

Markey, P. M. (in press). Video games and mental health. Invited chapter in H. Friedman (Ed.), Encyclopedia of Mental Health. Elsevier Ltd., Oxford, UK.

Video Games and Mental Health

Patrick M. Markey

Villanova University

Department of Psychology
Villanova University
800 Lancaster Ave.
Villanova, PA 19085
Phone: (610) 519-4743
Fax: (610) 519-4269
patrick.markey@villanova.edu

Abstract

Research suggests that video games can have both negative and positive effects on children and adults. Studies investigating the negative effects of games have tended to find a short-term link between violent video games and hostility. However, the effect size for this link is small and there are no clear data suggesting violent video games are linked to changes in violence at the national level. Researchers examining the positive effects of video games have effectively used video games to educate children in math and science, assist in medical procedures, and even reduce depression in adolescents.

Keywords: aggression, computers, education, media, mood, video game, violence, visuospatial cognition

Historical Background

The video game industry began in 1971 with the first commercially sold coin-operated video game *Computer Space* (Goldberg & Vendel, 2012). Although groundbreaking at the time, *Computer Space* allowed players the ability to control a crudely rendered rocket ship while attempting to shoot flying saucers. Over the past 40 years, video game technology has evolved from coin operated arcade machines to home video game systems that render photorealistic graphics, offer superb artificial intelligence, and allow individuals to play against other people around the world. The video game industry has grown from the early arcade game *Computer Space* (which only sold approximately 1,500 units) to hundreds of companies with worldwide sales totaling \$67 billion in 2012; the market is expected to grow to \$82 billion in 2017 worldwide (Gaudiosi, 2012). It is estimated that 4 out of 5 homes in the United States with a male child have a video game system with children playing video games an average of 9 hours a week (13 hours for boys and 5 hours for girls; Gentile, et al., 2004; Sherry, 2001). Given the popularity of video games, it isn't too surprising to learn that researchers have been examining various psychological and sociological effects of this medium since 1978¹.

Although researchers have been examining both the positive and the negative effects of video games, following the 1999 Columbine High School shootings, lawmakers, researchers, activists, and laypersons became increasingly concerned primarily with the potentially dangerous effects of violent video games. In response to this tragedy, Jack Thompson (2000), a lawyer who is a longtime critic of violent video games, noted, "In every school shooting, we find that kids who pull the trigger are video gamers." In a similar manner, researchers of video game violence have often discussed the effects of violent media in the context of school shootings (c.f., Anderson, 2004; Anderson & Bushman, 2001; Giumetti & Markey, 2007)². Of course, as others have pointed out, given that over 97% of American youth play video games (Lenhart, 2008), it

doesn't seem too surprising that youths who committed school shootings have played video games. In order to empirically examine the actual link between violent video games and aggression, numerous research articles have been published across numerous disciplines since the time of the Columbine High School shootings.

Potential Negative Effects of Violent Video Games

A number of psychological theories and models have been adopted in order to better understand how and why violent video games may affect aggression (e.g., social learning theory, arousal theory, etc.). However, one model, which was specifically constructed to understand this link, has garnered considerable attention: the *General Aggression Model* (GAM; Bushman & Anderson, 2002). The GAM suggests that the link between exposure to a situational variable (e.g., violent media) and aggression is mediated by one's cognition. At its most basic level, the GAM is an extension of social modeling theory and Berkowitz's (1990) cognitive-neoassociation model of aggression. The GAM proposes that exposure to situational cues (e.g., a gun in a video game) activates ideas with similar meanings to the cue (e.g., shooting, bullets, etc.), which, in turn, activates associated ideas (e.g., murder, kill, etc.). According to this model, when an individual is repeatedly exposed to a violent video game he will become more prone to hostile behavior.

More recently, the *Catalyst Model* was introduced to provide an alternative explanation for the link between violent video games and aggression (Ferguson, et al., 2008). The Catalyst Model is essentially a diathesis-stress model which suggests individuals who are biologically predisposed to be aggressive are most likely to engage in violent behavior during periods of environmental stress. In this model violent video games are not a direct cause of violent behavior but serves as a "stylistic catalyst" providing a model for how individuals high in

aggression might express their violence. In other words, when an individual who is predisposed to be aggressive experiences a stressful situation he or she might model the violent behaviors witnessed in a video game. Additionally, the Catalyst Model recognizes that individuals who are predisposed to aggression tend to seek out violent media, like video games, in order to provide them with models that express behaviors and desires consistent with their own innate motivational system (Surette, 2012).

Both the GAM and the Catalyst Model present clear explanations for why violent video games may be linked to violent or aggressive behaviors. The main difference between these two models is the direction of the causal link between violent media and aggression. The GAM suggests that violent video games directly impact violent behaviors, whereas the Catalyst Model argues that violent video games do not directly cause violence, but instead impact how violence is expressed by innately aggressive individuals. Although these models are often presented as competing against each other (c.f., Starcevic & Porter, 2010), researchers have found evidence suggesting the plausibility of both models by employing methodologies ranging from carefully controlled experimental studies to longitudinal and correlational studies.

Research Examining Violent Video Games

Cross-sectional research examining the link between violent video games and aggression fall into two distinct categories: correlational and experimental. The typical correlational study in this area asks participants to first describe their video game playing habits and then self-report feelings or behaviors related to aggression and violence. For example, Anderson and Dill (2000) found that preference for violent video games was related to self-reported aggressive delinquency. The majority of studies using a cross-sectional correlational structure have found that individuals who play or prefer violent video games tend to express hostile or aggressive

tendencies (for reviews see Anderson & Bushman, 2001; Anderson, et al., 2010; Ferguson, 2007; Sherry, 2001). Such findings suggest a link between violent video games and aggression but provide no clear indication of the causal direction of this link.

In order to better examine whether or not playing violent video games causes increases in aggressive behavior and cognitions, numerous studies have employed experimental manipulation and random assignment within the laboratory setting. Although each study employs a slightly different methodology, most involve having one group of participants play a violent video game (e.g., *Mortal Kombat*, *Doom*, etc.) and another group play a non-violent video game (e.g., *Tetris*, *Top Spin Tennis*, etc.) for a very short period of time (e.g., 15 minutes). Immediately after playing the assigned video game, the aggressive cognitions or behaviors of the participants are measured. Researchers employing this methodology have found that individuals who play violent video games are more likely to expose others to “noise blasts” (a loud sound which punishes others with an irritating noise; Anderson & Dill, 2000), report feeling more hostile on a questionnaire (Markey & Scherer, 2009), give longer prison sentences to hypothetical criminals (Deselms & Altman, 2006), endorse aggressive thoughts on a questionnaire (Anderson & Dill, 2000), and even giving hot sauce to hypothetical individuals who do not like spicy food (Barlett, et al., 2009).

The majority of experimental studies linking violent video games to aggression have assessed aggression and hostility immediately after a participant played a violent video game. Several research studies have recently been conducted to examine whether or not the negative effects of violent video games last beyond this limited time frame (c.f., Anderson et al., 2008; Ferguson, et al., 2012; Möller & Krahe, 2009). The largest and longest longitudinal study examined 1,492 male and female students between grade 9 to grade 12 (Willoughby, Adachi, &

Good, 2012). In this large scale study, participants reported their own violent video game use and reported their levels of aggression using a 10-item questionnaire. Results from this study suggested that students who played violent video games during high school tended to report increasingly greater levels of aggression during this same time period than students who did not play violent video games (Adachi & Willoughby, 2013, recently noted that this link may have been due to the competitiveness of video games instead of the violence). Taken together, empirical research suggests there is a link between violent video games and aggression and that this link is, at least somewhat, attributed to violent video games causing individuals to become more aggressive.

How Large are the Effects of Violent Video Games?

In an effort to understand how large of an effect violent video games have on various negative outcomes, several large meta-analyses have been conducted. Meta-analyses allow researchers to combine the results of numerous studies in order to better understand the general findings of research linking violent video games to aggression. Two of the earliest meta-analytic studies found that the strength of the relationship (i.e., Pearson r) linking aggression and violent video games was between .15 (Sherry, 2001) and .19 (Anderson & Bushman, 2001). More recently, Ferguson (2007) found that the average effect size yielded from these studies was .14 whereas Anderson and colleagues (Anderson, et al., 2010) found that the average effect size for experimental studies was .18 and for longitudinal studies the effect was .20. Interestingly, when gender was controlled in these longitudinal studies the overall effect size linking violent video games to aggressive behaviors dropped dramatically to .07. Although these meta-analyses yielded similar effect sizes, the authors of the studies presented drastically different interpretations. Ferguson (a frequent critic of the violent video game research; 2007) argued that

these effects were extremely small and might even simply have occurred due to publication bias. In contrast, Anderson (he and his collaborators conducted many of the studies examined; Anderson & Warburton, 2012) concluded that these effects were substantial arguing that these effects were larger than the effect of eating calcium on bone mass, of asbestos inhalation on related cancers, of condom use on reducing HIV infection numbers. . .” (pp. 67-68).

It is important to point out that while the effect sizes yielded linking violent video games to aggressive behavior is similar to these important medical outcomes, this statement must be interpreted with some caution³. Medical research linking calcium to bone mass, asbestos to cancer, and condom use to HIV infection actually measured participants’ bone mass, cancer, and HIV infection. In contrast, research linking violent video games to aggressive behavior have almost exclusively relied on self-reports of aggressive behavior or employed proxy measurements of aggression. Although people who play a violent video game may give hot sauce to another person who does not like spicy foods, these are actions with minimal repercussion and are obviously not a direct measurement of real world aggressive acts like homicide, rape, or aggravated assault. As such, it is likely the effect sizes found linking violent video games to aggression overestimate the true effect of violent video games on real world aggressive behaviors. Given the concern of proxy measurements used to assess aggression, from the concurrent effect sizes yielded from research (r value range = .14 to .20) and the longitudinal effect size controlling for gender ($r = .07$), it is probably most accurate to conclude that exposure to violent video games is linked to aggressive behaviors, but that this association is rather small.

Violent Video Games and Crime

Even though the effect of violent video games and aggression is small, some have correctly noted that small effects can have important outcomes on large populations. For

example, Bushman and Anderson (2001) have argued that although the effect of smoking on lung cancer is only slightly higher than the effect of violent media (i.e., television, movies, video games, etc.) on aggression, there is little doubt that smoking is related to lung cancer³. Figure 1 dramatically displays how the effect between smoking and lung cancer appears to have important implications at the societal level. Video game researchers (Bushman & Anderson, 2001) have explicitly made the analogy between the effect of smoking and lung cancer and the effect between violent media and aggressive behavior several times, noting that “[just as]... smoking is not the only factor that causes lung cancer, it is an important factor. Similarly, watching violent media is not the only factor that causes aggression, but it is an important factor” (p. 481) and “. . . because so many people are exposed to violent media, the effect on society can be immense even if only a small percentage of viewers are affected by them” (p 482).

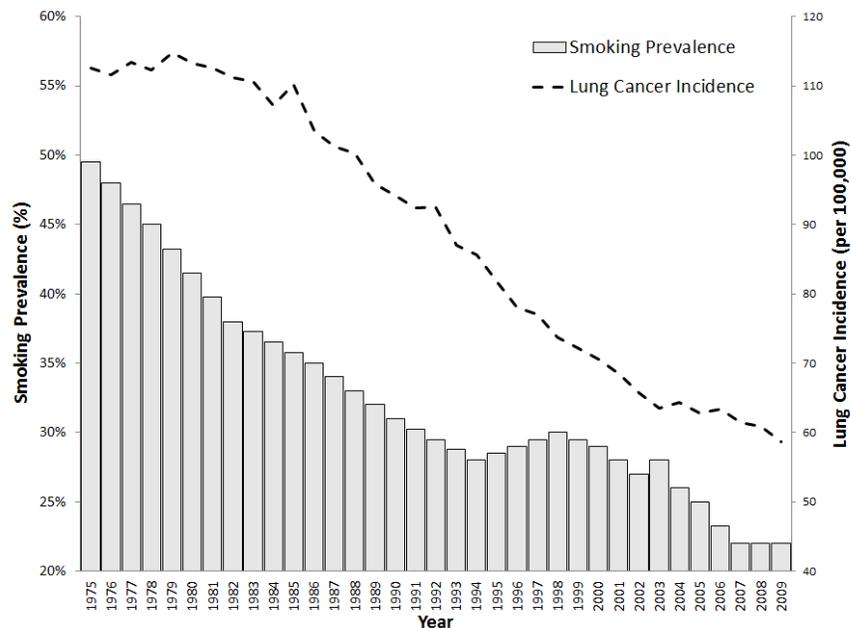


Figure 1. Lung cancer incidence and smoking prevalence between 1975 and 2009 for men located in the United Kingdom. Data source: Cancer Research UK.

Such dramatic language suggest that, similar to the observed association between smoking and lung cancer at the national level, as more people in a society consume more violent

video games, there will also be a an increase in the amount of violence experienced within that society. Figure 2 displays the near linear growth of video game sales across the past 15 years and changes in criminal homicide, forcible rape, aggravated assault, and overall violent crime during the same time period. As can be seen, even though video game sales have dramatically

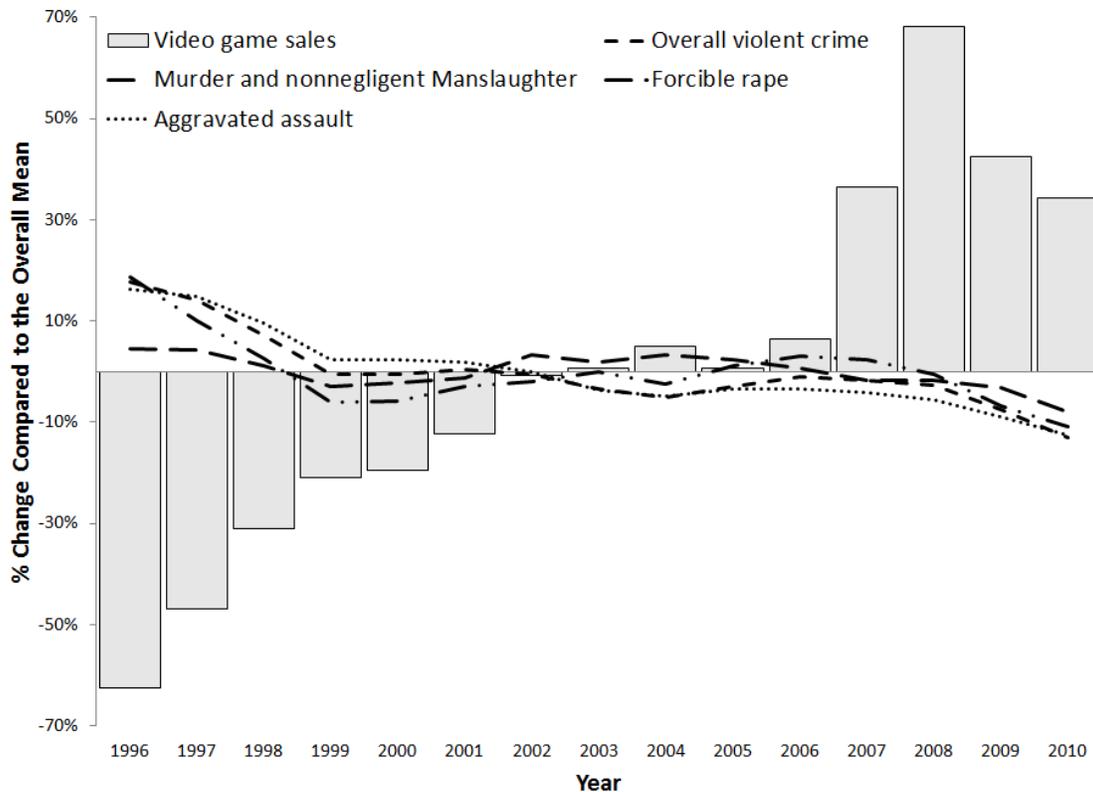


Figure 2. Changes in video game sales and violent crime between 1996 and 2010 in the United States. Violent crime data source: The Federal Bureau of Investigation. Video game sales data source: The NPD Group, Inc. / Retail Tracking Service.

increased over the past 15 years, there has not been an “immense” increase in violence. In fact, there is a negative relationship between sales of video games and criminal homicide ($r = -.55$), forcible rape ($r = -.87$), aggravated assault ($r = -.47$), and overall violent crime ($r = -.58$). It appears that although small effects, like the link between smoking and lung cancer, might become magnified at the societal level, this does not occur for the link between violent video

games and real world violence. One has to be cautious when examining aggregated data in order to make predictions about how video games might adversely affect individuals (i.e., Simpsons Paradox; Simpson, 1951). Additionally, as correctly pointed out by others, numerous factors influence violent and aggressive behaviors (e.g., SES, family background, etc.; Anderson & Warburton, 2012) that might hide the negative societal impact of violent video games. Therefore, while the societal data presented in Figure 2 does not necessary provide evidence that video games have no adverse effect on real world violence it does suggest that any negative effect of violent video games is dwarfed by the effects of other factors that the effects of violent video games appears nonexistent at the national level.

Potential Positive Effects of Video Games

Although the majority of video game research in the past twenty years has focused on the various negative effects of this medium, more recently researchers have begun to explore some potential positive outcomes of playing video games within the domains of education, mood regulation, and visuospatial cognition.

Education

The ability for video games to capture the attention of children and hold it for great periods of time has prompted educators and game developers to explore how this medium can be used to educate children. Some early examples of video games used to educate (often referred to as edutainment) include Oregon Trail (a game designed to teach children about 19th century life on the Oregon Trail), Where in the World is Carmen Sandiego (a game intended to teach geography and reference skills), and Math Blaster (a game designed to teach children mathematics). It is believed that well designed video games can aid in teaching children because they offer an educational environment with rewards and punishments, repetition for learning

important facts, and allow a player to learn at their own rate until a skill is mastered. Consistent with this reasoning, research suggests that the use of computer based educational programs is related to higher student achievement in both reading and mathematics (Murphy, et al., 2002).

Mood Regulation

Media, such as video games, can generate a wide variety of emotions such as happiness, joy, awe, dread, and anger (Oatley, 1995; Valkenburg, Cantor, & Peeters, 2000). Despite the differences between the “real world” and the artificial world created by video games, individuals play this medium as a way of experiencing such emotions. Casual video game play is associated with physiological changes related to increases in positive mood and decreases in stress (Russoniello, O’Brien, Parks, 2009). Recent research even suggests that specially designed video games are as effective at reducing the depression in adolescents as traditional treatments (Merry, et al., 2012) and might be effective means of reducing pain and anxiety associated with various medical procedures (Das, et al., 2005; Gold, et al., 2006). Children (especially girls) who play video games with their parents are less likely to internalize problems or express aggressive behaviors than other children (Coyne, et al., 2011). These positive emotions associated with video game play are also conceptualized as the mediating factor between video game play and creativity (Jackson, et al., 2012), increases in self-efficacy (Kato, et al., 2008), and even the satisfaction of basic psychological needs (Ryan, Rigby, & Przybylski, 2006).

Visuospatial Cognition

Video games often force players to process multiple virtual items simultaneously, understand the special relations between these virtual items, and to interact with these virtual items. During this process, players’ responses to their observations are either rewarded (e.g., the players’ scores increase, they advance to next level, etc.) or are punished (e.g., the players’

scores decrease, the character is eliminated, etc.). In short, video games provide the opportunity for players to practice and potentially improve their abilities to understand the visual representations of objects and the spatial relationships between these objects in order to successfully perform a task (i.e., their visuospatial cognition). Overall, there is convincing evidence that video game players tend to outperform nongamers in numerous visual tasks (c.f., Green & Bavelier, 2007; Greenfield, et al., 1994) and that the link between video game play and visuospatial cognition is large (average $r = .49$; Ferguson, 2007). For example, surgeons who play video games more than 3 hours a week make 37% fewer mistakes and are 27% faster than surgeons who do not play video games (Rosser, et al., 2007). Video game experience was even found to be a better predictor of surgical skill than the number of years of training a surgeon received or the number of surgeries he or she had previously performed (Rosser, et al., 2007). Experimental research further suggests that this is a causal relationship with video game play directly increasing a person's visuospatial cognition. Taken together, these early studies suggest video games might be useful for increasing a person's visual skills or even as useful tools for the rehabilitation of visual defects.

Conclusions

Video games are a medium used, primarily, to entertain children and adults. Games have also been used to educate children in math and science, assist in medical procedures, and may even one day be used to train surgeons. The majority of studies investigating the negative effects of games suggest a short-term link between violent video games and hostility. However, the longitudinal effect size for this link appears to be very small ($r = .07$ when gender is controlled) and, to date, there is no clear data suggesting violent video games are linked to actual societal changes in violence. As with all media, video games are not inherently "good" or

“bad.” Some games have artistic value (e.g., Flower, Journey, etc.), others can educate our children (e.g., Oregon Trail, Where in the World is Carmen Sandiego, etc.), and some are violent and morally depraved (e.g., Postal, Manhunt, etc.). With the constantly advancing technology in graphics and online access there is little doubt that this medium will continue to be of interest to both the general public and researchers.

Endnotes

1. The first video game study in psychology that could be located was a doctoral dissertation (Moulds, 1978) examining physiological arousal of anxious women during a video game competition.
2. One research article which examined the link between violent video games and hostility even began by discussing the 2001 terrorist attacks on the World Trade Center and Pentagon (Bushman & Anderson, 2002).
3. There is debate (c.f., Ferguson, 2009) on the how best to compute the effect sizes examining these medical outcomes and the accuracy of the conclusions from Anderson and Warburton (2012) and Bushman and Anderson (2001) regarding these effect sizes.

Cross-References

Human- Computer Interaction & Social Media

Television, Media Use and Mental Health

Media Violence

Biography

Dr. Patrick Markey is an associate professor of psychology at Villanova University, the director of the Interpersonal Research Laboratory, and a former president of the Society for Interpersonal Theory and Research.



References

- Adachi, P. J. C., & Willoughby, T. (2013). Demolishing the competition: The longitudinal link between competitive video games, competitive gambling, and aggression. *Journal of Youth and Adolescence, 42*, 1090-1104. Doi: 10.1007/s10964-013-9952-2
- Anderson, C. A. (2004). An update on the effects of playing violent video games. *Journal of Adolescence, 27*, 113-122. doi: 10.1016/j.adolescence.2003.10.009
- Anderson, C. A., & Bushman, B. J. (2001). Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: A meta-analytic review of the scientific literature. *Psychological Science, 12*, 353-359. doi: 10.1111/1467-9280.00366
- Anderson, C. A., & Dill, K. E. (2000). Video games and aggressive thoughts, feelings, and behavior in the laboratory and in life. *Journal of Personality and Social Psychology, 78*, 772 -790. doi: 10.1037/0022-3514.78.4.772
- Anderson, C. A., Sakamoto, A., Gentile, D. A., Ihori, N., Shibuya, A., Yukawa, S., Naito, M., & Kobayashi, K. (2008). Longitudinal effects of violent video games on aggression in Japan and the United States. *Pediatrics, 122*, 1067-1072. doi: 10.1542/peds.2008-1425
- Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B.J., Sakamoto, A., Rothstein, H.R., & Saleem, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review. *Psychological Bulletin, 136*, 151-173. doi: 10.1037/a0018251
- Anderson, C. A., & Warburton, W. A. (2012). The impact of violent video games: An overview. Chapter in W. Warburton & D. Braunstein (Eds.) *Growing Up Fast and Furious: Reviewing the Impacts of Violent and Sexualised Media on Children*, (pp. 56-84). Annandale, NSW, Australia: The Federation Press.

- Barlett, C., Branch, O., Rodenheffer, C., & Harris, R. (2009). How long do the short-term violent video game effects last? *Aggressive Behavior, 35*, 225-236. doi: 10.1002/ab.20301
- Berkowitz, L. (1990). On the formation and regulation of anger and aggression: A cognitive-neoassociationistic analysis. *American Psychologist, 45*, 494 – 503. doi: 10.1037/0003-066X.45.4.494
- Bushman, B.J., & Anderson, C.A. (2001). Media violence and the American public: Scientific facts versus media misinformation. *American Psychologist, 56*, 477-489. doi: 10.1037/0003-066X.56.6-7.477
- Bushman, B. J., & Anderson, C. A. (2002). Violent video games and hostile expectations: A test of the General Aggression Model. *Personality and Social Psychology Bulletin, 28*, 1679-1686. doi: 10.1177/014616702237649
- Coyne, S. M., Padilla-Walker, L. M., Stockdale, L., & Day, R. D. (2011). Game on. . . girls: Associations between co-playing video games and adolescent behavioral and family outcomes. *Journal of Adolescent Health, 49*, 160-165. doi: 10.1016/j.jadohealth.2010.11.249
- Das, D. A., Grimmer, K. A., Sparnon, A. L., McRae, S.E., & Thomas, B. H. (2005). The efficacy of playing a virtual reality game in modulating pain for children with acute burn injuries: A randomized controlled trial. *BMC Pediatrics, 5*, 1-10. doi: 10.1186/1471-2431-5-1
- Deselms, J. L., & Altman, J. D. (2006). Immediate and prolonged effects of videogame violence. *Journal of Applied Social Psychology, 33*, 1553-1563. doi: 10.1111/j.1559-1816.2003.tb01962.x

- Ferguson, C. J. (2007). The good, the bad, and the ugly: A meta-analytic review of positive and negative effects of violent video games. *Psychiatric Quarterly*, *78*, 309-316. doi: 10.1007/s11126-007-9056-9
- Ferguson, C. J., Rueda, S. M., Ferguson, D. E., Fritz, S., & Smith, S. M. (2008). Violent video games and aggression: Casual relationship or byproduct of family violence and intrinsic violence motivation? *Criminal Justice and Behavior*, *35*, 311-332. doi: 10.1177/0093854807311719
- Ferguson, C. J. (2009). Is psychological research really as good as medical research? Effect size comparisons between psychology and medicine. *Review of General Psychology*, *13*, 130-136. doi: 10.1037/a0015103
- Ferguson, C. J., San Miguel, C., Garza, A., & Jerabeck, J. M. (2012). A longitudinal test of video game violence influences on dating and aggression: A 3-year longitudinal study of adolescents. *Journal of Psychiatric Research*, *46*, 141-146. doi: 10.1016/j.jpsychires.2011.10.014
- Gaudiosi, J. (2012). New reports forecast global video game industry will reach \$82 billion by 2017. *Forbes*. Retrieved from <http://www.forbes.com>.
- Gentile, D. A., Lynch, P. J., Linder, J. R., & Walsh, D. A. (2004). The effects of violent video game habits on adolescent aggressive attitudes and behaviors. *Journal of Adolescence*, *27*, 5-22. doi: 10.1016/j.adolescence.2003.10.002
- Giumetti, G. W., & Markey, P. M. (2007). Violent video games and anger as predictors of aggression. *Journal of Research in Personality*, *41*, 1234-1243. doi: 10.1016/j.jrp.2007.02.005
- Gold, J. I., Kim, S. H., Kant, A. J., Joseph, M. H., & Rizzo, A. (2006). Effectiveness of virtual

- reality for pediatric pain distraction during IV placement. *CyberPsychology and Behavior*, 9, 207-212. doi: 10.1089/cpb.2006.9.207
- Goldberg, M., & Vendel, C. (2012). *Atari Inc.: Business is Fun*. New York, Carmel: Syzygy Company Press.
- Green, C. S., & Bavelier, D. (2007). Action video game experience alters the spatial resolution of vision. *Psychology and Science*, 18, 88-94. doi: 10.1111/j.1467-9280.2007.01853.x
- Greenfield, P.M., DeWinstanley, P., Kilpatrick, H., & Kaye, D. (1994). Action video games and informal education: Effects on strategies for dividing visual attention. *Journal of Applied Developmental Psychology*, 15, 105-123. doi: 10.1016/0193-3973(94)90008-6
- Jackson, L. A., Witt, E. A., Games, A. I., Fitzgerald, H. E., von Eye, A., & Zhao, Y. (2012). Information technology use and creativity: Findings from the children and technology projects. *Computers in Human Behavior*, 28, 370-376. doi: 10.1016/j.chb.2011.10.006
- Kato, P. M., Cole, S. W., Bradlyn, A. S., & Pollock, B. H. (2008). A video game improves behavioral outcomes in adolescents and young adults with cancer: A randomized trial. *Pediatrics*, 122, 305-317. doi: 10.1542/peds.2007-3134
- Lenhart, A. (2008). New Pew Internet/MacArthur report on teens, video games and civis. *Pew Internet and American Life Project*. Retrieved from <http://pewinternet.org> (full url?)
- Markey, P. M., & Scherer, K. (2009). An examination of psychoticism and motion capturecontrols as moderators of the effects of violent video games. *Computers in Human Behavior*, 25, 407-411. doi: 10.1016/j.chb.2008.10.001
- Merry, S. N., Stasiak, K., Shepherd, M., Frampton, C., Fleming, T., & Lucassen, M. F. G.

- (2012). The effectiveness of SPARX, a computerised self help intervention for adolescents seeking help for depression: randomised controlled non-inferiority trial. *British Medical Journal*, 344. doi: 10.1136/bmj.e2598
- Moulds, E. E. (1978). *Selected Physiological Measures of Arousal of High and Low Trait Anxiety Females During Competition*. (Doctoral dissertation). Louisiana State University and Agricultural and Mechanical College, Baton Rouge, LA.
- Möller, I., & Krahe, B. (2009). Exposure to violent video games and aggression in German adolescents: A longitudinal analysis. *Aggressive Behavior*, 35, 75-89. doi: 10.1002/ab.20290
- Murphy, R. F., Penuel, W. R., Means, B., Korbak, C., Whaley, A., & Allen J.E. (2002). *A Review of Recent Evidence on the Effectiveness of Discrete Educational Software*. Washington, DC: U.S. Department of Education, Planning and Evaluation Service.
- Oatley, K. (1995). A taxonomy of the emotions of literary response and a theory of identification in fictional narrative. *Poetics*, 23, 53-74. doi: 10.1016/0304-422X(94)P4296-S
- Rosser, J. C., Lynch, P. J., Caddihy, L., Gentile, D. A., Klonsky, J., & Merrell, R. (2007). The impact of video games on training surgeons in the 21st century. *Archives of Surgery*, 142, 181-186. doi:10.1001/archsurg.142.2.181
- Russoniello, C. V., O'Brien, K., & Parks, J. M. (2009). The effectiveness of casual video games in improving mood and decreasing stress. *Journal of CyberTherapy and Rehabilitation*, 2, 53-66.
- Ryan, R. M., Rigby, S. C., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotions*, 30, 347-363. doi: 10.1007/s11031-006-9051-8

- Sherry, J. L. (2001). The effects of violent video games on aggression: A meta-analysis. *Human Communication Research, 27*, 409-431. doi: 10.1111/j.1468-2958.2001.tb00787.x
- Simpson, E. H. (1951). The interpretation of interaction in contingency tables. *Journal of the Royal Statistical Society, Series B (Methodological), 13*, 238–241.
- Starcevic, V., & Porter, G. (2010). Virtual violence: The games people play. In E. Aboujaoude & L. M. Koran (Ed.), *Impulse Control Disorders* (pp 182-188). New York, NY: Cambridge University Press.
- Surette, R. (2012). Cause or catalyst: The interaction of real world and media crime models. *American Journal of Criminal Justice*. doi: 10.1007/s12103-012-9177-z
- Thompson, J. (Speaker). (2000, March 23). *ABC News: 20/20*. New York, NY: American Broadcasting Company.
- Valkenburg, P. M. , Cantor, J., & Peeters, A. (2000). Fright reactions to television: A child survey. *Communication Research, 27*, 82-99. doi: 10.1177/009365000027001004
- Willoughby, T., Adachi, P. J. C., & Good, M. (2012). A longitudinal study of the association between violent video game play and aggression among adolescents. *Developmental Psychology, 48*, 1044-1057. doi: 10.1037/a0026046