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Violent video game exposure and aggression

A literature review

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Over the last 30 years, the video game industry has grown into a multi-billion dollar business. More children and adults are spending time playing computer games, consoles games, and online games than ever before. Violence is a dominant theme in most of the popular video games. This article reviews the current literature on effects of violent video game exposure on aggression-related variables. Exposure to violent video games causes increases in aggressive behavior, cognitions, and affect. Violent video game exposure also causes increases in physiological desensitization to real-life violence and decreases in helping behavior. The current video game literature is interpreted in terms of the general aggression model (GAM). Differences between violent video game exposure and violent television are also discussed.

Key words: **Child - Video games - Violence - Aggression.**

Development and advances of video game industry

In 1972, a product was released to the American market that would open the door for the development of a multi-billion dollar industry. *Pong*, the first commercially available video game, had entered the homes of America. In *Pong*, 2 players tried to "hit" an electronic "ball" back and forth with electronic paddles. In less than 30 years, this humble beginning of the video game industry has grown into countless companies with annual sales totaling $ 20 billion worldwide.[1] The Playstation video game console, which began as a side project at Sony, now represents $ 6 billion of the company's $ 20 billion in annual sales.[1] In recent years, video game annual sales have steadily been higher than movie ticket sales.[2-4]

The history of video games can be divided into 3 eras.[5] The first era (1977-85) was the "Atari era", due to the fact that Atari consoles dominated the video game market. These first video games contained little violence. The little violence in these early games was quite abstract. Nolan Bushnell, the founder of Atari, said, "We had an internal rule that we wouldn't allow violence against people. You could blow up a tank or you could blow up a flying saucer, but you couldn't blow up people".[6] Another reason for the relatively low amount of violence in the early video games was that the graphical ability of the Atari games was so low that only simple graphics could be displayed.

Over the next decade computers became more sophisticated, enabling more complex

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video game graphics. As graphics developed, so did the potential for profits. Violence also began to appear more, even in children's games. The second era (1985-95), also known as the "Nintendo era", was dominated largely by Nintendo console games. The Nintendo console introduced a more powerful platform than its Atari predecessor and began introducing violent themes in numerous games. Even the seemingly innocuous *Super Mario Brothers* games included the capacity to destroy harmful creatures by jumping on top of them or by throwing fireballs at them.

The increased computing power of the second era consoles enabled more complicated graphics, including more realistic portrayals of violence. It was also during this era that video games became common on desktop computers and in hand-held mini-game systems such as Game Boy. As it became apparent to manufacturers that violent games sold well, the level of violence in the games also increased. Truly violent video games came of age in this era with the killing games *Mortal Kombat*, *Street Fighter*, and *Wolfenstein 3D*.[7] *Mortal Kombat* led the way in 1993 by becoming the most popular video game of the year.[2] In *Mortal Kombat*, the player controls a character enrolled in a fighting tournament where the only way to advance is to kill your opponent. Players also receive extra rewards for using extreme violence (*e.g.* ripping opponent's spine out or decapitating opponent). Both Sega and Nintendo released home console versions of the popular arcade game *Mortal Kombat* at about the same time. However, Nintendo sold a sanitized version of the game, removing the most graphically violent features, depictions of blood, and the worst of the fatal moves. Sega released the full version and outsold the Nintendo version by about 3 to 1. When Nintendo released *Mortal Kombat 2*, it included all of the blood, gore and fatal moves of the Sega version. This time, the Nintendo version outsold the Sega version, probably because Nintendo consoles were already dominant in the marketplace.

Some of the basic characteristics and labels of video games also emerged in this era. *Mortal Kombat* represents a type of game now known as "*Mortal Kombat* fighting" games. It is a "third-person" game because the player can see the character that he or she is controlling. It is a "fighting" game because virtually all of the game action consists of fighting other game characters. A variety of third-person fighting games were very popular in this era. *Street Fighter* is one such game. As in *Mortal Kombat*, the main theme is that the player engages in a series of fights with various opponents. Another interesting feature of many third-person fighting games is that the player can choose who he or she wants to "be" from a variety of male and female characters. In part, this was an attempt to attract more female consumers.

First-person shooter games were another type of violent video game that developed during the "Nintendo era." In these games, the player sees the scenario through the eyes of the main character. The player can see his or her own hands and arms, as well as the weapons being used, but does not see his or her whole character. The games are referred to as "shooters" because most of the action involves shooting enemies with one kind of weapon or another. *Wolfenstein 3D* was one of the first very popular 3-dimensional "first-person shooters." In one version of *Wolfenstein 3D*, the player assumes the role of B. J. Blascowitz, an American soldier caught and taken prisoner as a prisoner of war by the Nazis during World War II. The player's job is to escape the prison and shoot his or her way through Castle Wolfenstein, killing everything that moves (both prison guards and guard dogs), with the ultimate goal of assassinating Adolf Hitler. The graphics of this game were very violent for this era. A successful player would see multiple bloody murders and hear victims scream and groan. In *Wolfenstein 3D* the human hero can choose from an array of weaponry including a revolver, automatic weapons, a flamethrower, and a knife.

We currently are in the third video game era (1995-present). The console game market is largely dominated by the Sony Playstation and the most current platform, Playstation 2. Their graphic capabilities have been greatly enhanced not only by improvements in computer technology but also by Sony's decision

(emulated by others) to switch from cartridge-based systems to CD-ROM, and even more recently, DVD-ROM based systems. Currently, in addition to Playstation 2, video game buyers also have options of purchasing Nintendo's latest console (Nintendo Gamecube) or Microsoft's X-Box (Microsoft's first endeavor into the console market). With these changes in computing power and graphic quality, the growth of video gaming has been phenomenal in recent years. In 2001, despite an economic recession, the video game industry experienced 43% increase in sales, boosting American sales to $9.4 billion.[8] Of course, video gaming on computers has also evolved into more violent gaming with more realistic graphics.

An emerging current trend is the growth of online gaming. There are numerous games that one can play over local area networks and over the Internet. The most recent advancement is Microsoft's X-Box Online network. X-Box owners can use a broadband connection to access the X-Box network, where they can play a variety of games with or against other online players. Some of these games are simply more complex versions of first person shooters, in which groups of gamers can play with or against other gamers in real time. Perhaps the most interesting trend, though, is the emergence of subscription-based online role-playing games, known as massively multiplayer online role playing games (MMORPGs). To play these games, one must subscribe (currently, about $25-$40 per month) to the company hosting the game. Players create their own character for the game, and can increase the skills and power of that character by playing the game. Characters can kill and can be killed by other players as well as characters built into the game. *Everquest* is currently the largest MMORPG, with around 400 000 players worldwide.[9] Players can be heavily invested in their online quests, by buying and selling their created characters via online auctions for hundreds of dollars.[10] Indeed, this could be seen as the beginning of a new video gaming era.

The best selling console video games are also usually available on computers. Many games can now be downloaded from the Internet. This includes "demo" versions of extremely violent games that include most or all of the graphic features of the full game. Such demos can be downloaded at no charge by virtually anyone with a computer and a modem. Walsh [11] found that 32% of all boys surveyed who play video games have downloaded such "demo" games from the Internet.

Video games, violent content, and preference for violence

The content of video games has drastically changed from the decade dominated by Atari. Recent content analyses of video games show that as many as 89% of games contain some violent content,[12] and about 50% of the games include serious violent actions toward other game characters.[12-14]

In addition, many children prefer to play violent games. Even older surveys of school children (4th through 8th grade) showed that more than 50% preferred games dominated with themes of human violence or fantasy violence.[15, 16] In surveys of paired children and parents, about 2/3 of children named violent games as their favorites. Most parents, however, are not likely to know what their child is playing. Only 1/3 of parents were able to correctly identify their child's favorite video game. In 70% of the incorrect parental responses, children described their favorite game as violent.[17]

Not only is violence a dominant theme in current video games, but video game companies are marketing those violent games towards youth. A Federal Trade Commission report [18] revealed that 70% of the M-rated games (games suitable for people 17 or older according to the Entertainment Software Rating Board) were marketed to children under 17. Fifty-one percent of the M-rated game titles researched had at least one advertising plan that blatantly included targeting children under 17. Additionally, 10 of the 11 companies surveyed had documents that included males under 17 as part of the target audience for their M-rated games.

There is a large discrepancy between what the video game industry considers violent as compared to the public. The video game industry and its ratings board (Entertainment Software Rating Board) claim to see much less violence in their games than do parents [19] and other research groups.[20] For example, many games contain cartoon-like violence, (known as mild animated violence) which the industry claims is appropriate for all ages, but parents and children disagree.[17]

Time spent playing video games and parental control

As the financial aspect of the video game industry has grown, so has time spent playing video games. In the mid 1980s children were spending an average of 4 h a week playing video games, both at home and in arcades.[21] By the mid 1990s, video game usage had increased to 4.5 h per week for 4th grade girls and 7.1 h per week for 4th grade boys.[15]

Recent estimates have shown that video game usage has grown for both young and older children alike. Children ages 2 to 7 have been shown to play video games an average of 3 to 5 hours a week.[22] School-age children (both boys and girls) spend an average of about 7 h per week playing video games.[22] These numbers are even higher for slightly older youth, with 8th and 9th grade students reporting an average of 9 h (13 h for boys, 5 h for girls) a week spent playing video games.[23] In 1999, 2.5% of entering college men reported playing video games over 20 h per week.[24]

In addition, parental supervision of children's video game use is almost entirely absent. Walsh [11] reported that 89% of teens surveyed said their parents never put a limit on the amount of time spent playing video games. Also, 90% of the youth surveyed in grades 8-12 reported that their parents never check the ratings of video games before allowing the youth to purchase them. Only 1% of the youth surveyed reported their parents had ever prevented them from purchasing a video game because of its rating.

Effects of viewing media violence

The vast amount of research conducted on the effects of violent television and movies on aggressive behavior spans several decades. Eighty studies had been published on the effects of media violence on aggressive behavior by 1975. A meta-analysis conducted on these early studies revealed that exposure to media violence (both in the laboratory and in real-life settings) causes increases in aggressive behavior.[25] However, although the scientific research clearly demonstrated that exposure to media violence led to increases in aggressive behavior, the news media's coverage of this issue painted quite a different story. Since 1975, research on media violence has yielded even stronger evidence of causal effects on aggression, but the news coverage in following years portrayed the media violence effects as weaker than did earlier news reports.[25]

Despite how the news media continues to portray the effects of media violence, the research is clear: youth who view violent television tend to become more aggressive adults.[25-31] Viewing violent television causes increases in aggressive cognitions, affect, and behavior. In a recent meta-analysis, Bushman and Anderson [25] found that the correlation of viewing violent television and aggression is greater than correlations of being exposed to asbestos and contracting laryngeal cancer, consuming calcium and increased bone mass, or wearing a condom and not contracting HIV.

Another media violence effect besides increasing aggressive behavior is desensitization to violence. There is an empirical basis as well as a theoretical basis for the desensitizing effect of violent media. Research has shown that participants exposed violent media (slasher films, police television programs, violent boxing matches) are less physiologically aroused by real world violence than are those exposed to nonviolent media.[32-36] Exposure to violent media also changes peoples' perceptions of violence. Research has shown that after viewing several sexually violent movies, participants rated the last movies in the set as less violent [32, 37] and

showed less sympathy and assigned more responsibility to a rape victim compared to those who viewed nonviolent movies.[37, 38] Exposure to media violence has also been shown to cause decreases in helping a violence victim.[39-41]

Differences between television and video games

The effects of violent television and movie exposure have received considerably more research attention than the effects of violent video games. The main reason for this is because video games are still a relatively "new" medium of entertainment compared to television and movies, which have received decades of examination. Due to their similarity to television programs and movies, we can hypothesize that violent video game exposure will have similar effects on aggression and aggression related variables. However, besides their obvious similarities, there are also a variety of differences that need to be acknowledged. There are several theoretical reasons why exposure to violent video games may have greater or weaker effects than exposure to violent television on aggressive behavior, cognitions, affect, and desensitization. These differences are addressed below.

Why violent television exposure may be more detrimental

The most obvious difference between violent video games and violent television programs is the level of graphical quality. Current and past video game consoles do not have the graphic capability compared to television and movies. This difference, however, could become a moot point in the near future, as the graphical capabilities of video games are increasing a high rate. The original Sony Playstation processed 350 000 polygons per second (pg/s). Sega Dreamcast increased the graphical capability by over 9 times in 1999, when it processed over 3 million pg/s. Playstation 2 blew Dreamcast out of the water when it's new system processed 66 million pg/s. Microsoft's *Xbox*, released in 2001, increased graphic capability to 125 million pg/s. The goal for PlayStation 3 is 1 billion pg/s. The dramatic increase in speed and graphic capability has allowed for more realistic violence than ever before. At this rate, the difference of graphics between video games and television may not be an issue in the very near future.

Why violent video game exposure may be more detrimental

There are several reasons that violent video games could have larger effects than television programs. Some of these differences are that playing violent video games involve almost complete attention and involvement, more identification with violent characters, more reinforcement of violent acts, and higher frequency of violent scenes.[7, 42, 43]

Level of attention

Television or movies do not necessarily require a large amount of attention from viewers. Viewers are not forced to focus their attention to the television. Programs may be running in the background while individuals are completing other tasks (reading newspaper, talking with others, leaving the room, etc...). Attention from television or movies can shift without having any effect on the program itself. Video games, however, require a higher level of attention from the player. A player must typically focus his or her attention towards the video game or a failure of goals will occur. This means that the player is constantly watching the screen and is focused on any potential violence that will be shown.

Level of active involvement

Viewing television or movies can be a relatively passive process. Violence will occur during the television program regardless of what the viewer does. In video games, this is not the case. What happens next on the screen depends on how the player controls the characters in the game. Video game players are responsible for the violence they

see on the screen. Players are the ones who are pulling the trigger and throwing the punches. Research has shown that learning is enhanced when people are actively rather than passively involved.[44-46] This active component could enhance the negative effects of violent video games, relative to more passive forms of viewed violence.

Identification with violent characters

People who view violence in television programs or movies might identify with violent characters, but not necessarily. Violent video game players are essentially forced to identify with the character they are controlling. Players are required to take on the identity of a video game persona and "become" the violent character. In first person video games, the player sees the virtual world through the eyes of the main character. The perspective on the screen is everything that the main character would see. In some third person games, players are allowed to alter the appearance, gender, and name of the character they are controlling. This can allow the player to create a visual replica of oneself in the video game. In some more sophisticated games, the player can import scanned images of faces directly onto characters in the game (called "skins"). Research on violent television has demonstrated that identifying with a violent character increases the media violence effect.[29, 47-49]

Reinforcement of violent acts

When viewing television or movies, a viewer may only receive indirect rewards for violent actions of the characters (*e.g.*, witnessing when a violent character is rewarded for his or her actions). When individuals play violent video games, there is direct (and typically instant) reinforcement for their choice of action. This reinforcement can come in numerous forms: visual effects, sound effects (e.g., groans of pain from an injured target), verbal praise (*e.g.*, when a target is hit the computer says "well done" or "impressive"), points for various violent actions, and advancing to the next game level after obtaining certain goals. Bandura [50, 51] has demonstrated that aggression is likely to increase when it is rewarded.

Frequency of violent scenes

Even in the most violent movies, the violence is not completely constant. There are typically less intense scenes with a romantically or comical theme that enhance the plot of the TV program or movie. This is not necessarily the case for video games. Despite the more recent addition of "cut scenes" (digitized movie clips that enhance the plot of the game), the violence in video games is almost continuous. Player must constantly be ready to shoot the next enemy and witness the bloody repercussions. Players are almost continuously exposed to scenes of gore, blood, and screams of pain. Together these negative sights and sounds are accompanied with positive events (reward of points, new weapons, advancement to higher levels) that activate positive emotions. Because of this factor, desensitization is likely to occur at a higher rate from exposure to violent video games compared to violent television if the graphical nature of both forms of media is fairly equivalent.

Empirical issues in the video game vs *television debate*

Currently, it is unclear whether exposure to violent video games or exposure to violent television has a larger impact on aggressive behavior. The main reason for this haziness is because it is unclear exactly how to examine this issue in a laboratory setting. One issue is how to equate video games and TV programs on a variety of components (amount of violence, graphical nature of violence, active participation, etc. ...) or whether it is legitimate or possible to equate these factors. At the current time, it seems that each of these differences must be addressed one issue at a time. It still seems unclear how to control certain differences between these 2 types of media (*e.g.*, if trying to control frequency of violent scenes, how do you account for participants who are better players and view more violence because they accomplish more in the given amount of time?).

Effects of violent video games

Because violent video games are a rather new type of violent media, the literature examining its negative effects on players is rather small, but a rather clear consensus has already been reached. This consensus is virtually identical to the conclusions reached in the violent television literature: playing violent video games increases aggression. Several studies, both correlational and experimental, have demonstrated that playing violent video games can have a wide variety of negative effects on players.[52] Recent meta-analyses [52, 53] have demonstrated that exposure to violent video games increases aggressive behavior, cognition, affect, and physiological arousal, and decreases helping behavior.

Violent video games increase aggressive behavior

Correlational studies have revealed a positive relationship between playing violent video games and aggressive behavior. Anderson and Dill [7] showed a positive relationship between violent video game exposure and self-reported aggression on the National Youth Survey, which includes items assessing assault and robbery. Gentile *et al*.[23] found that young adolescents who played more violent video games reported more frequent aggressive behaviors, such as arguing with teachers and getting involved in physical fights.

Experimental studies have revealed the same results: participants exposed to violent video games behave more aggressively than participants not exposed to violent video games.[7, 54-58] The average effect size across studies between violent game play and aggressive behaviors was 0.19.[52] These effects have been found in children and adults, in males and females, and in experimental and non-experimental studies.

Violent video games increase aggressive cognition

There is both correlational and experimental evidence that playing violent video games increases aggressive cognitions. In a correlational study, young adolescents who played more violent games also had higher hostile attribution biases.[56] People with hostile attribution biases have been shown to act aggressively and are likely to be socially maladjusted.[59] These same biases have been found in laboratory settings. Bushman and Anderson [60] and Kirsch [61] showed that young adults who had just played a violent video game generated more aggressive endings to story stems than those who had played nonviolent video games.

Besides hostile attribution biases, aggressive cognitions can be measured several different ways. For example, Anderson and Dill [7] showed that playing a violent video game increased the relative speed with which the person could read aggression-related words (aggressive thoughts). In addition, studies measuring cognitive responses to playing violent video games have shown that aggressive thoughts are increased compared to playing nonviolent video games.[7, 56, 61-63]

Recent meta-analyses have shown the average effect size across studies between violent game play and aggressive cognitions is 0.27.[52] These effects have also been found in children and adults, in males and females, and in experimental and non-experimental studies.

Violent video games increase aggressive affect

Empirical studies have also demonstrated that playing violent video games can lead to an increase in aggressive affect. Anderson and Bushman's [52] meta-analyses found that the effect size of playing violent videogame on aggressive affect is 0.26. In one study, adults' state hostility and anxiety levels were increased after playing a violent game compared to control conditions.[64] In a study of 3rd through 5th grade children, playing a violent game increased frustration levels more than playing a non-violent game.[17] Results involving aggressive affect are less than clear because nonviolent video games can also cause increases in negative affect by being to difficult and frustrating the player.

Violent video games decreases prosocial behavior

Prosocial behavior has been shown to decrease with exposure to violent video games.

Studies measuring emotional responses to playing violent video games have shown that prosocial behaviors are decreased compared to playing nonviolent video games.[58, 65-67] Carnagey, Bushman and Anderson [68] showed that participants who played a violent video game were slower at providing help to a violence victim than participants who played a nonviolent video game. Anderson and Bushman [52] meta-analyzed 8 independent samples and found the average effect of these studies was -0.19.

Violent video games increase physiological arousal

Studies have found that playing violent video games tends to increase heart rate, systolic and diastolic blood pressure compared to playing non-violent video games.[69] The average effect size across studies between violent game play and physiological arousal was 0.22.[52] For example, Ballard and Wiest [70] showed that a violent game (*Mortal Kombat* with the blood "turned on") resulted in higher systolic blood pressure responses than either a nonviolent game or a less graphically violent game (*Mortal Kombat* with the blood "turned off").

Other physiological reactions have also been found. Adult males' brains have been shown to release dopamine in response to playing violent video games.[71] In addition, Lynch [72, 73] has found that the physiological effects of playing violent video games may be even greater for already aggressive children. Children high in trait hostility showed greater increases in heart rate, blood pressure, epinephrine, testosterone, norepinephrine and cortisol in the blood. These findings suggest that video game exposure effects may be greater for children who are already at a high likelihood for aggressive behavior.

Even though violent video game exposure has been shown to increase certain physiological measures, it has also been shown to cause physiological desensitization to real-life violence. Carnagey *et al*.[68] demonstrated that participants who previously had played a violent video game for 20 min had lower heart rates while watching scenes of real-life violence than participants who had played a nonviolent video game. This study is the first to demonstrate that violent video games can have a physiological desensitizing effect to real-world violence.

Criticisms of the video game literature

There are many criticisms of the current violent video game literature. Some of these criticisms are justified, while some of them are completely unjustified.

Justified criticisms

Small sample sizes

Many current studies contain less than ideal sample sizes. Small samples sizes can cloud a research area, by artificially generating what appear to be inconsistent effects. For example, if the average effect size for violent video game exposure on aggressive behavior is about r = 0.20,[52] then the number of study participants should be at least 200 for 0.80 power (likelihood of being able to find a legitimate difference between groups). Studies with smaller samples may yield results that appear inconsistent, with some apparently "working" and others failing to find a statistically significant effect, or even finding opposite effects. Two ways to overcome this obstacle are to increase sample sizes in future research and use meta-analytic strategies to summarize previous findings rather than using the more traditional narrative review. When this is done, a more consistent effect of video game violence is revealed.[52]

No differences in violent content between conditions

Some studies have been criticized for the lack of difference in violent content between violent and nonviolent conditions. Typically, either the violent condition resembles a nonviolent game or the nonviolent game resembles a violent game. When the "violent" and "nonviolent" comparison conditions have only a small difference in violent content, the effect sizes will also be small. When the differ-

ences are large, the effects tend to be large.[74] Future studies need to do a better job of assessing the violent content of the video games being compared and ensure there is a significant difference between games.

Additional differences between violent and nonviolent games

Some studies utilized video games that have other differences between them besides violent content. The nonviolent game could be more boring or frustrating than the violent game. These additional differences can yield inaccurate results. The obvious solution for future studies is to do more pilot testing or manipulation checks on such aggression-relevant dimensions.

Lack of results reporting

Some previously published studies have neglected to include all the necessary information needed to include them in meta-analyses. For example, this has occurred in studies in which 50% of the participants played a video game while the other 50% merely observed. Reported means were then collapsed across this play *vs* observe dimension. Future reports should include the individual means necessary for including in future meta-analyses.

Questionable measures of aggressive behavior

Modern definitions of aggression restrict its application to behaviors that are intended to harm another person.[43, 53, 75] A surprising number of past studies have used inappropriate dependent measures. For example, self-reports on "Trait Aggression" scales have been used as measures of aggressive behavior in short-term experiments. But there is no way for a short-term manipulation of exposure to violent *vs* nonviolent video game (*e.g.,* 20 min) to influence one's past frequency of aggression. In this short-term context, such a trait measure might possibly be conceived as a measure of cognitive priming, but it clearly is not a measure of aggressive behavior. Another example is operationalizing aggressive behavior such as hitting an inanimate object. Future studies need to use better measures of aggression.

No longitudinal studies

Currently, there has not been a longitudinal study conducted on the negative effects of violent video games. The main reason for this is because major funding is needed to conduct a large-scale longitudinal study and so far, no such funding has been issued. Until a large-scale study is funded, one must look to the longitudinal studies conducted in the TV/movie violence domain to get a reasonable guess as to the likely long-term effects.

Unjustified criticisms

Too few studies to warrant any conclusions

If a research area has too few studies, it may be impossible to detect a small effect size. However, this is not the case for the video game literature. As noted earlier, meta-analyses have been conducted and clear findings have already demonstrated that exposure to violent video games cause increases in aggressive behavior, cognitions, affect, and decreases in prosocial behavior.[52] If anything, it is remarkable that such reliable effects have emerged from such a relatively small number of studies (compared to TV and movie violence studies) that vary so much in method, sample population, and video game stimuli.

Lack of external validity

An old standby criticism used on a variety of research areas has been that experimental studies lack external validity, due to demand characteristics, participant suspicion, trivial measures, artificial settings, and unrepresentative participants. These arguments have been successfully debunked many times by empirical analyses and have found little cause for concern.[76-79] In addition, examinations of these issues in the aggression domain have consistently found evidence of high external validity, and have done so in several very different ways.[80-83]

Correlation is not causation

Psychology instructors teach this mantra to introductory psychology students, and hope that they will gain a much more sophisticated view of methods and scientific inference by the time they are seniors. Whole fields of science are based on correlational data (*e.g.*, astronomy). Correlational studies are used to test causal theories by providing opportunities for falsification. A well-conducted correlational design, one that attempts to control for likely confounding variables, can provide a large amount of useful information. The main key for a particular research area is that it provides a consistent pattern of results across studies that differ in design, procedure, and measures. The current research on violent video games and aggression related variables does yield consistent results.[52]

Arousal accounts for all video game effects

Another unjustified criticism of the video game literature is that the arousal caused in violent video games accounts for the differences in aggressive related variables. This criticism has several flaws. First, arousal dissipates fairly quickly and the criticism cannot apply to studies that measure aggressive behavior more than 30 min after game play has occurred. Also, this criticism generally does not apply to correlational studies, but they show a significant link between violent video game exposure and aggression.[52] Furthermore, there are some experimental studies in which the violent and nonviolent game conditions were equated on arousal, still revealing significant violent content effects.[7, 68]

No studies linking violent video game play to serious aggression

Another unjustified criticism of the video game literature is that there are no studies that examine the relationship between violent video game exposure to serious aggressive actions. This criticism is simply not true. A number of correlational studies have linked repeated violent video game play to serious aggression. Anderson and Dill[7] showed that college students' reports of violent video game play in prior years were positively related to aggressive actions that would be considered criminal (*e.g.*, assault, robbery) if known to police. Similarly, Gentile *et al.*[23]found significant links between violent video game exposure and fighting in school.

Violent media affect only a small portion of the population

There are certain reasons to believe that some sub-populations may be more susceptible than others to the negative effects of violent video game exposure. However, there has been no evidence that particular populations are completely "immune". Even some populations thought to be at low risk have nonetheless yielded significant violent video game exposure effects.[7, 23]

Effects of media violence are trivially small

One of the most well known criticisms is that even though there may be a violent video game exposure effect, the effect is so small that it is trivial. This is simply not true. Violent video game effects have been shown to be larger than the effects of passive tobacco smoke on lung cancer, exposure to lead on I.Q. scores in children, and calcium intake on bone mass.[25, 52]

Critics have used all of the unjustified criticisms discussed above to dismiss and trivialize the current video game literature. By using unjustified criticism "correlation does not equal causation", one can ignore all of the correlational research. In addition, with use of unjustified criticism "lab studies are trivial", all of the experimental studies can be similarly ignored. The only way to satisfy these unjustified criticisms is to conduct a longitudinal field experiment in which young children are assigned to high or no exposure to violent video games over the course of their life while measuring their violent, criminal activities. Obviously, such a study is completely unethical and could never (nor should ever) take place. It is not an accident that all ethically feasible types of studies are dismissed by the industry and its supporters and the only way to prove (in their eyes) the dan-

gers of their products is to conduct a study that would never be allowed.

The general aggression model: a theoretical explanation

A theory developed in recent years can be used in understanding the media violence research is the general aggression model (GAM).[53, 75] GAM is an integration that combines key ideas from earlier models: social learning theory and related social cognitive theory concepts,[50, 84-88] Berkowitz's cognitive neoassociationist model,[89-91] Dodge's social information-processing model,[59, 92] Geen's affective aggression model,[93] Huesmann's script theory,[94] and Zillmann's excitation transfer model.[95] GAM describes a cyclical pattern of interaction between the person and the environment. Three main points compose the cycle: *input variables* of person and situation, *present internal state* of the individual, and *outcomes* resulting from various appraisal and decision processes.

Input variables

According to GAM, a person's behavior is based on 2 main kinds of input variables: the person and the situation (Figure 1). The person variables are all the factors a person brings into the current situation, including traits, current states, beliefs, attitudes, values, sex, scripts, and aggressive personality. Situation variables are simply the environmental factors surrounding the individual, including factors in the environment that could affect the person's actions, like aggressive cues, provocation, pain, rewards, and frustration.

Routes

Input variables, sometimes interactively, affect an individual's appraisal of a situation and ultimately affect the behavior performed in response to that appraisal, primarily by influencing the present internal state of the individual. According to GAM, these influences can occur through 3 main aspects of the present internal state: cognition, affect and arousal.

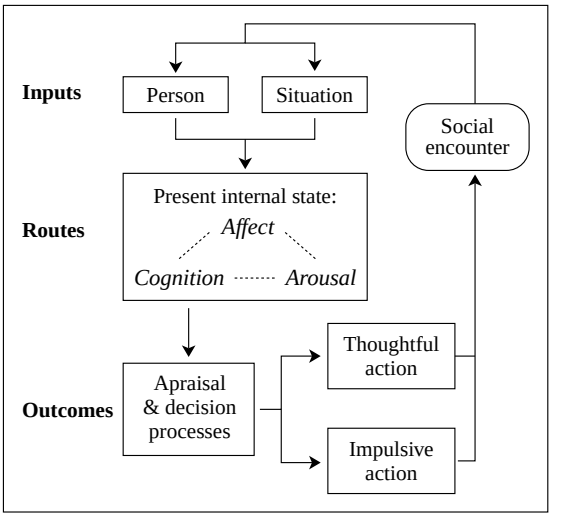

Figure 1.—The general aggression model: episodic processes.

Cognition

Input variables can influence internal states by making aggressive constructs more readily accessible in memory. Constructs can be either temporarily or chronically accessible.[96, 97] As a construct is repeatedly accessed, its activation threshold decreases. This means that the construct requires less energy necessary for activation, making it chronically accessible. A situational input (*e.g.*, a violent film) results in a temporary lowered threshold of activation, making the construct accessible for a short time. This temporary increase in the accessibility of a construct is often called "associative priming". Situational variables may also activate aggressive scripts.[94] Aggressive scripts can bias the interpretation of a situation and the possible responses to that situation. Repeated access of aggressive scripts can also make them more readily accessible and more likely to be activated in future situations, guiding future behavior.

Affect

Input variables can also influence the present internal state through affect, which in

turn can impact later behavior. For example, pain and uncomfortable temperatures can produce increases in state hostility (anger) and general negative affect.[98] Exposure to violent movies, TV, or video games also increases state hostility.[52, 99-103] Besides situational variables, personality variables are also related to hostility-related affect. Self-reported trait hostility has been shown to be positively related to state hostility.[98, 99]

Arousal

The final aspect of the present internal state that can be influenced is arousal. This can be accomplished a number of ways. An increase in arousal can strengthen an already present action tendency, which could be an aggressive tendency. For example, if the person has been provoked at the time of increased arousal, aggression is more likely to be an outcome than if the arousal increase didn't occur. Geen and O'Neal [104] demonstrated this phenomenon by showing that loud noise increased arousal and aggression. A second way in which arousal could increase aggression is commonly associated with excitation transfer theory.[95] Arousal elicited by other sources (*e.g.*, exercise) may be misattributed as anger in situations involving provocation, thus more likely producing anger-motivated aggressive behavior. A third, and untested, way is that unusually high and low levels of arousal may be aversive and may stimulate aggression in a similar manner as other aversive stimuli.[53]

Interaction between routes

Not only input variables can influence cognition, affect, and arousal, but these 3 routes may also influence one another. The idea that cognitions and arousal influence affect dates back all the way to William James [105] and was first popularized among social psychologists by Schachter and Singer.[106] Affect has also been shown to influence cognition and arousal.[107] Research has shown that people often use their affective state to guide inference and judgment processes.[108, 109] Thus, hostility-related affect may make hostile cognitions more accessible, and *vice versa.*

Outcomes

Typically, the individual will appraise the current situation and then select a behavior appropriate for the situation before that behavior is emitted. Depending on the situational variables and resources present, appraisals may be made hastily and automatically, without much (or any) thought or awareness, resulting in an impulsive behavior. However, frequently the individual will have the time and resources to reappraise the situation and perform a more thoughtful action. Of course, both impulsive and thoughtful actions may be aggressive or nonaggressive.

This action will then be followed by a reaction from the environment, which is typically other people's response to the action. This social encounter can alter the input variables, depending on the environmental response. This encounter could then modify situation variables, person variables, or both, resulting in a reinforcement or inhibition of similar behavior in the future.[75]

Applying GAM to media violence

GAM can be used to interpret the effects of exposure to violent media. Theoretically, violent media can affect all 3 components of internal state. As mentioned earlier, the literature on violent video games has shown that playing them can temporarily increase aggressive thoughts, affect and arousal.[52] Also noted earlier, exposure to violent media can reduce arousal to subsequent depictions of violence. Playing a violent video game can also influence the person's internal state through the affective route by increasing feelings of anger, and through the arousal route by increasing heart rate.[52]

Despite's the GAM's primary focus on the episode, it is not restricted to short-term effects. The cyclical process of GAM lends itself to addressing long-term effects of exposure to media violence. With repeated exposure to certain stimuli (*e.g.*, media violence), particular knowledge structures (*e.g.*, aggressive scripts) become more readily accessible. Figure 2 displays this process and several common types of long-term changes that may occur. Over time, the individual will

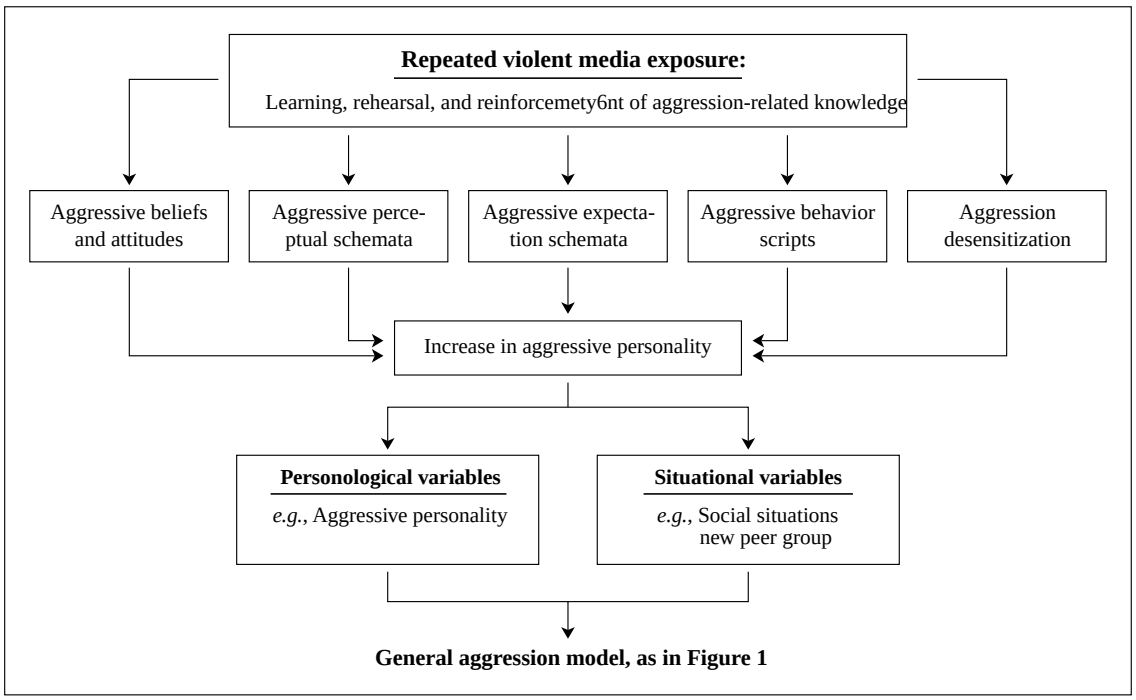

Figure 2.—The general aggression model: personality processes.

employ these knowledge structures and possibly receive environmental reinforcement for their usage. Over time, these knowledge structures become strengthened and more likely to be used in later situations. Research supports this notion by demonstrating that repeatedly exposing children to media violence produces aggressive adults.[110] Such long-term effects result from the development, automatization, and reinforcement of aggression-related knowledge structures. In essence, the creation and automatization of these aggression-related knowledge structures and the desensitization effects change the individual's personality. Long-term consumers of violent media, for example, can become more aggressive in outlook, perceptual biases, attitudes, beliefs, and behavior than they were before the repeated exposure, or would have become without such exposure.

Public policy implications and parental supervision

There are 3 main factors to consider when discussing the potential implications of research on violent video games. First, one must consider the research that has been conducted on violent video games. Even though this research area is still relatively small compared to research on the effects of violence in TV and movies, there is sufficient evidence to state that playing violent video games can cause significant increases in aggression in the short term, demonstrated both in laboratory-based situations and in real world contexts.

Second, one must consider the sheer size of the research literature on media violence in general. This literature has demonstrated that media violence has significant causal effects on aggression and on interpersonal violence in both the short and long term. The processes underlying the effects of TV and movie violence are very similar to those presumed to underlie the effects of violent video games, making findings from the TV domain very relevant to implications for video game research.

Third, one must consider the various processes underlying human aggression in general. Numerous advances in understanding

human aggression have been achieved in recent years; advances that allowed the formulation of the general aggression model. As Kurt Lewin [111] once said, "There is nothing so practical as a good theory." Though no theory is ever complete in all respects, a good one allows accurate predictions about the likely effects of certain actions. Social scientists' understanding of human aggression in general and of media violence effects in particular is now good enough to allow fairly accurate predictions of the likely effects of actions that policy makers and parents might take.

Potential public policy action

Public policy makers can aid parents in their attempts to provide a healthy media diet to their children by giving them back some of the parental control that has been lost to the media industry and their marketing departments. Legislation that restricts access of minors to violent media by requiring parental permission for minor children to buy, rent, or play violent video games in arcades, is likely to be helpful. Creating a single, unified rating system for various types of entertainment media would also help parents regain some control by simplifying the current confusion of systems. The new rating system should be applied by a group that is truly independent of the entertainment media industries. It should also be based on the best available research. We now know from research, for example, that strictly age-based systems encourage children to seek out media that are "too old" for them.[112] A rating system that more clearly labels the content of the video game might well be more informative to parents and might provide less encouragement to youth to violate age targets. Research also shows that even "cartoon" violence has a negative impact on children, especially on the youngest ones for whom the cartoon violence is supposedly created. Of course, feasible types of public policies vary widely across countries around the world. In the US, for example, the TV and movie industries have been quite successful in their efforts to prevent the creation of a legally binding system of access restrictions for children. The video game industry has been following in their footsteps in this regard. Other countries, however, do have governmental agencies that evaluate a variety of types of entertainment media for the primary purpose of restricting access to inappropriate material by children without parental permission (*e.g.*, Australia's Office of Film and Literature Classification).

Parental supervision

Based on survey research of parents and children, we know that parental supervision for obtaining and playing violent video games is relatively low.[11] Parents can correct this in a number of ways. First, parents need to discover what kinds of media, including video games, their children are ingesting, and then take steps to ensure that their media diet is a healthy one. Some parents lament that it is impossible to totally control what their children see and do and therefore throw up their hands in dismay. It is true that they cannot totally control their children's media diets, but this is no reason to give up all attempts at media diet control. For example, it is difficult to control what games your child plays at a friend's house. However, it is also difficult to control what your child eats when at a friend's house, but the solution is not to abandon your parental responsibility to provide nutritious meals at home. As the general aggression model illustrates, the long-term negative effects of exposure to violent video games is related to frequency of exposure. Steps that reduce such exposure in any environment, especially the home, can be beneficial. Such steps might include removing the TV, the video game console, and the computer from the child's room to an area that is more easily monitored by the parent. One can also monitor and control what kinds of computer games are on whatever computers the child uses and can restrict the web sites that the computer can access while in use by the child. Along these same lines, parents should encourage the parents of their children's friends to provide a healthy media diet rather than a violent one. None of these monitoring and

control tasks is easy, but a lot can be accomplished by a committed parent.

Second, parents can actively teach their children the reasons behind the restrictions they place on certain types of media, why such media can be bad for them. In a sense, this is teaching them to become more media savvy. Similarly, discussing alternative nonviolent solutions to interpersonal conflicts with one's children can help teach more positive values as well as practical guides to life. This can be done in the context of violent media themselves, as well as in numerous everyday situations as conflicts arise.

Third, reducing the amount of time children spend on electronic media and substituting increased time in social contexts and activities is likely to improve social skills and functioning over time.

In summary, parents need to be on the alert for any video game that encourages or allows the player to harm another creature, human or nonhuman. Such games are very likely teaching the game player subtle but harmful aggression lessons, regardless of how cute the game characters are or how unrealistic the violence appears.

Six questions parents should ask themselves regarding violent video games

When examining video games your child is being (or could potentially be) exposed to, it is best to get a first-hand demonstration of the game and ask yourself 6 questions. If you, like many parents, are not video game savvy enough to operate the game yourself, have someone else demonstrate it for you. Then ask yourself the following questions:

— Does the game involve some characters trying to harm others?

— Does this happen frequently, more than once or twice in 30 minutes?

— Is the harm rewarded in any way?

— Is the harm portrayed as humorous?

— Are nonviolent solutions absent or less "fun" than the violent ones?

— Are realistic consequences of violence absent from the game?

If 2 or more answers are "yes", think very carefully about the lessons being taught before allowing your child access to the game.

Future research

The evidence is now clear that playing violent video games increases aggressive behavior and decreases prosocial behavior in children and in young adults. Despite these conclusions, there are still many unanswered questions and much more work is needed. The following is a list of research needs in this domain.

1) Does explicitly gory violence desensitize video game players more so than less gory violence? If so, does this desensitization increase subsequent aggression? Does it decrease helping behavior?

2) What features increase the game player's identification with an aggressive character in video games? Prior research and theory in the media violence domain suggest that the impact of exposure to violent video games is likely to be greater when the game player closely identifies with an aggressive game character.[29]

3) What features, if any, could be added to violent video games to decrease the impact on subsequent aggression by the game player? For instance, does the addition of pain responses by the game victims make players less reluctant to reenact the aggression in later real-world situations, or do such pain responses in the game further desensitize the player to others' pain?

4) Can exciting video games be created that teach and reinforce nonviolent solutions to social conflicts?

5) What are the long-term effects of exposure to violent video games?

6) What types of people are most susceptible to violent video game effects, and who is relatively immune?

7) As mentioned earlier, does exposure to violent television or violent video games have larger impacts on aggression related variables and desensitization?

Answers to these questions are vital in

understanding the effects of video game violence, but will require considerable effort by the research community and considerable funding by federal and other research agencies and foundations. Violence in contemporary American culture is a major social concern, and media violence plays an important role. To date, researchers in the United State have studied violence and video game questions with virtually no governmental support. As video games continue to evolve in the digital age, becoming ever more realistic and violent, a commitment by federal governments is needed to fund basic research that will more adequately inform policy makers about the role that these games play in the development of childhood aggression. What we have learned so far has taken almost 20 years, in part because of the lack of research funding; let's hope that it will not take another 20 years to complete the next round of studies on this vital topic.

Riassunto

Esposizione a videogiochi violenti e aggressività: una review della letteratura

Nel corso degli ultimi 30 anni, l'industria dei videogiochi si è trasformata in un business plurimiliardario. Un numero sempre crescente di bambini e di adulti dedica del tempo ai videogiochi per computer, ai videogiochi per console e ai videogiochi on-line. La violenza figura come uno dei motivi dominanti nella maggior parte dei videogiochi più popolari. Il presente articolo offre una review aggiornata della letteratura circa gli effetti dell'esposizione a videogiochi violenti sulle variabili comportamentali legate all'aggressività. L'esposizione a videogiochi violenti determina un aumento dell'aggressività nella sfera comportamentale, in quella cognitiva e in quella affettiva. L'esposizione a videogiochi violenti determina anche un incremento nella fisiologica desensibilizzazione agli episodi di natura violenta che accadono nella vita reale e una diminuzione dei comportamenti di tipo solidale con chi è in difficoltà. La recente letteratura scientifica riguardante i videogiochi viene interpretata nei termini del Modello Generale di Aggressione. Vengono inoltre discusse le differenze tra l'esposizione a videogiochi e violenti e a programmi televisivi violenti.

Parole chiave: Età pediatrica - Videogioco - Violenza - Aggressività.

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