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Violent Video Games and Real-World Violence: Rhetoric Versus Data

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Laboratory and correlational studies often find a link between violent video games and minor or benign forms of aggressive behaviors (e.g., exposing an opponent to an unpleasant noise). Based on these studies, the media, lawmakers, and researchers often imply a link between violent video games and violent criminal behavior. Using a similar methodology employed by researchers to examine predictors of severe violent behaviors (Anderson et al., *Journal of Personality and Social Psychology* 73: 1213–1223, 1997), 4 time-series analyses investigated the associations among violent crime (homicides and aggravated assaults), video game sales, Internet keyword searches for violent video game guides, and the release dates of popular violent video games (both annually and monthly). Contrary to the claims that violent video games are linked to aggressive assaults and homicides, no evidence was found to suggest that this medium was positively related to real-world violence in the United States. Unexpectedly, many of the results were suggestive of a *decrease* in violent crime in response to violent video games. Possible explanations for these unforeseen findings are discussed and researchers are cautioned about generalizing the results from laboratory and correlational studies to severe forms of violent behavior.

Keywords: video games, time series, violence, homicide, ARIMA

Controlling the use of violent video games is one step we can take to help protect our society from violence.—Brad Bushman (2013)

... high exposure to media violence is a major contributing cause of the high rate of violence in modern U.S. society.—Craig Anderson (2000), testimony before the U.S. Senate Commerce Committee on the impact of interactive violence on children.

There is considerable evidence relating violent video games to aggressive behaviors and cognitions. In a comprehensive meta-analysis, Anderson et al. (2010) identified 74

studies that used the “best practices” (i.e., those studies that used valid measurements and sound methodologies), and concluded that exposure to violent video games is a causal risk factor for increased aggressive cognitions, aggressive affect, and aggressive behaviors. Although some researchers have cautioned that the apparent negative effects of violent video games are small and may be a result of publication bias (Ferguson, 2007), the popular media, lawmakers, and researchers have often linked violent video games to severe acts of violence. The current article examines whether the findings from these studies, which have been conducted primarily in laboratories with college students, generalize to severe forms of violent behavior occurring in the “real world.”

In the aftermath of the 1999 Columbine High School shootings, many media outlets discussed violent video games as one of the potential causes of this tragic event (cf., Simpson &

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Blevins, 1999). Following the shootings at Virginia Tech, local and national media noted that the gunman, Seung-Hui Cho, was a fan of the violent video shooter game *Counterstrike*¹ (cf. Benedetti, 2007). In a similar manner, media sources reported that the Sandy Hook Elementary School gunman, Adam Lanza, played the video game *Call of Duty*, a game that mimics wartime violence (cf., Smeltz, 2012).² A search of an online database of newspapers (ProQuest NewsStand) found that nearly 5,000 articles were released in the aftermath of these three tragedies, which discussed video games in the context of these three school shootings. The implication in many of these articles was that these violent acts were precipitated and perhaps even caused by exposure to violent video games. For example, on the popular ABC news program 20/20, one TV commentator noted, “In every school shooting, we find that kids who pull the trigger are video gamers” (Thompson, 2000).

The growing concern about a link between violent video games and severe forms of violent behavior prompted President Barack Obama in 2013 to encourage scientists to research the effects of violent video games (Molina, 2013). In the 30 years preceding this request, federal and local lawmakers conducted numerous hearings, proposed various legislative acts, and passed approximately a dozen laws in an effort to regulate the sale of violent video games. One of the most salient political events concerning video games was the 1993 hearing on video game violence led by Senator Joseph Lieberman, resulting in the creation of the Entertainment Software Ratings Board (ESRB; Kent, 2010). The ESRB is a self-regulatory organization whose purpose is to assign age and content ratings to video games. In 2011, the United States Supreme Court struck down a California law prohibiting the sale of violent video games to youth, thereby affording video games the same first-amendment protection as films, music, and other artistic works (Helle, 2011). This decision by the Supreme Court has not curtailed the concern of lawmakers. Following the tragedy at Sandy Hook Elementary School, several local and federal bills were introduced, including the federal bill “Video Games Enforcement Act” (H.R. 287), which would regulate the sale of violent video games. Various legislators continue to be concerned that violent video games

are a main contributor to youth violence, with Senator Lamar Alexander arguing that “. . . video games is (sic) a bigger problem than guns, because video games affect people” (Linkins, 2013).

In addition to lawmakers and the media, violent video game researchers have linked this medium to serious and deadly assaults. This connection has been explicit at times, such as when researchers described violent video games as “murder simulators” (Grossman, 1998), or when arguing that video games can train children to kill in a manner similar to how a flight simulator teaches a person to pilot a plane (Bushman, 2008; Gentile & Anderson, 2003). Some researchers have even contended that the negative effect of violent video games on public health is similar to the causal relationship between smoking and lung cancer (cf., Bushman & Anderson, 2001). Other times this link has been more subtle, such as when researchers reference real-world violence to substantiate the rationale of their research. For example, in the peer-reviewed “best practices” studies identified by Anderson et al. (2010), 28% of the studies discussed severe forms of violence, most often within the introduction or abstract of the article.³ Of these studies, 42% presented their research in the context of the Columbine High School shooting, with the remaining discussing other school shootings (e.g., the Heath High School shooting, Westside Middle School shooting, etc.), homicide rates, and terrorism, including the September 11th attacks on the World Trade Center and the Pentagon. Outside of journal pages, researchers have also linked laboratory findings with severe forms of violence during interviews with the popular media. For example, in searching for possible motivations of the 2013 Washington Navy Yard shootings, one prominent researcher noted that “. . . video game use may have been a contributing

¹ A governmental panel created after the Virginia Tech shootings found no evidence that Seung-Hui Cho ever played or owned the game *Counterstrike* or any other violent video game (Virginia Tech Review Panel, 2007).

² A governmental report noted that although the shooter owned *Call of Duty*, he spent most of his time playing nonviolent games, including *Dance-Dance Revolution* and *Super Mario Brothers* (Sedensky, 2013).

³ The first author of the current research article is also the author of one of the “best practices” studies that discussed violent video games in the context of school shootings.

factor,” and argued the shooter was probably a more accurate shot because he liked to play the video game *Call of Duty* (Bushman, 2013).

The concern about violent video games expressed by the media, lawmakers, and researchers may be justifiable, given the prevalence of this medium. Media researchers define a video game as violent if a character in the game displays realistic or cartoonish aggressive behavior toward another character. This classification is not focused on how graphic the violence is in a game; rather, it centers on whether the behavior the game character exhibits is intentionally harmful to another game character (cf., Gentile, Saleem, & Anderson, 2007; Thompson & Haninger, 2001). This definition is consistent with claims that cartoonish violence in E-rated games has the same negative effects on violent behavior as realistic violence portrayed in M-rated games (Gentile et al., 2007). Consequently, regardless of a game’s ESRB rating, games that contain cartoonish and realistic violence are both considered to be violent. For example, the violent video games used in the studies identified as using the “best practices” (Anderson et al., 2010) included a cartoonish platformer (*Ty2*; Rated E – content is suitable for everyone), a violent first person shooter (*Call of Duty*; Rated M – content is suitable for 17 years and up), an exaggerated version of baseball (*MLB Slugfest*; Rated E – content is suitable for everyone), and an adventure game where the main character uses cartoonish attacks such as “pepper breath” (*Herc’s Adventure*; Rated E – content is suitable for everyone). According to this definition, the majority of video games contain violence (Gentile, 2009; Thompson & Haninger, 2001; Thompson, Tepichin, & Haninger, 2006). In fact, among the most popular games sold in the past 5 years, more than 90% portray some form of violent behavior.⁴

Realistic and cartoonish violent video games have been linked to aggressive behavior and cognitions in numerous correlational, experimental, and longitudinal studies (for reviews see Anderson & Bushman, 2001; Anderson et al., 2010; Ferguson, 2007; Sherry, 2001). The typical correlational study in this area uses mainly questionnaires, asking 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 experimental studies involve having one group of participants play a violent video game (e.g., *Grand Theft Auto*, *Call of Duty*, etc.) and another group play a nonviolent video game (e.g., *Tetris*, *Top Spin Tennis*, etc.) for a very short period (e.g., 15 minutes). Immediately after playing the assigned video game, the aggressive cognitions or behaviors of the participants are measured. Researchers using this methodology have found that individuals who play violent video games are more likely to expose others to “noise blasts” (a loud sound that punishes others with an unpleasant noise; Anderson & Dill, 2000), report feeling more hostile on a questionnaire (Markey & Scherer, 2009), and even give hot sauce to hypothetical individuals who do not like spicy food (Barlett, Branch, Rodenheffer, & Harris, 2009).

One limitation of previous research examining violent video games and aggressive behavior is the manner in which “aggressive behavior” is operationalized. The majority of research studies in this area assess minor forms of aggression (e.g., giving an unpleasant noise or too much hot sauce to another person) or self-reports of aggressive feelings or behaviors. As pointed out by others (Anderson, Bushman, & Groom, 1997), laboratory studies are somewhat limited because how aggressive behavior is measured in these contexts is different from severe forms of aggression in the “real world,” which can involve aggravated assaults and homicides. In other words, is a person’s indication that they would give another person hot sauce analogous to shooting another person?

Given the ethical problems associated with studying real violence in a laboratory setting, researchers who study such severe forms of violence have often examined changes in violent crime rates in relation to changes in a variable of interest across time. Consistent with this notion, Anderson and colleagues have stressed the importance of examining changes in criminal data to determine whether these data

⁴ Represents the percent of game units sold between 2007 and 2011, as reported by the sale tracking site vgchartz.com, which has an ESRB content descriptor for any type violence (e.g., intense violence, fantasy violence, cartoonish violence, etc.).

point to the same conclusion as results from other methodologies (e.g., laboratory studies; Anderson, 1987; Anderson et al., 1997). Because each type of methodology affords different strengths and weaknesses, the confidence in the validity of a finding is strengthened if diverse methods support the same hypothesis. Conversely, if they do not support the same hypothesis, then the validity of the hypothesis is called into question.

To illustrate this notion, Anderson et al. (1997) presented a series of studies that examined the “heat hypothesis”—the idea that uncomfortably hot temperatures increase aggressive behaviors. These researchers found that between the years 1950 to 1995, the average annual temperatures were positively related to aggravated assaults and homicides, even after controlling for trends and serial dependency in the time series. What is perhaps most impressive about this study is, although violent behavior has a multitude of causes, the effect of heat was strong enough to express itself in real forms of violent behavior. By linking temperature to the changes in violent behavior across time, the authors of this study concluded that the “heat effect is real and significant when applied to large populations.” (Anderson et al., 1997, p. 1222).

To determine whether violent video games have a “real and significant” effect when applied to large populations, the current study also examined changes in aggravated assaults and homicides across time. Based on previous research and the speculation from the popular media, lawmakers, and researchers, it was predicted that years or months where many individuals were exposed to violent video games would yield relatively high rates of serious and deadly assaults. To examine this prediction, four time-series analyses were conducted to investigate the relations between various assessments of video game habits and violent crime within the United States. Analysis One examined annual changes in video game sales and changes in violent crime between 1978 and 2011. Analysis Two investigated monthly video games and monthly reports of aggravated assaults and homicides between 2007 and 2011. Analysis Three examined how changes in Internet searches for video game walkthroughs and guides of popular violent video games were related to monthly changes in serious and deadly assaults. Analysis Four investigated the

change in aggravated assault and homicide rates following the release of three extremely popular violent video games. In each analysis, both concurrent and delayed effects were examined. It is hoped that this comprehensive and diverse set of analyses will be able to detect any possible links between violent video games and real-world violent behavior.

Analysis One: Annual Changes in Video Game Sales and Violent Crime: 1978 to 2011

Although the video game industry began in 1971, with the first commercially sold coin-operated video game *Computer Space*, it did not gain widespread attention until the release of the Atari 2,600 game console in 1977 (Goldberg & Vendel, 2012). Over the past 40 years, the video game industry has grown to include hundreds of companies, with worldwide sales expected to grow to \$82 billion by 2017 (Gaudiosi, 2012). It is estimated that four of five homes in the United States with a male child have a video game system, with children playing video games an average of 9 hr a week (13 hr for boys and 5 hr for girls; Gentile, Lynch, Linder, & Walsh, 2004; Sherry, 2001). However, during this same period, violent crime has decreased. In 1978, the homicide rate in the United States was 9.0 homicides per 100,000 people, but this rate dropped dramatically to 4.7 homicides per 100,000 people in 2011 (United States Department of Justice, 2013). Given the prevalence of violence in most popular video games (Gentile, 2009; Thompson & Haninger, 2001; Thompson et al., 2006), the first analysis examined the link between overall video game sales between 1978 and 2011 and changes in aggravated assaults and homicides.

Method

Data and sources.

Annual video game sales. Annual game sale data between 1978 and 2011 were provided by researchers at SuperData. SuperData is an independent marketing company that collects data from publishers and developers to examine various trends within the video game market space (Van Dreunen, 2011). A second set of annual video game sales data were obtained from the NPD Group for the years 1997 to 2011 (data were not available from this group prior to 1997). The

NPD Group is a market research company that collects actual sales data from retailers and distributors in addition to tracking consumer-reporter purchasing behavior (NPD Group, 2013). Based on these data, the NPD Group releases monthly and annual reports to subscribers concerning video game sales. Both of these data sources provided almost identical sales information from overlapping years ($r = .92$) and sales data were averaged for overlapping years. Annual sales figures were then adjusted for inflation, and annual population counts from the United States were used to derive the amount of money spent on video game merchandise per 100,000 individuals (Figure 1).

Violent crime rates. The Federal Bureau of Investigation's annual Uniform Crime Reports (UCRs) were used to compute annual aggravated assault and homicide rates (United States Department of Justice, 2013). The UCRs contain crime-related statistics from most law enforcement agencies located in the United States, and consist of more than 17,000 city, county, state, and federal law enforcement agencies who voluntarily submit data concerning various crimes brought to their attention. Aggravated assaults are defined as an unlawful attack on a person with the intent of inflicting severe or aggravated bodily injury and often involve the use of a weapon. Homicide counts include the willful killing of another human being and exclude deaths caused by negligence or accidents. For each violent crime, annual crime rates per 100,000 were computed between 1978 and 2011 (Figure 1).

Analytic Strategy and Results

All analyses were conducted using SPSS 21. Simple correlations revealed that annual video game sales were negatively related to aggravated assault ($r(32) = -.40, p < .05$) and homicide ($r(32) = -.84, p < .01$) rates. However, these results need to be interpreted with extreme caution, as time series often contain a considerable amount of autocorrelation, indicating that an observation for a given period is correlated with past periods (Sadler, Ethier, Gunn, Duong, & Woody, 2009; Warner, 1998). Autocorrelations and trends were removed from each time series using the Box–Jenkins approach to fit time-series data to an autoregressive integrated moving average (ARIMA) statistical model (Box, Jenkins, & Reinsel, 2008).

ARIMA models are a popular technique for dealing with time-series data and have been used in numerous research studies across various disciplines. For each time series, an ARIMA model is created by identifying autocorrelations and trends in the data. This model is then used to estimate the parameters for a given time series. By applying resulting ARIMA models to each time series, a set of residuals for each series can be generated, which are free of trends, cycles, and autocorrelations (a process called prewhitening; West & Hepworth, 1991).

The removal of trends is especially important; otherwise, a spurious relationship may be found between two time series simply because they share similar (or opposite) trends. For example, video game sales have tended to become more popular across these 36 years, whereas crime (especially homicide) has tended to decrease during this period (Figure 1). Stronger evidence of the link between video game sales and violent crime would be provided if deviations from these trends were related to each other. To examine this possibility, the residuals from each of the time series were related to each other using the cross-correlation function (CCF). The CCF allows comparisons at the same time point in both series (concurrent effect) and up to a specific number of lagged periods (see Warner, 1998 and West & Hepworth, 1991, for additional information).

Based on autocorrelation and partial correlation functions, it was found that both annual reports of video game sales and aggravated assault were fit by an ARIMA (2,1,0) model, and an ARIMA (1,1,0) model was adequate to fit annual homicide rates (for additional information about ARIMA models, see Box et al., 2008). Ljung–Box Q tests for white-noise residuals revealed that when this model was applied to video game sales (Ljung–Box Q at lag 10 = 5.43, $P = .86$), aggravated assault rates (Ljung–Box Q at lag 10 = 7.86, $P = .64$), and homicide (Ljung–Box Q at lag 10 = 7.59, $P = .70$) rates, there were nonsignificant autocorrelations among the residuals. The ARIMA residuals for video game sales were then cross-correlated with the residuals for the crime assessments both concurrently and up to a 4-year lag. As seen in Figure 2, violent annual video game sales were unrelated to concurrent rates of ag-

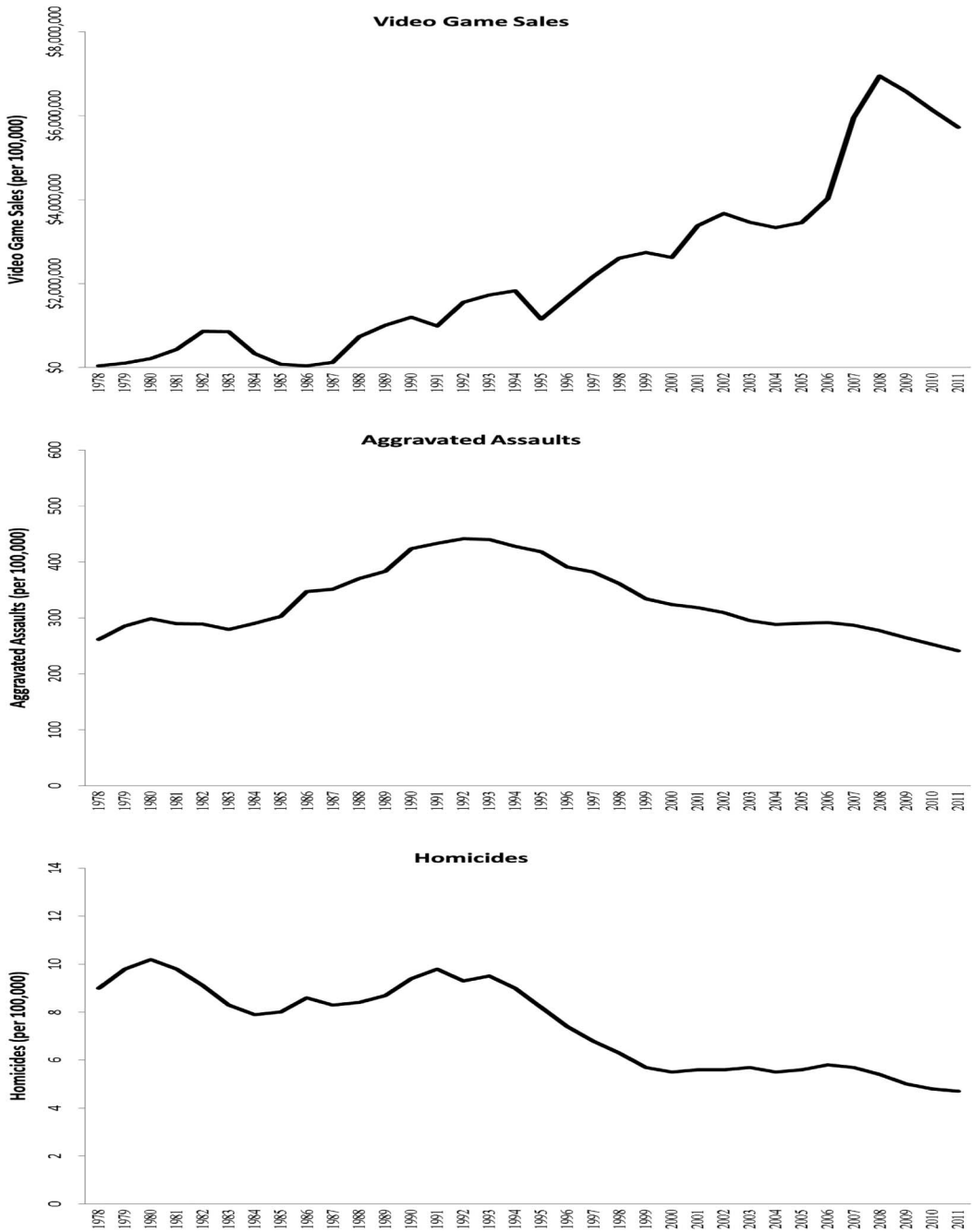


Figure 1. Annual changes in video game sales and violent crime between 1978 and 2011.

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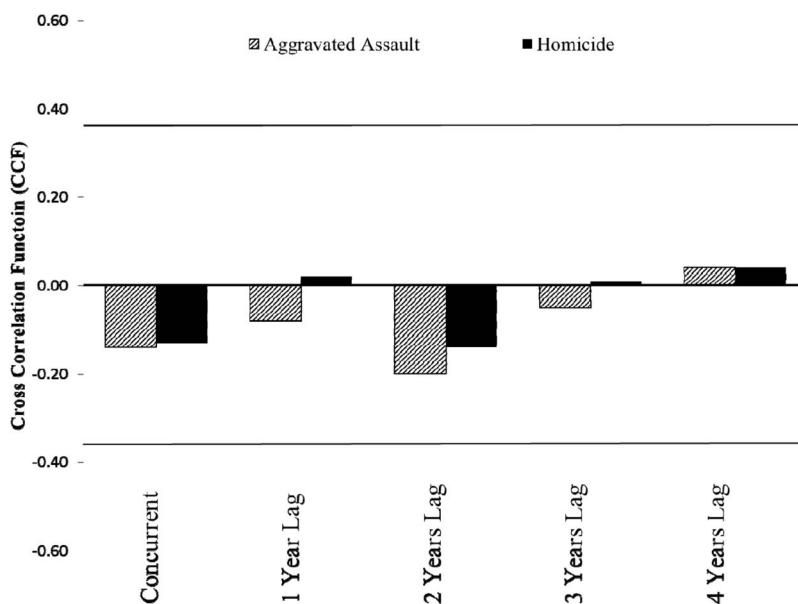


Figure 2. Cross-correlations between annual video game sales and violent crime. *Note.* The horizontal lines represent the 95% confidence interval under the null hypothesis.

gravated assaults and homicides and remained unrelated up to 4 years later.

Analysis Two: Monthly Changes in Video Games and Violent Crime: 2007 to 2011

Results from the previous analysis revealed no link between changes in annual video game sales and changes in serious and deadly assaults across 33 years. However, it is possible that rather than affecting violent behavior years later, the negative effects of violent video games are only expressed months later. Such a possibility is consistent with one large-scale meta-analysis that found that, after controlling for gender, violent video games have a small but significant concurrent effect on aggressive behavior assessed in the laboratory (average $r = .14$), but this effect becomes much smaller when examined longitudinally (average $r = .07$; Anderson et al., 2010). To investigate the possibility that the negative effects of violent video games express themselves quickly, the second analysis examined *monthly* video game sales and *monthly* reports of aggravated assault and homicide between 2007 and 2011.

Method

Data and sources.

Monthly video game sales. Monthly video game sales data were provided by the NPD Group. For the current analyses, the NPD Group provided monthly sales data between January 2007 and December 2011. Monthly sales were adjusted for inflation, and yearly population counts were then used to derive the monthly amount of money spent on video game merchandise per 100,000 individuals (Figure 3).

Monthly crime rates. The UCRs were used to compute monthly aggravated assault and homicide rates between January 2007 and December 2011 (Figure 3). Because the current analysis focused on monthly reports of violent crime only, law enforcement agencies that consistently provided monthly crime statistics for a given year were included in the analyses.

Analytic Strategy and Results

Simple correlations revealed that monthly video game sales were negatively related to aggravated assault rates ($r(58) = -.45, p < .01$) and were unrelated to homicide rates

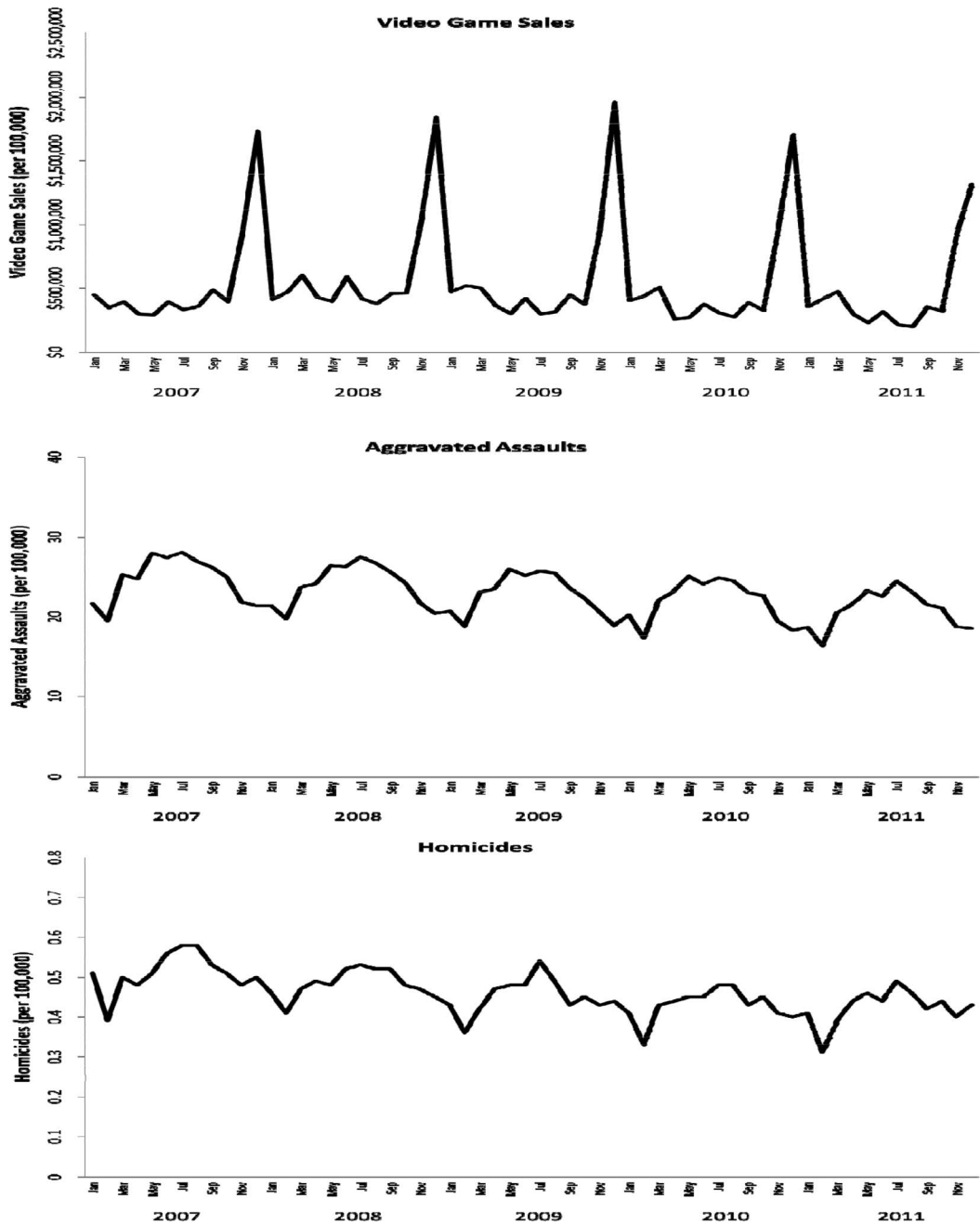


Figure 3. Monthly changes in video game sales and violent crime between 2007 and 2011.

($r(58) = -.15, p = .25$). However, as before, owing to the trends and dependency contained within these time series, these findings need to be interpreted with caution. Because monthly

reports of video game sales and violent crime follow a seasonal pattern (Figure 3), the seasonal ARIMA (SARIMA) extension was used (Box et al., 2008). SARIMA models are able to

deal with a time series that possesses a seasonal component that repeats every s observations (e.g., every 12 months). The removal of seasonal trends is especially important if two time series share similar (or opposite) cycles. For example, video game sales peak during the winter (around December), whereas violent crime increase during the warm months (as predicted by the heat hypothesis; Anderson et al., 1997). Similar to the previous analysis, each time series was prewhitened to remove trends, cycles, and autocorrelations. The residuals from these time series were then related to each other using the CCF both concurrently and up to 4 months later.

Using the autocorrelation and partial correlation functions, game sales could be fit with the seasonal model SARIMA (0,1,0)(0,1,1)₁₂. Aggravated assault required two additional autoregressive terms (SARIMA [2,1,0][0,1,1]₁₂), and homicide required four autoregressive terms (SARIMA [4,1,0][0,1,1]₁₂) to achieve adequate fit and remove trends and cycles in the data (for additional information about SARIMA models, see Box et al., 2008). Ljung–Box Q tests for white-noise residuals revealed that when this seasonal model was applied to video game sales (Ljung–Box Q at lag 12 = 4.19, $p = .98$),

aggravated assault rates (Ljung–Box Q at lag 12 = 6.95, $p = .86$), and homicide rates (Ljung–Box Q at lag 12 = 9.52, $p = .66$), there were nonsignificant autocorrelations among the residuals. The SARIMA residuals for video game sales were then cross-correlated with the residuals for the crime assessments both concurrently and up to a 4-mo lag. As seen in Figure 4, a negative relationship was found between video game sales and concurrent rates of aggravated assault ($r = -.39$). There were no significant lagged correlations, indicating that monthly video game sales were unrelated to monthly rates of assaults and homicide up to 4 months later.

Analysis Three: Keyword Searchers for Violent Video Games and Violent Crime: 2004 to 2011

Although the majority of video games contain some form of violence (Gentile, 2009; Thompson & Haninger, 2001; Thompson et al., 2006), Analysis Three examined the possibility that only extremely violent and realistic video games affect serious forms of violent behavior. The current analysis focused solely on popular M-rated video games, which contain graphic

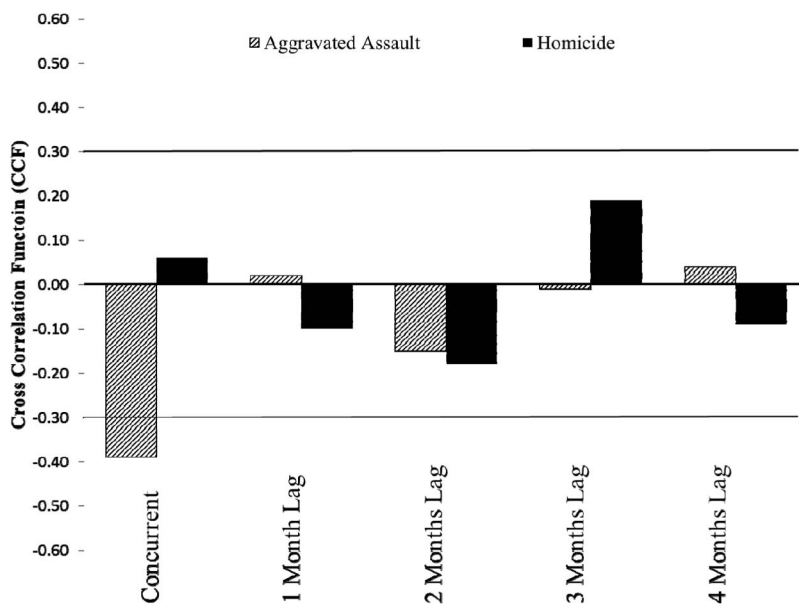


Figure 4. Cross-correlations between monthly video game sales and violent crime. *Note.* The horizontal lines represent the 95% confidence interval under the null hypothesis.

and realistic forms of violence. Additionally, instead of examining the sales of video games, Analysis Three used a different assessment of game play.

One way to assess when individuals are playing a specific game is to examine behaviors that are related to this activity. When playing video games, players often use “walkthroughs” or strategy guides to augment their play experience. Before the popularity of the Internet, retail sales of the strategy guides for specific games frequently sold more than 1 million copies (Snider, 2004). However, since the Internet has become popular and widely accessible, a simple search using Google allows players to quickly find these guides online. Such walkthroughs and game guides are available on various Web sites, one of the most popular being the CBS Interactive-owned “GameFaq.” (Alexa, 2013). To estimate when a large group of individuals are playing violent video games, Analysis Three examined the Internet searches for walkthroughs and game guides for popular M-rated violent video games between 2004 and 2011.

The current analysis investigated Internet keyword searches via the popular search engine Google. Using this service, a person might type the words “walkthrough Grand Theft Auto” or “gamefaqs Grand Theft Auto” into Google’s search engine when attempting to find a walkthrough or game guide to assist him or her with playing this video game. For example, Figure 5 displays the frequency of searches for the term

“walkthrough Grand Theft Auto” during the first year *Grand Theft Auto IV* was released. As would be expected, searches for this keyword phrase peaked in May following the release of the game on April 29, 2008. If playing the video game *Grand Theft Auto* contributed to violent crime, it seems likely a similar increase in crime would have also occurred around May. Past researchers have successfully used Internet keyword searches to examine interest in a wide variety of topics, including seasonal affect disorder (Yang, Huang, Peng, & Tsai, 2010), dieting (Markey & Markey, 2013), suicide (McCarthy, 2010), pornography searches (Markey & Markey, 2010a, 2011), and even to track H1N1 outbreaks (Ginsberg et al., 2009). In a similar manner, Analysis Three examined whether there was a link among keyword searches for violent video game walkthroughs and game guides and concurrent and future rates of aggravated assault and homicide.

Method

Data and sources.

Keyword searches for violent video game walkthroughs and guides. Google Trends was used to determine how often individuals searched for walkthroughs and game guides of popular violent video games between January 2004 (the earliest time point data were available) and December 2011. Violent video game searches included the keywords “walkthrough”

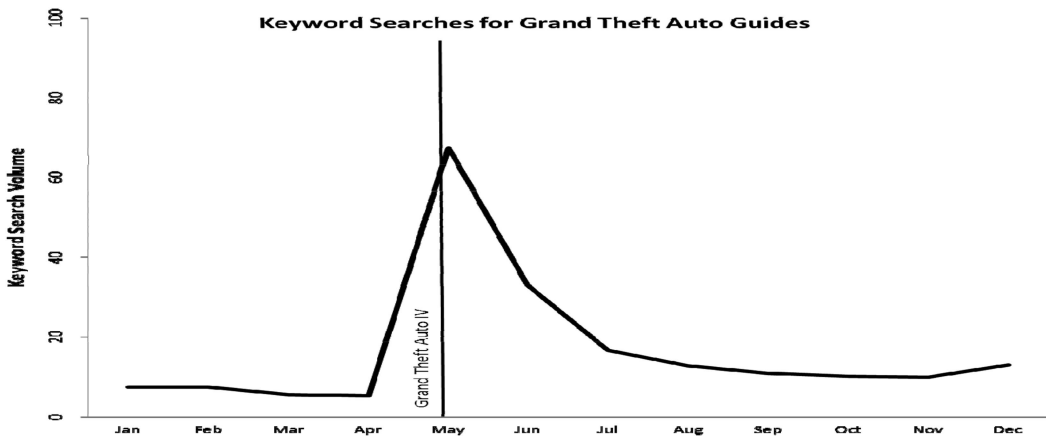


Figure 5. Internet keyword searches for *Grand Theft Auto* guides following the release of the *Grand Theft Auto IV* on April 29, 2008.

or “gamefaqs” along with the name of popular M-rated violent video games sold within this period (e.g., *Call of Duty*, *Grand Theft Auto*, *Gears of War*, *Halo*, etc.). For example, a user who searched for “walkthrough of Halo” would be included in this analysis, but a user who only searched for “Halo” or “walkthrough” would be excluded. Google Trends examines Google Web searches to determine how many searches for the given set of keywords had been conducted in a given week relative to the average number of searches on Google for those keywords over the entire observed period. Search data were standardized by dividing the search volume for each period by the greatest search volume and multiplying by 100. In this range, a value of 100 would indicate the period with the greatest overall searches for a set of keywords. A period with half of the keyword searches as the highest period would receive a value of 50, and so forth (Google, 2013). Weekly reports were then aggregated to estimate the volume of Internet searches for walkthroughs and game guides of violent video games that occurred each month between January 2004 and December 2011 (Figure 6).

Monthly crime rates. Violent crime statistics from the UCRs were used to compute monthly violent crime rates for aggravated assault and homicide. In the current analyses, monthly reports were collected between January 2003 and December 2011 (Figure 6).

Analytic Strategy and Results

Searches for violent video game walkthroughs and guides were negatively related to aggravated assault ($r(94) = -.31, p < .01$) and were unrelated to homicide ($r(94) = -.12, p = .27$). SARIMA models were used to prewhiten each time series. Using autocorrelation and partial correlation functions, it was found that keyword searches for violent video game guides and tips fit a SARIMA (1,0,0)(0,1,1)₁₂ model, and both aggravated assault and homicide time series were fit by the same seasonal models used in the previous analysis. Ljung–Box Q tests for white-noise residuals further revealed that when these models were applied to keyword searches (Ljung–Box Q at lag 12 = 9.49, $p = .66$), aggravated assault (Ljung–Box Q at lag 12 = 10.00, $p = .61$), and homicide (Ljung–Box Q at lag 12 = 8.15, $p = .83$), it produced nonsignif-

icant autocorrelations among the residuals. The residuals of these time series were then related to each other using CCF concurrently and up to 4 months later. As seen in Figure 7, keyword searches for violent video game walkthroughs and guides were negatively related to both aggravated assaults ($r = -.22$) and homicides ($r = -.22$) 2 months later. None of the other lags produced significant relations between keyword searches for violent video walkthroughs and guides, aggravated assaults, or homicides.

Analysis Four: Violent Crime Following the Release of Three Popular Violent Video Games

Video game releases are similar to movie releases in that the majority of the public consumes the product when it is first released. The violent first person shooter, *Call of Duty: Black Ops*, earned \$360 million the first day it was released, \$650 million within the next 4 days, and more than \$1 billion in sales by 41 days (Associated Press, 2010). These impressive sales are not limited to this single game. For example, between 2003 and 2011, three of the most popular M-rated violent video games (*Grand Theft Auto: San Andreas*, *Grand Theft Auto IV*, and *Call of Duty Black Ops*) combined earned more than \$3.5 billion in sales. Given the violent content of these games and their popularity, the media, lawmakers, and researchers have linked *Call of Duty* and *Grand Theft Auto* to serious acts of violence in the real world. Some have implied that *Call of Duty* was a causal factor in numerous mass shootings, including the 2011 Norway attacks, the Sandy Hook Elementary School shooting in 2012, the Toulouse and Montauban shootings in 2012, and the Washington Navy Yard shootings in 2013 (Bushman, 2013; Smeltz, 2012). *Grand Theft Auto* has been associated with both general trends in violence and specific violent crimes, including the arrests of William and Josh Buckner in 2003 for homicide; Devin Moore in 2003 for first-degree murder; Cody Posey in 2004 for homicide; Ryan Chinnery in 2008 for rape and grievous bodily harm; Stephen Attard, Samuel Philip, Dylan Laired, and Jaspreet Singh in 2008 for various robberies and assaults; and Zachary Burgess, only 4 days after the release of *Grand Theft Auto IV*, in 2013 for vehicle theft and kidnapping (cf., Crowley, 2008; Newcomb, 2013).

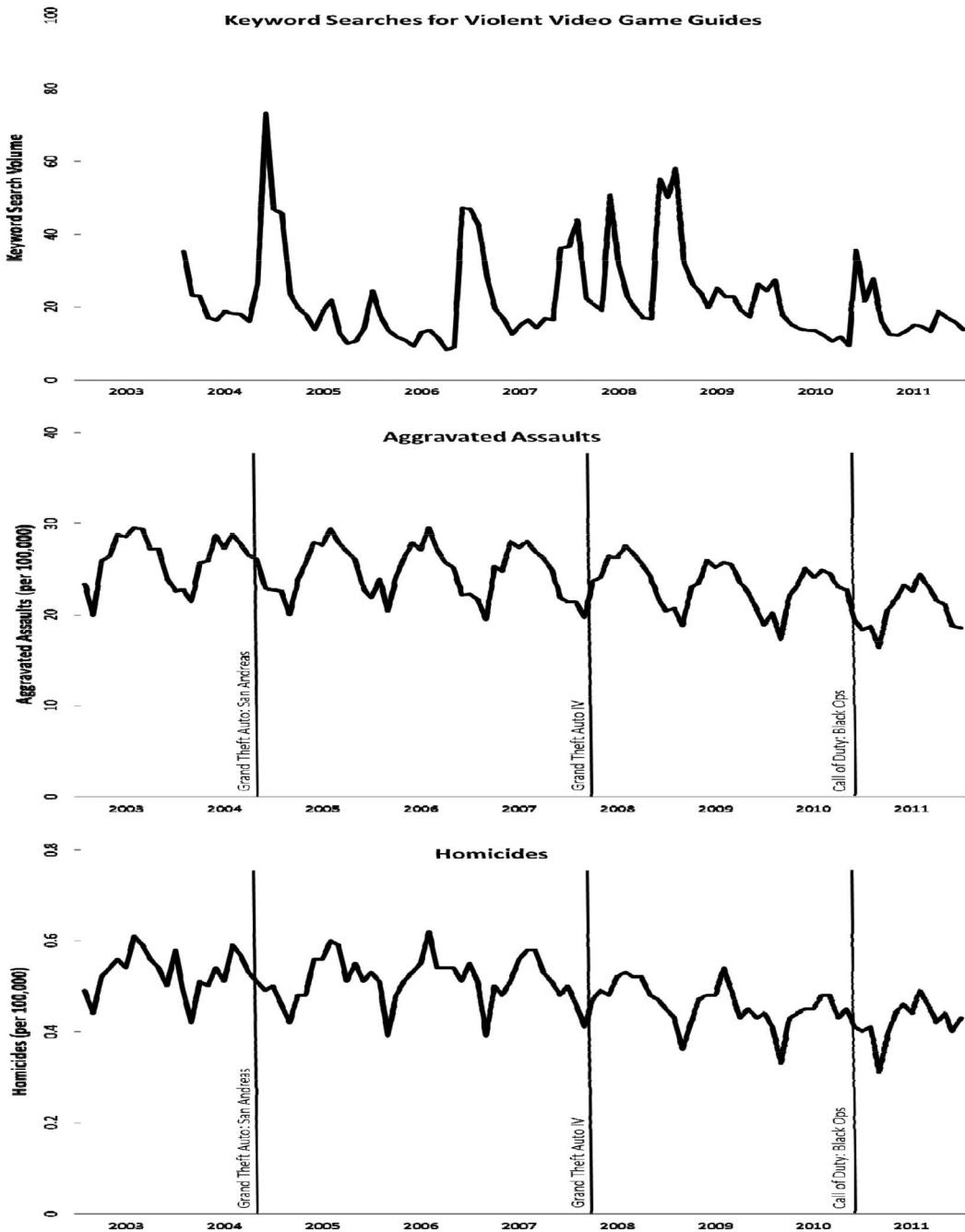


Figure 6. Monthly changes in searches for violent video game guides and violent crime between 2003 and 2011.

If violent video games are causes of serious violent crimes, it seems probable that serious and deadly assaults would increase following the release of these three popular violent video

games. To examine this hypothesis, the final analysis used an interrupted time-series analysis. Such a methodology has been used in the past to examine numerous health and social

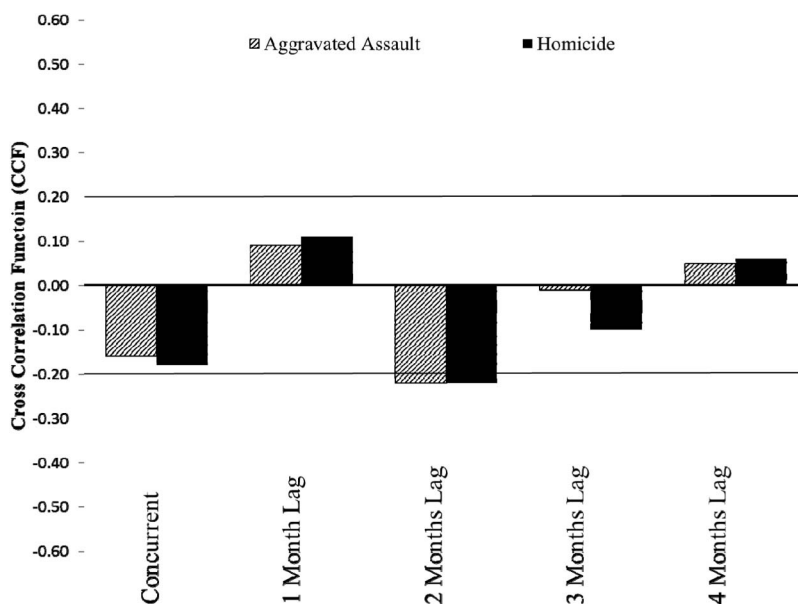


Figure 7. Cross-correlations between searches for violent video game guides and violent crime. Note. The horizontal lines represent the 95% confidence interval under the null hypothesis.

issues and is among the strongest, quasi-experiment design available to evaluate longitudinal effects of “real world” outcomes (Wagner, Soumerai, Zhang, & Ross-Degnan, 2002). It is predicted that following the release of these extremely popular violent video games, there will be an increase in aggravated assaults and homicides. Because the duration of this effect is unknown, increases in violent crime will be examined for continuous periods of 1 to 12 months after the release of these violent video games.

Method

Data and sources.

Release dates of popular violent video games. The North American release dates of *Grand Theft Auto: San Andreas*, *Grand Theft Auto IV*, and *Call of Duty: Black Ops* were obtained from each game’s publisher (Figure 6). These three video games were selected because they were among the top-selling M-rated video games during the period examined and owing to their frequently discussed links with violent criminal behavior (cf., Bushman, 2013; Crowley, 2008; Newcomb, 2013; Smeltz, 2012).

Monthly crime rates. UCR crime statistics from the previous analysis were used to compute monthly violent crime rates for aggravated assault and homicide between January 2003 and December 2011 (Figure 6).

Analytic Strategy and Results

Interrupted time-series analyses were computed to compare violent crime before and after the release of three popular violent video games. In the current analysis, the violent crime rates following the release of *Grand Theft Auto: San Andreas*, *Grand Theft Auto IV*, and *Call of Duty: Black Ops* were examined to determine whether these games were related to changes in aggravated assaults and homicides. Specifically, monthly changes in violent crime were examined for continuous periods of 1 to 12 months after the release of these violent video games. This methodology provides insight into whether the release of these violent video games predicted violent crime over and above the prediction derived from understanding the trends and cycles of violent crime, 1 to 12 months after these games were released.

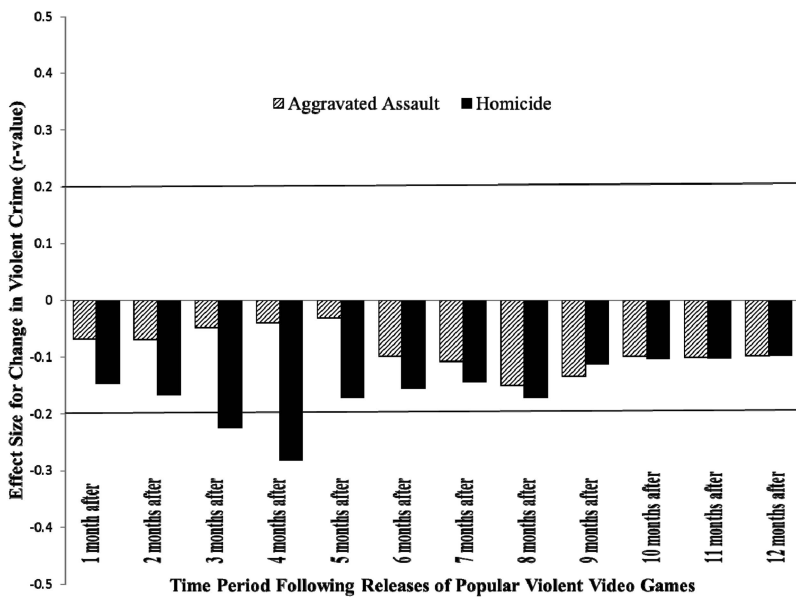


Figure 8. Changes in aggravated assault and homicide rates following the release of three popular violent video games. *Note.* The horizontal lines represent the 95% confidence interval under the null hypothesis.

The same SARIMA models used in Analysis Three were again used to eliminate trends, cycles, and autocorrelated errors in each time series. Binary dummy variables were then used to model pulse effects on violent crime for continuous periods of 1 to 12 months after the release of these violent video games. Ljung–Box Q statistics at a lag of 12 revealed nonsignificant autocorrelations among the residuals for each of the 24 analyses (12 for aggravated assault and 12 for homicide). The resulting *t* tests for the pulse effects of each period were transformed to *r*-values to provide assessments of effect sizes. As can be seen in Figure 8, aggravated assault rates tended to show a decrease following the release of these three violent video games, but this change failed to reach significance. Homicides also decreased after these violent video games were released and displayed significant decreases 3 and 4 months following the release of these games.

Discussion

Laboratory and correlational studies suggest violent video games are a causal risk factor for increased aggressive cognition, aggressive af-

fect, and aggressive behavior (Anderson & Bushman, 2001; Anderson et al., 2010; Ferguson, 2007; Sherry, 2001). Based on the results from these studies, the media, lawmakers, and researchers have linked violent video games to serious forms of violent behavior, including aggravated assaults and homicides. The current study sought to examine whether such studies, which tend to examine mundane forms of aggression (e.g., giving an unpleasant noise or too much hot sauce to another person), generalize to serious and deadly assaults reported in the real world. Crime data provided by the FBI for the past 30 years along with sales of video games, Internet keyword searches for violent video game guides, and release dates of popular violent video games were examined annually and monthly using large-scale time-series data analytic techniques (e.g., ARIMA, SARIMA, interrupted time designs, CCFs, etc.). Concurrent effects of violent video games and lagged effects lasting months and years were considered.

Contrary to the claims that violent video games are linked to aggressive assaults and homicides, no evidence was found to suggest that this medium was a major (or minor) contributing cause of violence in the United States.

Annual trends in video game sales for the past 33 years were unrelated to violent crime both concurrently and up to 4 years later. Unexpectedly, monthly sales of video games were related to concurrent *decreases* in aggravated assaults and were unrelated to homicides. Searches for violent video game walkthroughs and guides were also related to *decreases* in aggravated assaults and homicides 2 months later. Finally, homicides tended to *decrease* in the months following the release of popular M-rated violent video games.

The findings that violent crime was more likely to show decreases instead of increases in response to violent video games were contrary to what was expected. One possible explanation for this reduction in violence is that playing violent video games leads to a catharsis. In other words, when people play violent video games, they are able to release their aggression in the virtual world instead of in the real world. Consistent with this notion, adolescent boys tend to report feeling less angry after playing violent video games, and even actively select to use this medium to control their aggression (Olson, Kutner, & Warner, 2008). However, other researchers have found little evidence to suggest that venting one's anger on a safe target actually reduces aggression (cf. Bushman, 2002).

A more parsimonious and less contentious explanation than the catharsis effect focuses on the qualities and desires of people who are innately predisposed to violent behavior (cf., Ferguson et al., 2008; Pinker, 2002). Individuals who are prone to aggression and violence tend to seek out violent media, like video games, to provide them with models that express behaviors and desires consistent with their own innate motivational system (Markey, in press; Surette, 2012). When violent games, like *Grand Theft Auto* or *Call of Duty*, are released, these aggressive individuals likely spend time playing these video games. Such a behavior effectively removes these individuals from the streets or other social venues where they might have otherwise committed a violent act. In other words, because violent individuals are playing violent video games in their homes, there may be a decrease in violent crime when popular violent video games are released.

The results from this study should be considered within the context of the methodological limitations of this study. Given both the number

of analyses conducted and the unexpected direction of the results in the current study, researchers should examine whether these results generalize to future periods and other geographic regions. Additionally, although theories of video game violence operate at the level of the individual, data for the current study were collected at the aggregate level. Owing to this ecological fallacy, caution is warranted when attempting to draw causal relations between these variables, as trends sometimes become altered when subpopulations are aggregated (i. e., Simpson's paradox; Wagner, 1982). However, even with this concern, prominent video game researchers have argued that theories framed at the individual level can translate into concrete empirical predications at the aggregate level (Anderson et al., 1997). Consistent with this notion, it was predicted that years or months when many individuals were exposed to violent video games would yield relatively high serious and deadly assault rates. Such an empirical prediction is falsifiable, constituting "a legitimate test of the theory despite its cross-level nature" (Anderson et al., 1997, p. 1221).

This research is also limited because it only examined a single risk factor for violent behavior—violent video games. Researchers have often adopted a risk factor approach when discussing the negative effects of violent video games. This approach acknowledges there are many risk factors for violent crime. Each factor may elevate the risk for violent behavior, and with enough risk factors present, it becomes likely a person will act violently (Anderson, Gentile, & Buckley, 2007). No scientist has suggested violent video games are the only cause of violent behavior, just as no scientist has suggested that heat is the only cause of violent crime or smoking is the only cause of lung cancer. Of course, risk factors like heat and smoking are strong enough that when it becomes hotter, there is a significant increase in violent crime (Anderson et al., 1997), and as more people have stopped smoking, there has been a dramatic decrease in lung cancer rates (Centers for Disease Control and Prevention, 2013). Such a pattern does not exist for violent video games. As more people have been exposed to violent video games, serious and deadly assaults have not increased. It appears that any adverse effects violent video games have on serious violent behavior are either non-

existent or they are dwarfed by the effects of other factors that make the effects of violent video games appear nonexistent.

The rhetoric used by some in generalizing the findings of research conducted primarily in laboratories and with questionnaires to serious and deadly assaults appears to be unfounded. The current study found no evidence that violent video games are contributing to the high rate of violence in the United States (Anderson, 2000) or that controlling the use of violent video games would protect our society from violent crime (Bushman, 2013). The effect of violent video games on public safety does not appear to be equivalent to the effect of smoking on lung cancer (Bushman & Anderson, 2001). Although video games might “affect people,” it is unlikely they are a bigger problem than guns (Linkins, 2013). If video games are really the equivalent of flight simulators training people to kill (Bushman, 2008; Gentile & Anderson, 2003; Grossman, 1998), it is difficult to explain why homicide rates would go down after millions of these “murder simulators” have been sold. When the media, politicians, or researchers link the murderous rampages of male adolescents with violent video games, they are conveying a classic illusory correlation (Ferguson, 2013). These individuals are ignoring that 90% of young males play video games (Lenhart, 2008). Finding that a young man who committed a violent crime also played a popular video game, such as *Call of Duty*, *Halo*, or *Grand Theft Auto*, is as pointless as pointing out that the criminal also wore socks. The rhetoric about violent video games does not match the data.

It is important to note that in no way does this conclusion imply previous research examining violent video games is unimportant. There is ample evidence that violent video games do increase aggressive cognition, aggressive affect, and some aggressive behaviors. It is possible that although violent video games are not related to severe forms of violence, they may affect other types of less aggressive behaviors, such as bullying, spreading gossip, minor fights at school, pushing and shoving, or hurling insults. This study also does not provide insight into whether certain subpopulations are adversely affected by violent video games. Although research has been mixed on this issue (Ferguson & Olson, 2014), it is possible that violent video games adversely affect only some

individuals, and those who are affected have preexisting dispositions (e.g., high levels of psychoticism, anger, etc.), which make them susceptible to such violent media (Markey & Markey, 2010b; Markey & Scherer, 2009). Finally, the current research does not address how exposure to violent video games at a young age might affect later adult behavior. As scientists, we can reflect about such a relationship based on available research, but we need to be upfront that this is only supposition. We need to be clear with our peers and the general audience about the claims we make that are backed up by research and those that are speculation. In short, as scientists, we need to be careful that we do not blur the line between our scientific results and our scientific conjecture.

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