biological modifiers (for example, low arousal levels, low serotonin, ADHD, hormonal imbalances; Anderson & Carnagey, 2004), and environmental modifiers (for example harsh or inconsistent parenting practices, cultural influences, poverty; Anderson & Carnagey, 2004).

Insert Figure 1.

Proximate factors (displayed in the lower part of *Figure 1*) are person and situation variables that are present and active in the current social episode. Situational factors that have been shown to influence aggression include exposure to media violence (Anderson et al., 2003), provocation (Bettencourt & Kernahan, 1997), heat (Anderson, 1989), and ostracism (Warburton, Williams, & Cairns, 2006). Person factors that influence aggression include trait aggression (Bushman, 1995), psychoticism (Markey & Scherer, 2009), trait hostility (Kirch, Olczak & Mounts, 2005) and anger (Berkowitz, 1994). Numerous person and situation factors influence

the individual's present internal state – cognitions, affect and arousal. These internal state variables influence one another and affect the probability of aggressive behavior.

The contents of one's present internal state influence appraisal and decision processes. Appraisals can be made automatically, resulting in an impulsive behavior. If the individual has the time and resources to reappraise the situation and if the outcome is important and unsatisfying, a thoughtful behavior is likely to occur. Both impulsive and thoughtful behaviors can be aggressive or non-aggressive.

The ensuing behavior influences the on-going social encounter. In return, the results of the social encounter influence the situational input factor. Thus, GAM includes a feedback loop that can lead to a violence escalation cycle (Barlett & Anderson, 2010; Anderson, Buckley & Carnagey, 2008).

Insert Figure 2.

The long term effects of any repeated episodic encounter (such as bullying, rejection), including the repeated play of violent video games, is illustrated in Figure 2. Long-term consumers of violent media can become more aggressive in outlook, develop hostile perceptual biases, attitudes, beliefs and behavior. Development, automatization and reinforcement of aggression-related knowledge structures can lead to long-term personality changes (Carnagey & Anderson, 2003; Bartholow, Sestir & Davis, 2005).

It is important to keep in mind that the learning processes described by GAM are general processes that cognitive, developmental, and social psychologists have studied for decades. Therefore, they can be applied not only to aggression, but also to other kinds of behavior – for example, learning prosocial behavior (Gentile et al., 2009). The General Learning Model (GLM; Bartlett & Anderson, 2010; Buckley & Anderson, 2006; Gentile et al., 2009; Swing & Anderson,

2008) is an extension of GAM that illustrates how long-term attitudes and knowledge structures are formed with continued exposure to any type of repeated social encounter (including media). Short-term processes described by GLM are similar to those in GAM – situational and personality factors influence one's internal state (cognitions, affect and arousal). Internal state variables influence appraisal and decision processes that lead to different types of behavior. In turn, one's behavior influences the situational input factor. GLM also predicts long term changes that result from repeated learning. The main difference between GAM and GLM are that the latter explicitly states that the same learning processes apply to all types of social behavior. In addition, the most recent version of GLM categorizes the outcome of long-term effects in a somewhat different way, as illustrated in *Figure 3.*

Insert Figure 3.

As applied to media effects, GLM (Barlett & Anderson, 2010) notes that repeated exposure to any type of media influences personality through the development of pre-cognitive and cognitive constructs (perceptual schemata, beliefs and behavioral scripts), cognitive-emotional constructs (attitudes and stereotypes) and emotional constructs (conditioned emotions and affective traits). Considerable support for GLM comes from research exploring prosocial media influences on prosocial behavior (e.g. Gentile et al., 2009; Greitemeyer, 2009; Greitemeyer & Osswald, 2009; 2010).

Types of studies in video game research

Empirical researchers generally use three basic types of studies – experimental studies, cross-sectional correlational studies and longitudinal studies (Anderson & Bushman, 2001; Swing & Anderson, 2010). Each study type has advantages and drawbacks and each is appropriate for certain kinds of research problems. Results obtained from different kinds of

studies complement each other and allow researchers to get a complete picture of media violence effects.

In experimental studies researchers manipulate exposure to media violence and view the short-term results of brief exposure. Participants are randomly assigned to different conditions (for example, playing a violent or nonviolent video game). With all other factors controlled, a difference between two groups in, for example, aggression, establishes a causal link between violent media and subsequent aggression. A potential disadvantage of experimental research is that certain types of more extreme physical aggression cannot ethically be used in such studies. For example, one cannot randomly assign children to play a violent or nonviolent video game and then give each of them a gun to see which group more frequently attempts shoot other people. The best field experiments use measures of real physical aggression in natural settings, such as hitting, pushing, and fighting on the playground. The best laboratory experiments use well-validated paradigms to test important hypotheses. In general, experimental research in the aggression domain has shown high generalizability (Anderson & Bushman, 1997).

Cross-sectional correlational studies test for positive or negative relationships among theoretically relevant variables (for example, a relationship between violent video game exposure and aggressive affect). The strengths of good correlational studies include the ability to measure more extreme forms of aggression, to test specific alternative explanations, and to suggest new hypotheses about causal relationship. However, the main disadvantage is that the results of a single correlational study (or of several) cannot establish cause and effect, because the variables are measured at the same single point in time. Nonetheless, such studies are relevant to testing causal hypotheses because they provide an opportunity for falsification of the causal hypothesis,

they can test alternative hypotheses (and thus rule them out or support them), and they allow the research to control for extraneous variables by statistical procedures.

In a longitudinal study researchers collect data on the same group of people at two or more points in time. This allows stronger causal statements than cross-sectional correlation studies, because of the temporal relations among the variables. For example, one can assess media habits and aggressive behavior tendencies both early and late in a school year, and then test whether amount of media violence exposure at Time 1 predicts aggressive behavior at Time 2 after statistically controlling for Time 1 behavior tendencies. Longitudinal studies have allowed researchers to document the real life consequences of repeated exposure to large amounts of media violence. The main disadvantages of longitudinal studies are that they are time-consuming and expensive.

Each research design has its place in the study of media violence and strong causal conclusions depend on consistent results across each of these designs (Abelson, 1995; Swing & Anderson, 2010). Meta-analytic procedures can be used to combine results of several studies and draw conclusions from integrated data. The most comprehensive meta-analysis of all three types of violent video game studies yielded consistent evidence that violent video game play causes an increase in the likelihood of physical aggression and a decrease of prosocial behavior (Anderson et al., 2010).

Probabilistic Causality and the Risk Factor Approach

To understand how violent video games influence players, it is important to understand the concept of probabilistic causality. Modern scientific causality is probabilistic, rather than "necessary and sufficient." That is, a variable X causes an increase in the likelihood of an outcome Y (Anderson, 2004). For example, saying that "smoking causes lung cancer" means that

repeated smoking increases the likelihood that one will contract lung cancer. It does not mean that all smokers get lung cancer (a violation of sufficient causality). Also, in some cases non-smokers get lung cancer (a violation of necessary causality). Similarly, saying that "violent video games cause aggression" does not mean that any person who plays violent video games will become aggressive or that any aggressive act is a product of violent video game play. It means that exposure to violent video games causes an increase in the likelihood of aggression.

Probabilistic causality is a result of the fact that human behaviors (such as aggression or prosocial behavior) are multi-causal. They are influenced by a large number of interacting factors, and exposure to violent media is just one of those factors. No one causal factor can explain more that a small proportion of the variance of that behavior. This same modern view of causality applies in numerous other scientific domains as well, medical science being a obvious example (heart disease, cancer…).

A useful approach for understanding how multiple causes determine behavior is the risk and resilience approach (Gentile & Sesma, 2003). This approach focuses on life experiences (biological, environmental, social…) that may put people at risk for future maladaptation (risk factors) and those factors that serve to protect from this risk exposure (protective factors). Within this approach violent media are viewed as a risk factor for aggression. Other risk factors for aggression include genetic predispositions (Hudizak et al., 2003), poor parenting practices (Patterson, 1995), poverty (Ewart & Suchday, 2002), and having been bullied (Osofsky and Osofsky, 2001) among many others. Protective factors that decrease the risk of aggression include being female (Archer, 2004), having a positive family environment (Estévez López et al., 2008), and high empathy (Björkqvist, Österman & Kaukiainen, 2000) among others.

Effects of risk and protective factors are cumulative – each additional risk factor increases the likelihood of aggression and each protective factor decreases it. No single factor alone is sufficient to elicit more extreme forms of aggression, but each is relevant and steps could be taken to minimize them (Anderson, Gentile & Dill, 2010). One non-obvious implication of this approach is that from a practical standpoint we, as parents and as members of society, cannot allow exposure to violent video games (or any other single risk factor) be used as a completely exonerating excuse for violence. Several key aggression-inhibiting factors rely on the individual's belief that he or she is responsible for his or her own behavior and will be held responsible by others.

Violent Video Game Effects

Short and long term effects on aggression and related variables

Effects of violent video games on aggression are a topic that has received a lot of attention and has been much discussed, both by researchers and by the general public. A large body of research papers have been published on the subject, as well as several review papers (Barlett, Anderson & Swing, 2009; Dill & Dill, 1998; Emes, 1997; Griffiths, 1999; Bensley & Van Eenwyk, 2001) and meta analyses (Anderson, 2004; Anderson & Bushman, 2001; Anderson, Carnagey, Flanagan, Benjamin, Eubanks, & Valentine, 2004); Sherry, 2001).

The most recent and most comprehensive meta-analysis in this domain (Anderson et al., 2010) combined a total of 136 research papers with 381 effect size estimates involving over 130,000 participants. This is a much larger sample than in previous meta-analyses, both because of the rapid expansion of violent video game research in the past few years and because of the inclusion of previously unavailable studies from Japan.

Six outcome variables were included in the meta-analysis: aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, desensitization / low empathy and prosocial (helping) behavior. Results reported in this chapter are based on the sample of studies whose methodology met all best practices criteria (the "Best Raw" sample in Anderson et al., 2010). The "Best Raw" sample includes 221 effect sizes and a total of 61,000 participants. Both the best practices sample and the full sample yielded the same results – violent video games had significant effects on all six outcome variables, proving that video game violence is indeed a risk factor for increased aggression and decreased prosocial behavior. The main findings of the meta-analyses are shown in *Figure 4.* Results according to type of research design are displayed in *Table 1*.

Insert Figure 4.

Are the effect sizes large enough to be considered important? Because aggressive behavior is determined by a large number of factors (e.g. genetic predispositions, parental practices, cultural influences, personality, arousal levels etc.; Anderson & Huesmann, 2003), no single factor can explain more than a small proportion of the individual differences in aggression. However, even small effect sizes can have important practical consequences. If large portions of the population are exposed to a risk factor and if effects accumulate across time, the risk factor can significantly influence the individual and society (Anderson et al., 2010). In fact, the obtained effect size of violent video games on aggression compares favorably to such risk factors as substance use, abusive parents and poverty (U.S. Department of Health and Human Services, 2001).

Insert Table 1.

Aggressive behavior. The notion that playing violent video games causes aggressive behavior has been supported by substantial research evidence. The consistency of the results from experimental, cross-correlational, and longitudinal studies demonstrate a that violent video game play is a causal risk factor for physical aggression.. This effect occurs in short-term and long-term contexts, across gender and culture, and to children and adolescents.

For example, in an experimental study by Konijn, Bijvank and Bushman (2007) adolescent boys played a violent or a nonviolent video game. Next, the boys competed with a supposed partner and the winner could blast the loser with loud noise through headphones (the aggression measure). The boys who had played a violent video game were more prone to behave aggressively, and especially so if they had identified with the violent characters in game. Identification with violent characters in the virtual world influenced the adolescents to behave more aggressively against others in the real world.

In a correlational study, adolescents exposed to greater amounts of video game violence were more likely to be involved in physical fights than those with lesser exposure (Gentile et al., 2004). The link between exposure video game violence and physical aggression remained significant even when gender and trait hostility were statistically controlled.

A two year long longitudinal study tracked children's exposure to violent media and their violent and delinquent behavior between the ages of 12 and 14 years (Hoph, Huber & Weib, 2008). Exposure to violent video games at the age of 12 was a significant predictor of violence (b = .18) and delinquency (b = .29) at the age of 14, even after controlling for earlier violence and delinquency and several other important variables. That is, violent video game play led to a relative increase in violent and deliquent behavior over time.

Perhaps the most persuasive evidence that video game violence is a significant risk factor for physical aggression is provided by the new meta-analysis cited earlier and displayed in Figure 4 and Table 1. This effect was significant regardless of the type of research design. The overall average effect size for best practices studies was $r+ = .244$, $p < .01$. The significant effect found in longitudinal studies ($r+ =.203$, $p < .01$) shows that playing violent video games can increase aggression over time. The relationship between violent video game play and aggressive behavior was moderated neither by sex nor by culture. It seems that effects of violent video games on aggression are robust, affecting both men and women, individuals from Western and Eastern cultures. A marginally significant age effect was found, suggesting that children might be more susceptible than adults. However, more research is needed to clarify this question (Anderson et al., 2010).

Aggressive cognition. Exposure to violent video games can have a number of cognitive consequences which can, in turn, lead to aggressive behavior. GAM predicts that violent video game exposure will have both short term and long term effects on cognition. In the short term, media violence can prime aggressive thoughts, making them more accessible (Anderson & Huesmann, 2003). Repeated exposure to virtual violence activates and strengthens aggression-related knowledge structures, such as perceptual and expectation schemas and behavioral scripts. It also reinforces normative beliefs that aggression is an appropriate response in a particular situation (Carnagey & Anderson, 2003; Bushman & Huesmann, 2006). These predictions have been confirmed by experimental, cross-sectional correlational, and longitudinal research.

An experimental study by Kirsh (1998) showed that playing violent video games can lead to the development of a hostile attribution bias. In this experiment, children who had played a violent video game were more prone to attribute malevolent intent to the wrongdoer in an

ambiguous provocation story. The tendency to interpret ambiguous behaviors of others as malevolent can increase the likelihood that children will respond to real-life ambiguous provocation situations with aggression. Similar findings have been reported in other experimental studies (e.g., Bushman & Anderson, 2002).

A correlational study by Funk et al. (2004) explored the possibility that media presentations of justified violence may change the belief that violent behavior is wrong, encouraging the development of proviolence attitudes. Indeed, exposure to video game violence was positively associated with proviolent attitudes ($r = .30$, $p < 0.01$) and with diminished empathy ($r = -.24$, $p < 0.01$). Similar findings have occurred in numerous studies (e.g., Anderson et al., 2004).

A longitudinal study by Möller and Krahé (2009) tracked adolescents' violent video game usage, endorsement of aggressive norms, hostile attribution bias, and aggression over a period of 30 months. Results show that exposure to violent video games at the first time of measurement influenced physical aggression 30 months later via an increase of aggressive norms and hostile attribution bias. Similar findings have been reported the other major longitudinal studies (e.g., Anderson, Gentile & Buckley, 2007).

The meta-analysis by Anderson and colleagues (2010) has shown that exposure to violent video games is significantly related to higher levels of aggressive cognition, regardless of research design. The average effect size was $r+ = .175$, $p < .01$. Perhaps the most important finding is the significant longitudinal effect of violent video games on aggressive cognition. Together with the findings of experimental and cross-sectional studies, the data provide strong evidence that violent video game play is a significant causal risk factor for both short-term and long-term increases in aggressive thinking (Anderson et al., 2010). Furthermore, several of the

longitudinal studies show that these changes in aggressive thinking at least partially mediate the long term effects of violent video games on physical aggression.

Aggressive affect. Violent media increase aggression, at least in part, by producing feelings of anger and hostility (Swing & Anderson, 2010). Short-term effects of violent video game play on mood dissipate quickly (Barlett et al., 2009), but repeated exposure to violent media can lead to the development of a hostile personality (e. g. Bartholow, Sestir & Davis, 2005; Bushman & Huesmann, 2006).

An experimental study by Markey and Scherer (2009) on a sample of late adolescents and young adults showed that playing a violent video game caused the participants to feel more hostile. The relationship between exposure to video game violence and ensuing hostility was moderated by trait psychoticism - the negative effect of violent video games on mood was greater for individuals with high psychoticism scores. This finding is consistent with other research showing that persons with high trait aggression (Bushman, 1995) and high trait hostility (Kirsh, Olczak & Mounts, 2005) might be more susceptible to some effects of violent media. Other studies, however, have found that brief exposure to violent video games increases the hostile affect of game players regardless of aggressive personality (e.g., Anderson & Carnagey, 2009, Experiment 2).

In a cross-sectional study, Bartholow et al. (2005) found that hostility mediated the relationship between habitual violent video game exposure and physical aggression ($z = 2.26$, $p < .05$). Numerous correlational studies have found positive correlations between video game violence and aggressive affect (e.g., Gentile et al., 2004). These findings suggest that increased hostility provides one pathway through which exposure to video game violence influences aggression.

The abovementioned two year long longitudinal study by Hoph, Huber & Weib (2008) showed that both media stimulated and real experiences of aggressive emotions associated with the motive for revenge are core risk factors for later violent behavior and delinquency. The authors conclude that continued exposure to real and virtual violence can lead to long-term emotional consequences. The Anderson et al. (2010) meta-analysis found that the average effect size for best practices studies of the violent video game effect on aggressive affect was $r+ = .124$, $p < .01$. These effects were statistically significant in experimental, cross-correlational and longitudinal studies.

Physiological arousal. Playing video games, both violent and nonviolent ones, tends to produce physiological arousal (Swing, Gentile, & Anderson, 2009). Arousal can be measured in experimental studies using indicators such as heart rate, blood pressure or skin conductance. The average effect size of violent video games on physiological arousal found in the meta-analysis by Anderson and his colleagues (2010) was $r+ = .184$, $p < .01$.

Aggression can be influenced by arousal in several ways. Heightened arousal strengthens the dominant action tendency, including aggressive tendencies. If a person is provoked to aggress while highly aroused, the result is a higher likelihood of aggression (Geen & O'Neal 1969). According to excitation transfer theory, arousal can increase aggression if arousal from one source (e.g. exercise) is mislabeled as anger resulting from provocation (Zillmann, 1983). For example, arousal from viewing an erotic film can increase provoked aggression (Zillmann, 1971).

Research suggests that several features of video games can influence the amount of arousal they generate. Violent video games tend to produce more arousal that nonviolent ones (e.g. Fleming & Rickwood, 2001). Playing a realistic violent video game has been shown to

stimulate more arousal and more aggressive thoughts than playing an unrealistic violent video game (Barlett & Rodeheffer, 2009). The presence of blood in a violent video game can lead to higher arousal as well as more hostile feelings and cognitions (Ballard & Wiest, 1996; Farrar, Krcmar & Nowak, 2006; Barlett, Harris & Bruey, 2008).

How long do these effects last? A study by Barlett et al. (2009) shows that heightened arousal immediately after game play lasts between 4 and 9 minutes. Aggressive feelings and thoughts may last as few as 4 minutes. However, authors suggest that these short-term changes can start aggression promoting processes that last much longer than 4 to 9 minutes.

Desensitization and empathy. Exposure to violent media can lead to desensitization – a reduction in emotion-related physiological reactivity to violence (Carnagey, Anderson & Bushman, 2007). Although lessening anxiety can be a positive outcome in many contexts (for example, treatment of phobias or PTSD), desensitization of children and other civilians to violent stimuli can have several harmful consequences. Anxiety associated with violence can serve to inhibit violent behaviors, so desensitization to violence could be expected to lead to disinhibition of aggression. This kind of emotional blunting may also lead to an underestimation of the seriousness of observed violence and reduce the likelihood of helping a victim (Carnagey& Anderson, 2003).

Empathy refers to the degree to which a person subjectively identifies and commiserates with a victim and feels emotional distress (Anderson et al., 2010). One of the predicted consequences of desensitization is a decrease in empathy for violence victims (Carnagey, Anderson & Bushman 2007). The fact that viewing violent films can lead to desensitization to violence and decreased empathy for victims has been shown by a body of empirical research (e.g. Mullin & Linz, 1995; Dexter, Penrod, Linz & Saunders 1997). The hypothesis that violent video games

can have those same effects have also received empirical support, from experiments, correlational studies and longitudinal studies.

For example, in an experimental study (Carnagey, Anderson & Bushman, 2007) participants played a violent or a nonviolent game for 20 minutes and then watched a videotape containing scenes of real-life violence. Their physiological reactions while viewing violence were measured by monitoring their heart rate galvanic skin response. Participants who had played a violent video game had a lower heart rate and GSR, showing evidence of physiological desensitization to violence.

Evidence of chronic desensitization to violence through playing video games also exists. A study by Bartholow, Bushman & Sestir (2005) shows that habitual violent game players have reduced amplitudes of the P300 component of the event-related brain potential while viewing violent images. P300 is associated with activation of the aversive motivational system. This reduced brain response while viewing violence predicted increased aggressive behavior in a later competitive task.

The previously mentioned study by Bartholow et al. (2005) showed that both short-term and long term exposure to violent video games is associated with increased aggression. Mediators in the relationship between long-term exposure to violent video games and aggressive behavior were variables related to desensitization (decreased empathy, hostile perceptions and hostile personality).

Although there are only a few high quality studies in this domain, meta-analytic results (Anderson et al., 2010) confirm that violent video game play is related to decreased empathy and desensitization. The average effect size for best practices studies was $r+ = - 0.194$, $p < .01$.

Helpful and Prosocial Behavior

Prosocial behavior can be defined as behavior involving helping or rewarding others, especially when this behavior brings no benefit to the helper (Barlett, Anderson & Swing, 2009). The same learning processes that link violent video games to aggressive behavior could also be expected to suppress and interfere with prosocial behavior, at least in some contexts. In fact, several studies have documented reduced prosocial behavior in response to violent game play.

An experimental study by Bushman and Anderson (2009) showed that violent video game play can decrease helping a victim. Participants played a violent or nonviolent video game for 20 minutes. Afterward, while completing a lengthy questionnaire, they heard a loud fight outside the lab in which one person was injured. Participants who had previously played a violent game were less likely to notice the fight, perceived the fight as less serious and took longer to help the injured victim. The authors suggested that people exposed to media violence may become ‘‘comfortably numb’’ to the pain and suffering of others and are consequently less helpful.

A correlational study by Gentile et al. (2009) assessed video game habits of a large sample of Singaporean children, along with several prosocial measures. Playing prosocial video games was shown to be positively related to helping, empathy and cooperation. In contrast, violent video game play was negatively related to helping behavior.

A longitudinal study by Anderson, Gentile & Buckley (2007) monitored children’s violent media exposure, aggression and prosocial behaviors two times during a school year. High exposure to video game violence at time 1 significantly predicted a relative decrease in prosocial behavior (as rated by teachers and peers) at time 2 (explaining 8% of the variance in prosocial behavior, $t = -5.14$, $p < 0.001$).

Results of the meta-analysis by Anderson and colleagues (2010) confirm that exposure to violent video games is significantly related to lower levels of prosocial behavior. The average

effect size was r+ = -.110, p < .01. The effect was significant in experimental, cross-correlational and longitudinal studies.

It is also important to note that prosocial and antisocial behaviors are not simply opposite sides of the same coin. People can be high in both aggressive and prosocial behaviors – for example, hostile toward enemies and helpful toward friends (Gentile et al., 2009). Prosocial and aggressive measures tend to be negatively correlated, but not strongly so.

Effects on attention and cognitive control

Benefits to visuospatial attention. A number of correlational and experimental studies show that video game play can have beneficial effects on a wide array of visual and spatial skills (e.g. Green & Bavelier, 2003, 2006; Castel, Pratt & Drummond, 2005; Feng, Spence & Pratt, 2007). Habitual video game players outperform non-players on several different visual tasks – for example visual enumeration, useful field of view and target localization (Green & Bavelier, 2003, 2006). Non-players trained on action video games show improvements in such skills. For example, in an experiment by Feng, Spence & Pratt (2007) participants substantially improved their spatial attention and mental rotation after only 10 hours of training with an action video game. Women benefited more than men, so playing the action game reduced gender differences in spatial cognition.

In their review of video game effects on visual skills, Achtman, Green and Bevalier (2008) conclude that action video games can be effectively used to train visual skills. Action video games offer a new way of rehabilitation for different patient groups (for example, stroke patients with visual field deficits).

Interestingly, these beneficial effects on visuospacial processing have only been found for action games, not all video games in general (Cohen, Green, & Bavelier, 2007; from Green, Li &

Bavelier, 2009). Many action games include violent content, which shows that one video game can have both positive effects (improved visuospatial skills) and negative effects (increased aggression). However, both violent and nonviolent games have been associated to spatial-cognitive gains (e.g. Barlett et al., 2009; De Lisi & Wolford, 2002). Therefore, players do not need to use a violent video game in order to achieve the spatial-cognitive benefits of video game exposure.

Attention deficits. The beneficial effects of video games on visuospatial skills have sometimes been misinterpreted as a claim that video games enhance attention in general. However, an emerging line of research suggests that video games may also have disruptive effects on attention and cognitive control.

Television viewing has been linked with greater subsequent attention problems in childhood (e.g. Mistry et al., 2007; Landhuis et al., 2007; Levine & Waite, 2000). Researchers propose that, because most television programs involve high excitement and rapid changes of focus, exposure to television may harm children's abilities to sustain focus on less exciting tasks and shorten their attention spans (Christakis et al., 2004). Because many video games share these characteristics, it can be expected that they have the same type of negative effects on attention.

Several studies have found a higher prevalence of attention related problems and/or ADHD/ADD diagnoses among habitual video game players (Gentile, 2009; Bioulac, Arfi & Bouvard, 2008; Mistry et al., 2007). Swing and his colleagues (2010) conducted the first longitudinal study to explore the effects of violent video games on attention. School-aged children were assessed over a 13 month period. More frequent game-play and television viewing over this period of time each led to more teacher-reported attention problems. These results were significant even when effects of previous attention problems and gender were partialled out.

Furthermore, the video game effect was stronger than the TV effect. This study provides the strongest evidence yet that the association between video game play and attention problems may be causal, not merely coincidental. Note that this study did not distinguish between violent and nonviolent media.

Swing et al. (2010) also reported a correlational study on a sample of late adolescents/early adults. The associations of exposure to screen media and attention problems found on this sample were similar to those found on the middle childhood sample, suggesting that adolescents are still vulnerable to these effects.

Disruption of cognitive control. Evidence from a small number of studies shows that video game experience may also be negatively related to cognitive control - the ability to maintain goal-directed information processing in the face of distraction or competing response alternatives (Bailey, West & Anderson, 2010). Cognitive control can be measured using the Stroop interference task. In one version of this task participants are shown a series of words and are asked to name the color. The words can be printed either in congruent colors (the word "red" printed in red) or incongruent colors (the word "red" printed in blue). The reaction time for naming the color of congruent words is faster than for incongruent ones, which is known as the Stroop effect.

Kroneberger et al. (2005) showed that adolescents who spent a lot of time viewing violent media (both television and video games) performed more poorly on the Stroop task than those who rarely consumed violent media. The association between violent video games and attention problems remained significant even after the level of exposure to violent television was controlled, showing that there is a unique effect of video game exposure on attention.

A study by Mathews et al. (2005) measured neural recruitment using functional magnetic resonance imaging (fMRI) while individuals performed a counting Stroop task. In low gamers a typical pattern of neural recruitment was observed, that reflected greater activation of the anterior cingulated and lateral frontal cortex for incongruent blocks of trials relative to neutral blocks of trials. In contrast, high gamers failed to activate these brain structures while performing the incongruent trials.

Bailey, West and Anderson (2010) explored the effect of video game experience on proactive and reactive cognitive control. Proactive control represents a future oriented form of control that serves to optimize task preparation. Reactive control represents a just-in-time form of control that serves to resolve conflict within a trial (Braver, Gray & Burgess, 2007). Participants with extended versus limited experience with playing video games performed the Stroop task while event-related brain potentials were recorded. The results showed that the conflict adaptation effect (a behavioral measure of proactive control) was poorer in high gamers relative to low/no gamers when there was a long delay between trials. This effect was associated with attenuation of the ERP indicators of medial frontal negativity and frontal slow wave (ERP indices of proactive control) in high gamers. There was no difference between high gamers and low/no gamers in reactive cognitive control. This suggests that video game experience has a negative effect on proactive, but not reactive cognitive control. These correlational findings complement evidence of an association between playing video games and attention deficits/hyperactivity and lead to the suggestion that video game experience may have a selective effect on proactive cognitive control processes that allow one to maintain optimal goal-directed information processing (Anderson, Gentile & Dill, 2010).

Additional experimental and longitudinal research is required to establish the existence of a causal relationship between video game experience and cognitive control. However, these results constrain the claims that playing video games improves attention in general (e.g. Green & Bevalier, 2006).

School performance

A number of studies have found a significant negative association between the amount of screen time (video game play and television viewing) and school performance of children, adolescents and college students (Anderson & Dill, 2000; Anderson Gentile & Buckley, 2007; Chan & Rabinowitz, 2006; Cordes & Miller, 2000; Gentile, 2009; Gentile et al., 2004; Rideout, V. J., Foehr, U. G. & Roberts, 2010; Sharif & Sargent, 2006). For example, a longitudinal study of elementary school children found that screen time (the amount of time spent on television and video games combined) was significant negative predictor of children's grades (Anderson, Gentile & Buckley, 2007).

Gentile et al. (2004) explored gaming habits of adolescents and the level of parental monitoring of adolescent video game use. A significant negative correlation was found between the amount of video game play and grades. Parental involvement acted as a protective factor, showing a positive association with school performance.

One explanation of this relationship is the displacement hypothesis. Regardless of content, the amount of play could affect grades negatively by displacing time spent in other educational activities (such as reading, homework etc.; Gentile et al., 2004). The displacement hypothesis has received some empirical support. A study on a large nationally representative sample of youth showed that gamers spent 30% less time reading and 34% less time doing homework than nongamers, indicating that video game play is a distraction from school-related

activities (Cummings, & Vandewater, 2007). Rideout, Foehr & Roberts (2010) found that nearly half (47%) of heavy media users get poor grades, compared to 23% of light media users.

However, further research is needed to establish whether mechanisms other than displacement might also be involved in the association of media exposure and school performance (Barlett, Anderson & Swing, 2009). It also might be true that children who have trouble at school seek to play games to feel a sense of mastery, or that attention problems cause both poor school performance and an attraction to games (Gentile, 2009).

Gaming addiction

There is growing concern among researchers, educators, and parents about the addictive potential of video games. Most researchers studying the pathological use of video games have defined it similarly to how pathological gambling is defined – based on damage to family, social, school, occupational and psychological functioning (Anderson, Gentile & Dill, 2010). This approach appears to be valid, since both pathological video game use and pathological gambling are types of behavioral addictions (Tejeiro Salguero & Bersabé Morán, 2002; Griffiths, 2000). Games, like gambling, are initially played as a form of entertainment, because they are stimulating and produce positive emotions. At first this activity isn't pathological, but it can become so for some people when it begins to produce serious negative life consequences (Gentile, 2009).

Video game addiction has not yet been included in the Diagnostic and Statistic Manual of Mental Disorders (DSM) as a formal diagnosis. In the draft for the DSM-V, which is due to be published in 2013, the American Psychiatric Association proposed a category of addiction-like behavioral disorders. Gambling disorder has been moved into this category, and other addiction-like behavioral disorders such as "Internet addiction" will be considered as potential additions to

this category as research data accumulate (APA, 2010). Before "Internet addiction" and "Video game addiction" can be accepted as a recognized mental health disorders more research is needed to discover how large a problem this is, who is most at risk, the etiology of the disorder, how long it lasts, what the outcomes are, whether treatment is needed, and what types of treatment are most effective. Researchers have started gathering knowledge on these topics.

Gentile (2009) investigated video-gaming habits of a large nationally representative sample of American youth (aged 8 to 18 years). This study found that about 8% video game players in this sample exhibited pathological patterns of play. Pathological gamers spent twice as much time playing than nonpathological gamers and received poorer grades. Pathological gaming also showed comorbidity with attention problems. In a large European sample 11.9% of gamers fulfilled diagnostic criteria of addiction concerning their gaming behavior (Grusser, Thalemann, & Griffiths, 2007). A considerable prevalence of gaming addiction was found in samples from other parts of the world, for example Korea (Kim et al., 2008) and Taiwan (Hsu, Wen & Wu, 2009). Researchers have also started exploring the predictors and risk factors of video game addiction. Online game addiction has been associated with lower self-control, aggression and narcissistic personality traits (Kim et al., 2008) and a preference for virtual life (Liu & Peng, 2009). It seems that gaming addiction is a problem affecting a considerable number of people worldwide and that additional research in this area is needed (Anderson, Gentile & Dill, 2010).

Conclusions

The recent explosion in video game research has helped improve our understanding of how video games in general and violent video games in specific affect players. A wealth of research now shows that playing violent video games is a causal risk factor for aggression and several aggression-related variables. One common mechanism for both the short and long term increases

in aggressive behavior is increased accessibility of aggressive cognitions. The recent comprehensive meta-analysis yielded theoretically and empirically consistent findings, including significant effects of violent video game exposure on aggressive behavior, cognition, affect and arousal as well as negative effects on empathy/desensitization and prosocial behavior. These effects were similar across experimental, cross-sectional, and longitudinal designs; for males and females; children, adolescents and young adults; and individuals from both Eastern and Western cultures (Anderson et al., 2010). Useful frameworks for understanding media effects on aggression as well as other types of learning (e.g. prosocial behavior) are provided by the General Aggression Model and the General Learning Model.

A smaller but not insignificant number of studies demonstrate that violent video games also have significant effects on attention and cognitive control. Some of these effects are positive – action games can improve some visual and spatial skills (e.g. Green & Bavelier, 2003, 2006). However, there also is growing evidence that video games may have negative effects on proactive cognitive control (e.g. Bailey, West and Anderson, 2010) and are linked to attention deficits (e.g. Swing et al., 2010). Another reason for concern is the negative relation between time spent playing video games and school performance (e.g. Gentile et al., 2004; Sharif & Sargent, 2006). A growing number of studies are investigating the phenomenon of gaming addiction (e.g. Gentile, 2009).

To sum up, violent video games have been shown to have some limited positive effects (benefits to visuospatial functioning) and a host of negative effects. Although these effects aren't huge, they also are not trivial in size. Considering that a large number of children, adolescents and adults play violent video games, the accumulation of these effects can have a significant impact on individuals and on our society.

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Figure 1. The General Aggression Model: Overall View. From Anderson & Carnagey, 2004.

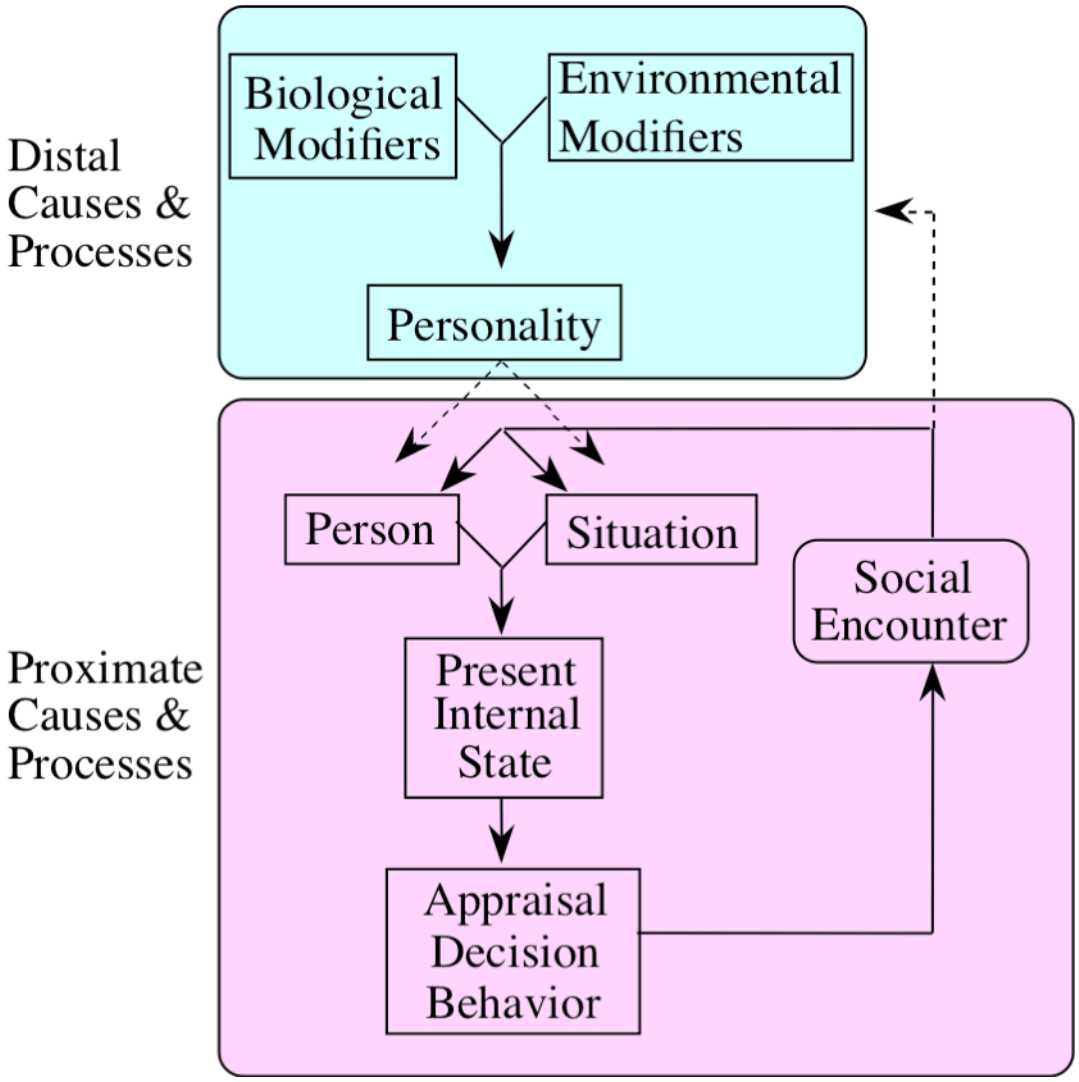

Figure 2. The General Aggression Model: Distal Developmental and Personality Processes. From Anderson & Carnagey, 2004.

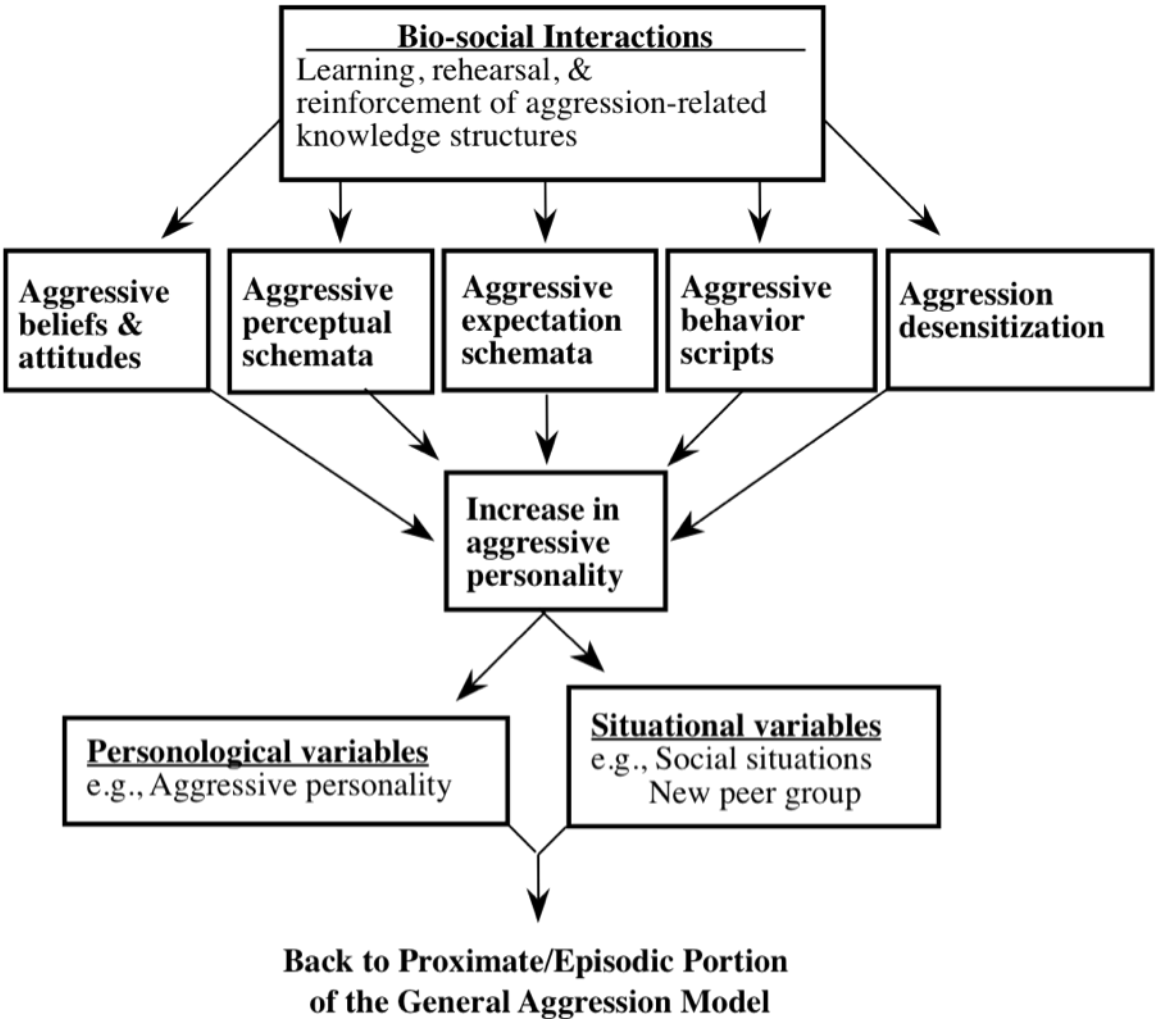

Figure 3. The General Learning Model: Extension of GAM to Non-violent Contexts. Long term processes. From Barlett & Anderson, 2010.

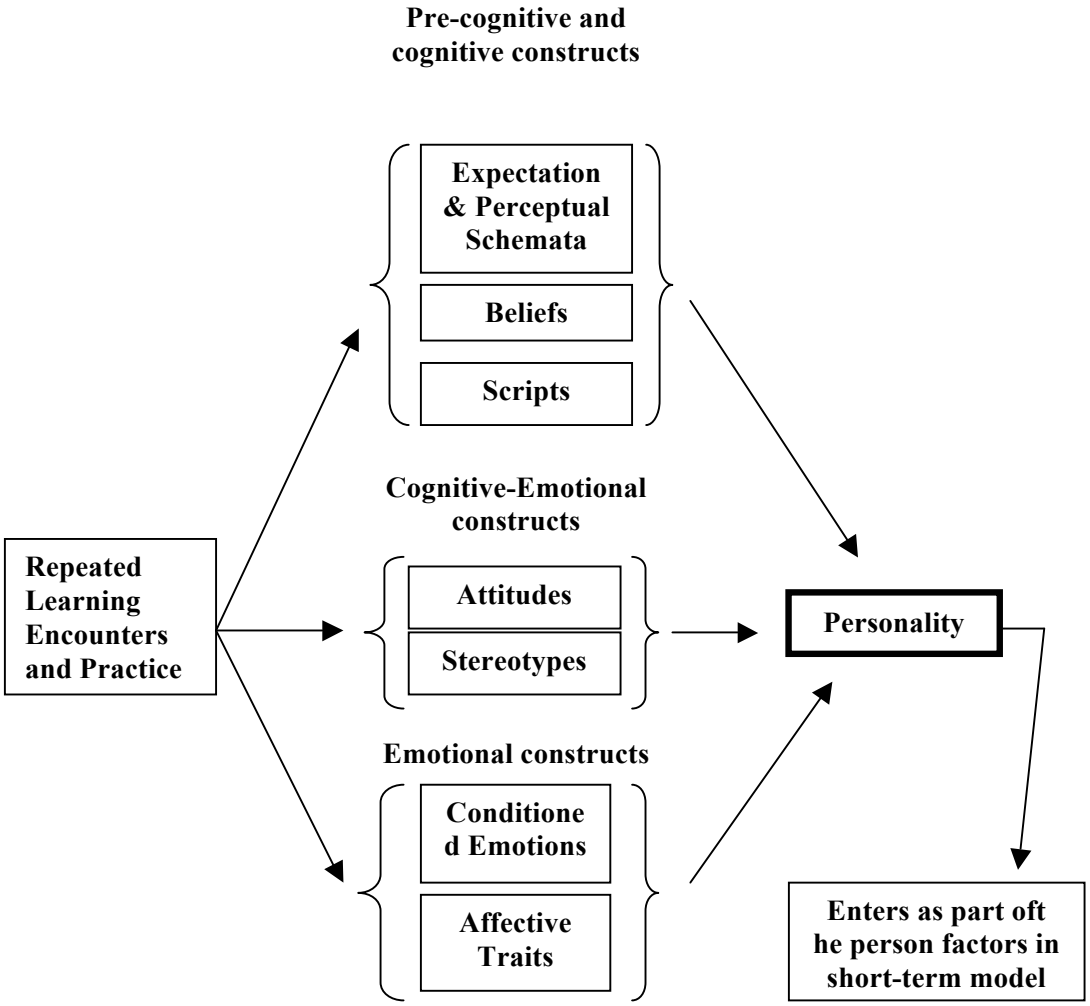

Figure 4. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, empathy/desensitization and prosocial behavior (results from the "Best raw" sample, Anderson et al., 2010). K = number of effects. N = total sample size. Vertical capped bars are the upper and lower 95% confidence intervals.

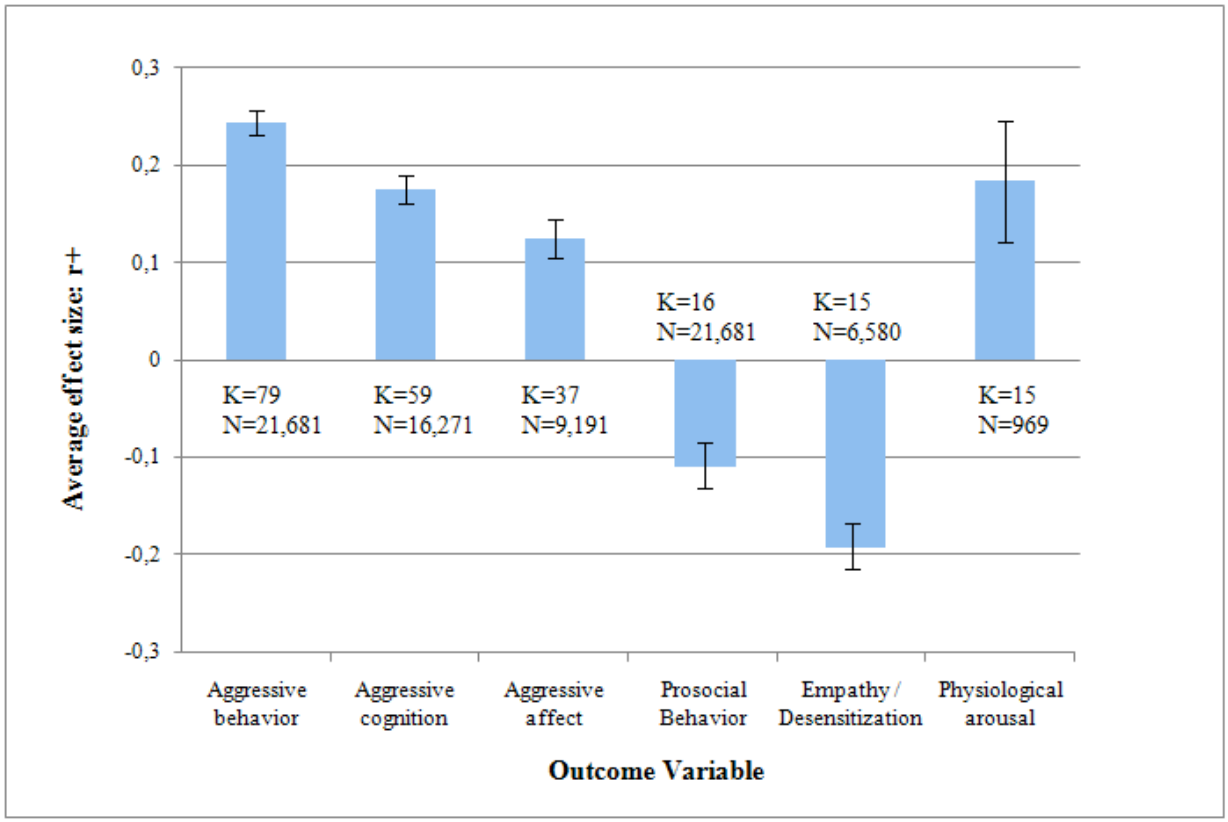

Table 1. Average effect size of violent video game play. (Results from the "Best Raw" data, Anderson et al., 2010.) Notes: Total N is the total number of participants in all of the summarized studies. K is the number of different studies. The Average effect (r+) is the weighted average effect size, expressed as an r-value. Z is the Z-test of whether the effect is significantly different from zero.

Design	Total N	K	Ave. Effect (r+)	Z
Physical Aggression				
Experimental	2513	27	.210	10.512**
Longitudinal	4526	12	.203	13.787**
Cross-Sectional	14,642	40	.262	32.291**
Aggressive Cognition				
Experimental	2887	24	.217	11.695**
Longitudinal	3408	8	.115	6.728**
Cross-Sectional	9976	27	.183	18.445**
Aggressive Affect				
Experimental	1454	21	.294	11.289**
Longitudinal	2602	5	.075	3.836**
Cross-Sectional	5135	11	.101	7.227**
Prosocial (helping) Behavior				
Experimental	633	4	-.182	-4.599**
Longitudinal	2778	5	-.114	-6.022**
Cross-Sectional	3495	7	-.093	-5.506**
Empathy/Desensitization				
Experimental	249	1	-.138	-2.175*
Longitudinal	2421	4	-.184	-9.147**
Cross-Sectional	3910	10	-.203	-12.845**

* $p < .05$. ** $p < .001$.