Examining homicides and suicides cross-nationally: Economic factors, guns and video games

Christopher J. Ferguson and Sven Smith

Department of Psychology, Stetson University, DeLand, FL, USA

*U*nderstanding why different nations have different homicide and suicide rates has been of interest to scholars, policy makers and the general public for years. Multiple theories have been offered, related to the economy, presence of guns and even exposure to violence in video games. In the current study, several factors were considered in combination across a sample of 92 countries. These included income inequality (Gini index), Human Capital Index (education and employment), per capita gun ownership and per capita expenditure on video games. Results suggest that economic factors primarily were related to homicide and suicide cross-nationally. Video game consumption was not a major indicative factor (other than a small negative relationship with homicides). More surprisingly, per capita gun ownership was not an indicator factor cross-nationally. The results suggest that a focus on economic factors and income inequality are most likely to bear fruit regarding reduction of violence and suicide.

Keywords: Homicide; Suicide; Income inequality; Gun ownership; Video games.

While there are many geopolitical aspects to crime in terms of what specific acts constitute a "crime," it is generally agreed upon across cultures that violent crimes involving the death of an individual are serious violations of morality. However, there is little scholarly consensus on the significant factors playing a role in the development of violent criminals. Some point to violent video games as having a strong relationship with aggressive conduct (Anderson et al., 2008). Others have suggested that access to guns may predict violent outcomes (Cook & Ludwig, 2006; Moore & Bergner, 2016). There are also those that claim that while neither of these necessarily creates a more violent population, they may serve to exacerbate—that video games may trigger aggression in individuals already exhibiting anger problems (Giumetti & Markey, 2007; Kirsh, 1998; Markey & Scherer, 2009) or that guns may encourage those who would not commit an attack otherwise (Altheimer, 2010). But these issues are complex: there is further research that finds no effect on violence from video games (Durkin & Barber, 2002; Kutner & Olson, 2008; Unsworth et al., 2007), or that guns actually reduce the likelihood for violent crime (Lott, 2000). Instead, these studies point to social structures such as poverty as the main indicator of such activity (Brown & Males, 2011; Hannon & DeFina, 2005).

With so much tension in the literature surrounding what factors play a role in the development of violent actors, we explore the links between each of these three potential risk areas to determine which may have significant practical relationships to crime.

Guns and violence

For nearly four decades, one of the most contested issues in criminology has been the ongoing debate around the potentially causal relationship between gun ownership and violent crime. On one side, there is an argument that access to firearms increases the risk of crime (Altheimer, 2010; Cook & Ludwig, 2006; Moore & Bergner, 2016); others argue that firearm prevalence reduces the risk (Kleck, 1997; Lott, 2000). While many empirical studies have been conducted on this link, that research is methodologically difficult for several reasons. First, there is a lack of reliable data for cross-country comparisons. Official gun ownership statistics may possess significant "dark numbers," that is, to say poor record-keeping and unknown, unregistered ownership and the statistics on numbers of violent crimes committed are known to be heavily influenced by different reporting and recording practices (Van Dijk, 2008). Second, the

data used often comes from relatively small populations, which limits the generalizability of the results. While many studies have been conducted using data from the United States, the dynamics of guns and violence in the United States are not necessarily representative of the rest of the world.

Arguments that firearms reduce the risk of crime typically centre on the weapon substitution hypothesis; this states that the use of a gun may reflect an aggressor's greater motivation to harm a victim and in the absence of which they would choose another weapon to achieve this desired outcome (Wolfgang, 1958). This idea has been influential in academic research. Scholars have proposed that increased gun ownership would be the most cost-effective method to deal with crime (Lott & Mustard, 1997), as aggressors may refrain from committing crime due to fear of violent retaliation (Kleck, 1997). This may be a specific deterrent, such as in an instance where an offender refrains from attempting future attacks after being confronted by an armed victim, or a general deterrent, by shifting the balance of power to potential victims because the aggressor believes they may be armed (Rengert & Wasilchick, 1985; Tark & Kleck, 2004).

However, Wolfgang's theory has frequently been contested on multiple fronts. The weapon instrumentality hypothesis surmises that the presence of a gun during an assault or robbery makes it easier to inflict injury at long distances or to multiple victims, increasing the likelihood of death or serious injury to occur (Cook, 1991). Additional study of this hypothesis for the 200 largest counties in the United States suggested that while violent crimes such as rape and assault did not correlate to firearm prevalence, a reduction in firearm prevalence could reduce the homicide rate (Cook & Ludwig, 2006). A later study accounting for data from over 1000 U.S. counties then suggested that in addition to homicide, the rates of rape, assault and robbery increase as firearm prevalence increases (Moore & Bergner, 2016).

Weapon substitution theory implies that aggressors are always determined to cause physical harm to others, which may not be the case from a macro perspective. The facilitation hypothesis states that because guns reduce the likelihood of a physical attack being necessary and enhance the power of a potential aggressor, gun availability may encourage those who would not normally commit an attack (Altheimer, 2010).

The facilitation hypothesis may also explain the link between gun ownership and femicide. A study comparing female homicide victimisation in 25 high-income countries found that while the United States, which had the highest level of household firearm ownership, accounted for only 32% of the total female population but 70% of female homicide victims and 84% of female firearm homicides in the survey group (Hemenway et al., 2002).

However, a majority of the studies conducted thus far have focused on industrialised western countries and considerable variation can be found on gun use and legislation even within a surveyed population. One study comparing data from metro, suburban and rural counties in the United States determined that firearm prevalence may predict the number of homicides in metro areas but is not predictive in other environments (Moore, 2017).

The International Crime Victim Survey, conducted six times from 1989 and 2010, collected self-reported data on victimisation and gun ownership and may be the most comprehensive attempt to gather cross-national data on the subject, with results from over 80 countries. This allowed for analysis of the links between the two at both the individual level and the aggregate level of countries. One multilevel analysis of the ICVS found a positive relationship between gun ownership and serious violence, but also noted that higher levels of ownership appeared to diminish an individual's risk of less serious violence such as property crime (Van Kesteren, 2014). A cross-national comparison of 171 countries analysing the distribution of mass shooters over a 56-year period to homicide, suicide and gun ownership rates suggested a link between gun availability but not overall homicide or suicide (Lankford, 2016). While results on the link between guns and overall violent crime are certainly mixed, they have broadly suggested that gun availability facilitates more serious types of violence such as homicide, which is in line with the situational crime prevention theory stating that levels of crime are determined by available opportunities.

One last theory is worth mentioning and, that is, the *weapons effect* theory (Berkowitz & Lepage, 1967). This theory, briefly, states that the mere presence of a weapon such as a firearm may increase aggressive responses. This theory has been controversial, with recent evidence for it appearing to be weak (Benjamin et al., 2018). As such, it appears unlikely that the *mere presence* of a weapon increases aggressive behaviour as was once thought.

Poverty and violence

There is a tendency, particularly in public media, to blame individual actors for violent crime rather than social structures such as poverty. Some scholars have indeed agreed that there is no empirical evidence to support the hypothesis that conditions of poverty cause conflict, stating that pervasive poverty is not a sufficient condition in and of itself to drive individuals or even entire nations to acts of violence (Von Hippel, 2002). In support of this theory, a study on poverty clustering found little evidence of a direct relationship to murder, rape, robbery, or assault in high poverty districts (Stretesky et al., 2006) even though impoverished people have been shown to be more exposed to crimes at home (Larsson, 2006).

However, it is well established in the literature that poverty contributes to feelings of alienation and exploitation (Sampson et al., 1997; Sen, 2008) that a sense of social deprivation has a strong correlation to lethal violence (Wu, 2003) and that the poorest citizens in a society are more likely to live outside the legal framework of that society (DeSoto, 1989; Justino, 2009). In fact, while the previously mentioned study on poverty clustering found little connection to violent crime rates within poverty clusters themselves, there was a strong relationship to homicide in cities with high levels of poverty clustering (Stretesky et al., 2006). And while there remains those scholars that argue there is no evidence to support that poverty alone causes conflict, other studies have found strong correlations between poverty and violent crime rates regardless of other factors such as age (Brown & Males, 2011) or race (Hannon & DeFina, 2005).

Poverty may be understood in multiple ways. One can be *income inequality* where in individuals perceive poverty relative to the wealthiest and least wealthy individuals in their community and the size of the gap between them. This can be measured by the Gini index, named after the sociologist who, in the early twentieth century, developed the relevant calculations. Data suggests that income inequality is a strong predictor of violent crime and, cross-nationally, explains away previous theories that hot weather was a predictor of crime (Coccia, 2017).

Poverty can also be understood through the concept of human capital, essentially involving education attainment and employment. Low educational attainment has long been understood to be a predictor of crime, though most data are within-community rather than cross-national (Rossegger et al., 2009). Likewise, unemployment is associated with crime, though relationships are often context-specific and complex (Andresen, 2013). As such, consideration of these variables can be valuable in understanding violent crime rates cross-nationally.

Video games and violence

There are currently three main theories regarding a potential correlation between video games and aggression. The first, relating back to Bandura's social learning theory (Bandura et al., 1961, 1963), is that playing video games influences the learning process (Anderson et al., 2008). While Bandura's research occurred before gaming reached mainstream popularity and did not discuss video games, it did propose that mere exposure to aggressive models of behaviour encouraged aggression in youth. Therefore, much of the research following this line of thinking has focused on the empirical strength of Bandura's thesis and whether it can be extended to violent media (Anderson, 2004; Huesmann, 2007). Many studies, particularly from the early 2000s suggested

violent video games are capable of increasing a user's feelings of aggression (Eastin & Griffiths, 2006; Krcmar & Lachlan, 2009; McGloin et al., 2013). However, others have criticised Bandura's research and many researchers suggest that the evidence is not as solid as advertised to the public (Cumberbatch, 2008; Mitrofan et al., 2009; Olson, 2004; Savage, 2004). This has become increasingly the case for preregistered studies of the 2010s, which have generally not found evidence for violent game effects on aggression (e.g. Ferguson & Wang, 2019; Hilgard et al., 2019; McCarthy et al., 2016).

It also suggested that video games essentially exhibit a selection effect, with individuals with overly aggressive personality traits being attracted to violent media (Etchells et al., 2016), but that violent video games themselves do not increase real-world aggression or violence (Breuer et al., 2015). Under these circumstances there could be a correlation between video games and aggression, but the direction of causality would only move from aggressive traits to violent gameplay rather than the inverse. This line of thinking posits that more influential pressures like genetics and social forces such as family structure encourage an aggressive personality and that such a person could then be encouraged to seek out more violent forms of media (McCown et al., 1997; Rentfrow & Gosling, 2003). There is indeed some evidence that genetics may predict violent media preferences (Nikkelen et al., 2014) and that correlations between violent media use and criminal violence disappear when genetics are controlled for (Schwartz & Beaver, 2016).

Another notion is that there is little value in attempting to predict low base rate behaviours such as violent crime with a high base rate behaviour such as childhood exposure to video games and that any relationship between video game use and aggressive behaviour is spurious rather than causal. This becomes an issue of low variance for both variables. A high base rate behaviour becomes common both for people who do engage in a low base rate behaviour (e.g., committing crimes) as well as those who do not, eliminating that variable's ability to distinguish between those groups and, as such, have predictive value. This theory proposes that correlations between the two would disappear with proper control variables in place. For example, boys both play more violent video games and are more physically aggressive (Kutner & Olson, 2008), so any correlation between them could be affected by gender differences. In longitudinal studies on the effects of video game violence, it has been noted that the more careful and comprehensive the controls, the weaker the evidence of an effect (Ferguson & Wang, 2019; Furuya-Kanamori & Doi, 2016; Smith et al., 2018a, 2018b). Furthermore, evidence at the population level finds that playing violent video games is associated with reduced violent crime (Beerthuizen et al., 2017; Markey et al., 2015).

Video games, guns and poverty

While it is difficult to connect all three of these potential factors together when studying violence, research has previously been conducted around various links between them. Studies have shown that impoverished youth who have been victims of violent crime are significantly more likely to carry a gun (Spano & Bolland, 2010) and that income inequality and a lack of social trust are strongly correlated with firearm homicide (Kennedy et al., 1998). Additional research has suggested that childhood poverty is a significant predictor of Post-Traumatic Stress Disorder and Major Depressive Disorder (Nikulina et al., 2011) and that depression and other early childhood mental health symptoms can predict criminal behaviour later in life (Smith et al., 2018a, 2018b). Despite these findings, other studies have found no support for the hypothesis that youth with elevated mental health symptoms who also play violent video games are at a greater risk for delinquent behaviour (Ferguson & Olson, 2014), or that children who played shooter games as children are more susceptible to criminality later in life (Smith et al., 2018a, 2018b). However, research has suggested that participants playing games using a realistic firearm controller reported increased feelings of immersion and realism (McGloin et al., 2015). One study suggested that children who played a game with gun violence were more likely to touch a disabled handgun and hold it for longer than children playing a nonviolent game (Chang & Bushman, 2019). However, another scholar with access to the data suggested this was a fluke result from a questionable decision to eliminate several cases from the data and that when they were restored there was no relationship between game play and gun use in children (Hilgard, 2019). These various data points suggest that evolving technology will likely require additional research on each of these factors, which is one of the motivations for the present study.

We elucidate here a theoretical model of how variables related to economic factors, video games and guns are related to each other and may influence each other. First, we include two economic indicators as, though we expect them to be correlated, each taps into a different element of economic well-being and stress. Human Capital Index (HCI) and income inequality each are indicators of economic health but may function in different ways on individual well-being. These two factors need not always rise or fall in lockstep. For instance, Nordic nations and the United States both are relatively high in HCI but differ in income inequality. As noted, income inequality has been associated with violent crimes in past data, but associations between HCI and crime are less clear. Video game play may also be related to economics, given we might expect that higher HCI countries will have more disposable income to invest in leisure activities such as gaming. However, given controversies over violence in games, we might expect gaming exposure to have a *negative* influence on individual behaviour even if improved economic circumstances has a *positive* influence on behaviour. Thus, examining video games in conjunction with economic factors can help us to understand whether gaming has a *unique* predictive value in relation to behavioural outcomes, or merely functions as yet another economic indicator.

In our theory, guns may appear to be a sort of wild card related to suicides and homicides. In effect, there are two ways to approach the understanding of guns. First, as noted above, is *weapons effect theory* wherein the presence of guns should influence the *motivation* to commit violent acts of all sorts (not just homicide.) The theoretical mechanism behind weapons effects theory is a largely cognitive one. The presence of a weapon activates cognitive scripts and these scripts then become more accessible when responding to socially provocative situations. In other words, the mere presence of a weapon does not only increase the risk of homicide but, by activating cognitive scrips, makes all aggression more likely even if the weapon itself is not involved. For instance, in one study (Bushman et al., 2017), participants in a driving simulator drove more aggressively when a gun was on the seat next to them as opposed to a tennis racket. Much of this cognitive process occurs automatically and unconsciously, effectively a priming effect.

However, overall, as indicated earlier, evidence for the weapons effect has been underwhelming (Benjamin et al., 2018). There are also larger critiques of *priming* as a method of behavioural activation as priming theory as been at the centre of psychology's replication crisis (e.g. Pashler et al., 2012). These critiques fall into two lines. First, that study methodologies were seldom robust, particularly related to data analysis. As a consequence, p-hacking (when scholar run and rerun and re-rerun their analyses to get desired results, typically to achieve $p = .05$) may have been very common, resulting in a plethora of false positive results (Open Science Collaboration, 2015). A second issue is that of demand characteristics (Orne, 1962) wherein study hypotheses might be obvious and participants change their behaviour accordingly. Consider the Bushman et al. (2017) driving simulator study, for instance. How unlikely would one find it to be asked to drive a course in a simulator for an experiment only to find a gun sitting on the seat next to oneself without said gun being rather obviously important to the experiment? As such, we suspect the weapons effect theory to be insufficient to explain the role of guns in violence.

More promising, by contrast, is simply the observation that firearms represent convenient tools for converting assaults to homicides. This can be observed in United Nations data on violent crime, for instance for the United States. Compared to Europe and Anglophone countries such as New Zealand and Australia, the United States

has a fairly unremarkable per capita rate of most violent crimes including assaults and sexual assaults (indeed, the US rate is lower than most Anglophone or Francophone countries). However, the US homicide rate is much higher than these other countries. One explanation is that the widespread availability of guns in the United States is converting assaults to homicides. Yet, others may point to low-homicide rate countries such as Switzerland which has relatively high gun ownership as an exception. So, it is possible that gun ownership may be relevant, albeit in combination with other factors such as income inequality.

With these observations in mind, it appears relevant to consider multiple factors (income inequality, HCI, gun ownership and video games) in combination to elucidate which are more critical. Examining this issue cross nationally has several advantages. First, this provides a cross-cultural analysis to examine which variables are most relevant on a global scale. This is not to diminish the importance of culturally specific factors, of course. However, we do suggest that those factors that are related to outcomes cross-culturally may be particular useful to consider from a policy perspective and reduce risks of misfitting policy efforts that work in one context to another context where they do not work. Second, the cross-national perspective adds variance, such that it may be easier to see the influence of these factors with greater variability. For instance, though we naturally expect income inequality to vary between the US states, we expect more variance for income inequality between countries than between regions in any given country. As such we hope a cross-national examination will be of particular theoretical and empirical value.

The present study

To our knowledge, no study has examined the issue of cross-national indicators of homicide and suicide looking at economic factors, gun ownership and video game consumption in conjunction. As such, we sought to examine these factors using a cross-national database. Although our primary interest was in examining homicide data, we included suicide as an outcome as well, given common overlaps of these outcomes in discussion of gun policy, in particular. Even in regard to video games, some scholars have suggested they may be related to suicide, though evidence for this has been slim (Gauthier et al., 2014).

METHODS

All sources of data were compiled from publicly available sources. These sources are described below. Data sources are mainly from approximately 2017.

Homicide and suicide

Per capita homicide data were provided by the United Nations Global Study on Homicide (United Nations Office on Drugs and Crime, 2020). Per capita suicide data were provided by the World Health Organisation (WHO) Global Health Observatory data (WHO, 2017).

Video game consumption

Population data is based on the United Nations Population Division data (see worldometers.info, 2020). This information was used to calculate per capita data on video game consumption. Raw sales data across countries was obtained by We PC (2020), which provides a wide range of industry data on video games, including sales in dollars per country. Sales in dollars was divided by country population to obtain a per capita index of video game sales for each country.

Gini index

The Gini index provides an estimate of wealth dispersion within a country and estimates the gulf between the wealthiest and least wealthy citizens. This provides an estimate of relative disparities within a nation. Gini index data for each country was obtained from the World Bank (World Bank, 2020a).

Human Capital Index

The HCI provides an estimate of individual earning power within a country by considering education and employment in that country. This data is provided by the World Bank (World Bank, 2020b).

Firearms ownership

Per capital firearms ownership data was obtained from Small Arms Survey of the International Programme Council (Small Arms Survey, 2020). This data provides an estimate of civilian firearms holding per country.

Statistical analysis

All statistical analyses were done using the SPSS software programme. Each outcome (homicide, suicide) was tested using ordinary least squares (OLS) regression with pairwise deletion for missing data. Indicator variables included per capita video game consumption, Gini index, HCI and civilian firearm ownership. Examination of variable inflation factors (VIFs) revealed no evidence for multicollinearity. Highest VIFs were between video game consumption and HCI, with VIFs at about 2.3.

TABLE 1
Correlation matrix between variables

Variable	Gini	HCI	Firearms	Video games	Homicides	Homicides(log)	Suicides
Gini	1.00	−.478**	−.049	−.327**	.683**	.722**	−.231*
HCI		1.00	.245*	.709**	−.461**	−.578**	.398**
Firearms			1.00	.323**	−.036	−.049	.043
Videogames				1.00	−.283*	−.504**	.238*
Homicides					1.00	.813**	−.117
Homicides(log)						1.00	.004
Suicides							1.00

*$p < .05$. **$p < .01$.

TABLE 2
Outcomes for homicide and suicide

Indicator	Homicide(log transformed)				Suicide			
	β	B	SE	p-Value	β	B	SE	p-Value
Gini index	.572	.041	.006	<.001	−.048	−.034	.088	.696
HCI	−.164	−.704	.492	.157	.438	19.027	7.142	.010
Gun ownership	.094	.003	.003	.241	−.043	.015	.041	.710
Video games	−.230	−.006	.003	.038	−.075	−.019	.040	.635

Note: HCI = Human Capital Index.

This suggests slight collinearity, though not enough to significantly result in variable inflation for standardised regression coefficients.

RESULTS

Correlations between all variables are presented as Table 1. The dataset is available at https://osf.io/56mtr/. Output files for the main regressions are available at https://osf.io/jgntp/.

Homicide

For homicide data, complete information was available for 73 nations. The overall regression model was statistically significant ($R = .703$, $R^2_{adj} = .464$, $F(4, 68) = 16.60$, $p < .001$). Only the Gini index was a significant indicator of homicides cross-nationally ($β = .597$, $p < .001$). In the interest of full disclosure, HCI was close to statistical significance ($β = −.230$, $p = .086$). We will leave it to the reader how best to interpret such a threshold result. Neither video game consumption ($β = .066$, $p = .601$) nor firearms ownership ($β = .028$, $p = .308$) was related to homicides cross-nationally.

However, we noted that the homicide outcome variable had a high degree of skew (3.429) and particularly kurtosis (13.731). As such, we conducted a logarithmic transformation on this variable. This brought both the skew (.696) and kurtosis (−.141) to within acceptable parameters. With the transformed variable the Gini index ($β = .572$, $p < .001$) remained significant and the largest indicator of homicide. However, video games per capita was now inversely related to homicides ($β = −.230$, $p = .038$). Neither firearms ownership nor HCI were significant indicators. It is this data with the transformation presented in Table 2.

Suicide

Regarding suicide as outcome, once again the full model was statistically significant [$R = .407$, $R^2_{adj} = .120$, $F(4, 72) = 3.58$, $p = .010$]. Skew (1.065) and kurtosis (1.149) were within acceptable parameters for this variable. Data were available for 76 countries. Only HCI ($β = .438$, $p = .010$) was an indicator of cross-national suicide. Neither video game consumption ($β = −.075$, $p = .635$), Gini index ($β = −.048$, $p = .696$) nor gun ownership ($β = −.043$, $p = .710$) was related to suicide cross-nationally.

Basic scatterplots are provided for the Gini index for homicides (log transformed) and HCI for suicide outcomes as Figures 1 and 2.

DISCUSSION

The purpose of this study was to further examine potential connections of video game play, gun ownership and poverty (as measured through HCI and the Gini index) to homicide and suicide at the aggregate level of countries. Debates continue to focus on which variables have the most impact on violent death rates cross-nationally and these debates can shape public policy. Current results
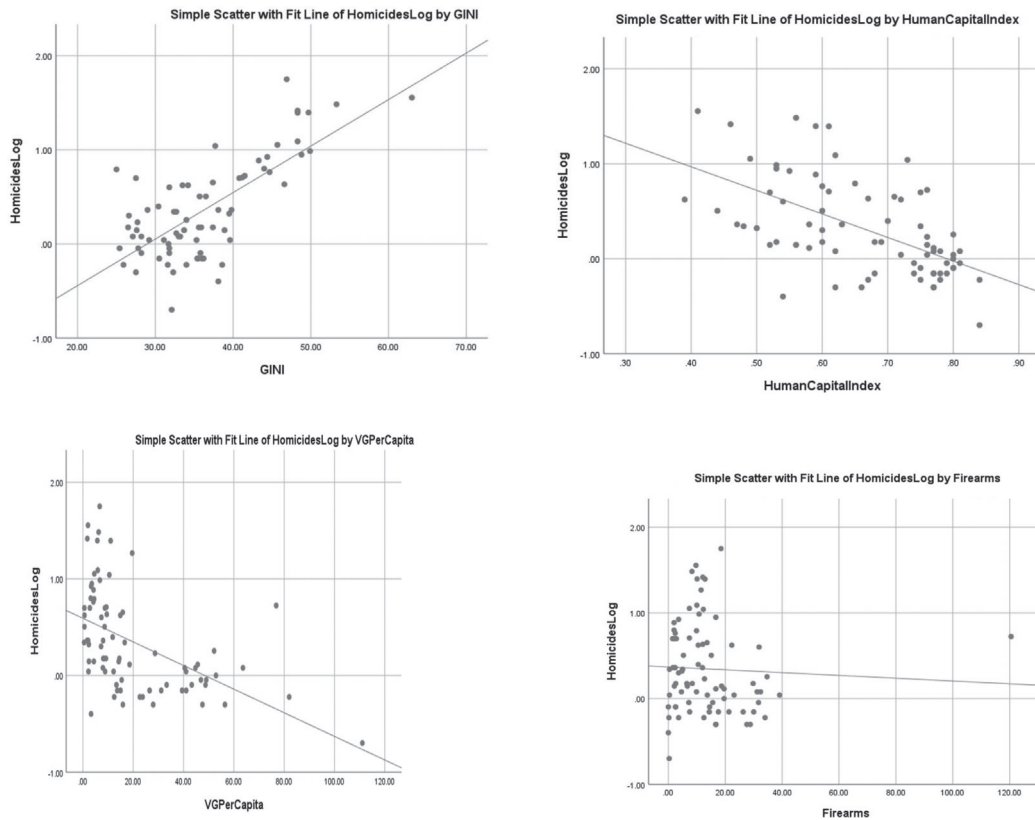
Figure 1. Scatterplots for homicides (log transformed).

suggest that economic factors may be the most promising in reducing violent death rates. It is worth noting that the covariance between economic variables and outcomes were moderately strong, suggesting the economic factors have practical significance in indicating (if not causing) violence related outcomes.

The HCI was shown to be indicative of and suicides, while the Gini index was related to homicides. Economic indicators have long been considered as one possible factor related to violent death rates. Income inequality within a country is an important factor and can be understood as potentially causing resentment or despair due to perceived violations of the social contract and inequities in how a culture treats is citizens of various classes. The current study appears to be among the first studies to look at HCI, which measures how much capital a country loses through lack of education and work-related productivity and has therefore generally been used to examine economic theory. Results from this study suggests that there is a need for further research regarding the link between human capital and violence.

Across the countries analysed in our study, we found that video game use had little relationship with either homicide or suicide. The exception to this was for the log transformed homicide outcome, wherein video game consumption was inversely related to homicide. Given

that game consumption itself tended to correlate with economic factors (particularly HCI), it is possible that game consumption may itself be a kind of economic indicator. Consumption of video games may mediate relationships between larger economic factors and homicide, possibly making the relationship between HCI and homicide appear to be smaller than it is in reality. Nonetheless, regarding the concern gaming may cause violence, this outcome fits well with other studies (e.g. Beerthuizen et al., 2017; Markey et al., 2015) that suggest the release of violent games does not predict violent outcomes or, if anything, may be associated with reductions in violent crime. Some have even found evidence that video games can have positive effects on children's mental health and social skills (Jones et al., 2014; Kovess-Masfety et al., 2016). As such, it does not appear that focusing on video games is likely to be productive from a public health standpoint in reducing either homicide or suicide. Commonly, video games are invoked particularly after high-profile acts of violence by young men (though not as commonly after violence by older men or women, suggesting some confirmation bias), particularly when the perpetrators do not fit societal expectations of who is likely to commit criminal violence (Markey et al., 2019). In this sense, it may be best to understand the issue of video games through the lens of *Moral Panic Theory*
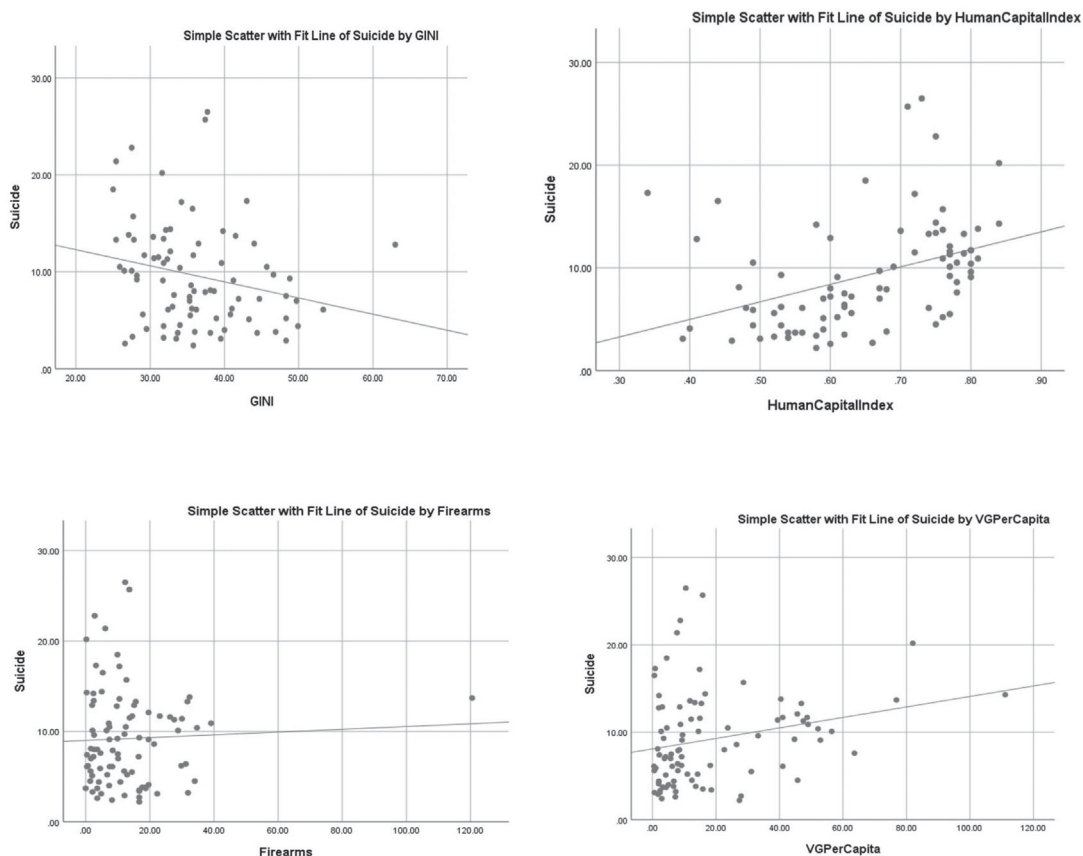
Figure 2. Scatterplots for suicide.

(Cohen, 1972) wherein video games are being used a scapegoat for violent deaths, despite evidence to suggest video games play no role in this phenomenon.

Interestingly and surprising to us, gun ownership rates were not indicative of either homicides or suicides cross-nationally. It is possible that these results are affected by the non-uniformity of crime and gun ownership reporting common in cross-national comparisons (Van Dijk, 2008). Regardless, the lack of a relationship found here suggests that proximity to firearms alone is not sufficient to affect the likelihood of lethal violence and that other cultural factors may have a more significant effect than gun ownership. Future studies on the subject may therefore want to include additional controls in their analysis. On this matter we note that studies of the relationship between gun ownership and female homicide appear to have found a positive correlation between these variables (Hemenway et al., 2002; Killias & Markwalder, 2012; Miller et al., 2007), so it's possible that some situational issues may still apply. It is also possible that broader national trends may differ from trends in high-income countries only, which were more common in other analyses. In other words, the United States may be an outlier among both gun ownership and violent deaths in the developed world, though the relationship between gun ownership and violent death may be less noticeable in the less developed world.

Economic factors were related to both suicide and homicide. For homicide, Gini index indicated homicide in the expected direction, with higher income inequality associated with higher homicide rates. However, for human capital, a higher HCI was associated with *higher* suicide rates. This suggests that suicides are particularly prevalent in more developed nations. This finding, though anecdotally consistent with high suicide rates reported in countries such as the United States and South Korea is a bit harder to explain theoretically. One possibility is that elevating personal concerns beyond basic subsistence and safety leads to greater focus on psychological needs, belongingness, social connectedness and meaning which, if found lacking, could lead to suicide. However, more analysis is needed.

Policy recommendations

We observe two things. First, the general public may become confused by multiple messages on what does and does not cause violent death, particularly when each potential cause is considered in isolation. Second, some issues may be more prone to attract attention than others.

For instance, both video games and gun ownership have been subject to intense public debates, whereas issues related to income inequality and other economic issues may be less attention grabbing. Thus, it is important to consider what policy approaches are most likely to provide success in reducing violent death and tailor public education or policy campaigns accordingly.

To the extent economic issues attract less heated debate, these issues may be easier for policy makers to address and can often go to the general public's concerns about prosperity. The current analysis further suggests that economic factors may be among the most promising to consider when attempting to reduce violent death. By contrast, gun ownership may or may not be particularly helpful but, either way, particularly within the United States, opinions may be so entrenched as to make progress difficult. On the other hand, video games do not appear to be a fruitful avenue for policy at all.

In regard to policy recommendations, it is worth noting that our analyses occur at the level of cross-national comparisons, yet most policies are enacted within countries. It is possible that within-country analyses (such as for gun ownership in the United States) may provide different answers to our cross-national view. Nonetheless, we feel that having a larger cross-national perspective is helpful in examining how violence occurs on a larger scale and can, in particular, aid with policy on the international scale such as through the United Nations, World Health Organisation, and so on. Naturally, it would be interesting to see how results remain similar or differ at the national level in various countries. Nonetheless, we believe that examination of cross-societal differences can help inform policies by understanding which variables are key as risk factors for negative outcomes.

Related also to policy recommendations it is worth reminding that our data are correlational, not causal. Thus, we can speak only to national risk markers for which countries are experiencing higher homicide and suicide. Naturally, experimental data on societal level outcomes may be difficult to consider and correlational data, particular when effect sizes are non-trivial, may help inform discussions of policy.

Limitations

As with any study, this paper has several limitations. First, the design is correlational and, as such, no causal attributions can be made. Second, only a limited number of factors were considered cross-nationally. Naturally, it is possible that other important factors indicative of violent death have been missed. Third, a limited number of countries for inclusion by necessity reduces power. In this case, effect sizes for video games and gun ownership were so weak it is unlikely that Type II error is the explanation for our results, but Type II error is always a concern for smaller samples. As a related issue, it is possible that data may be less available for less economically developed countries, leading to some bias in estimates due to exclusion of these countries.

Conclusions

The current analysis found that economic factors rather than either video games or gun ownership were most related to violent deaths, either by suicide or homicide cross-nationally. This suggests that policy efforts focused on economic issues are most likely to bear fruit.

REFERENCES

Altheimer, I. (2010). An exploratory analysis of guns and violent crime in a cross-national sample of cities. *The Southwest Journal of Criminal Justice*, 6(3), 204–227.

Anderson, C. (2004). An update on the effects of playing violent video games. *Journal of Adolescence*, 27, 113–122.

Anderson, C., Sakamoto, A., Gentile, D., 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(5), e1067–e1072.

Andresen, M. A. (2013). Unemployment, business cycles, crime, and the Canadian provinces. *Journal of Criminal Justice*, 41(4), 220–227. https://doi.org/10.1016/j.jcrimjus.2013.05.006

Bandura, A., Ross, D., & Ross, S. A. (1961). Transmission of aggression through imitation of aggressive models. *Journal of Abnormal and Social Psychology*, 66, 575–582.

Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology*, 66, 3–11.

Beerthuizen, M. G. C. J., Weijters, G., & van der Laan, A. M. (2017). The release of grand theft auto V and registered juvenile crime in the Netherlands. *European Journal of Criminology*, 14(6), 751–765. https://doi.org/10.1177/1477370817717070

Benjamin, A. J., Jr., Kepes, S., & Bushman, B. J. (2018). Effects of weapons on aggressive thoughts, angry feelings, hostile appraisals, and aggressive behavior: A meta-analytic review of the weapons effect literature. *Personality and Social Psychology Review*, 22(4), 347–377. https://doi.org/10.1177/1088868317725419

Berkowitz, L., & Lepage, A. (1967). Weapons as aggression-eliciting stimuli. *Journal of Personality and Social Psychology*, 7(2, Pt.1), 202–207. https://doi.org/10.1037/h0025008

Breuer, J., Vogelgesang, J., Quandt, T., & Festl, R. (2015). Violent video games and physical aggression: Evidence for a selection effect among adolescents. *Psychology of Popular Media Culture*, 4(4), 305–328.

Brown, E., & Males, M. (2011). Does age or poverty level best predict criminal arrest and homicide rates? A preliminary study. *Justice Policy Journal*, 8(1), 1–30.

Bushman, B. J., Kerwin, T., Whitlock, T., & Weisenberger, J. M. (2017). The weapons effect on wheels: Motorists drive more aggressively when there is a gun in the vehicle. *Journal of Experimental Social Psychology*, *73*, 82–85. https://doi.org/10.1016/j.jesp.2017.06.007

Chang, J. H., & Bushman, B. J. (2019). Effect of exposure to gun violence in video games on children's dangerous behavior with real guns: A randomized clinical trial. *JAMA Network Open*, *2*(5), e194319.

Coccia, M. (2017). A theory of general causes of violent crime: Homicides, income inequality and deficiencies of the heat hypothesis and of the model of CLASH. *Aggression and Violent Behavior*, *37*, 190–200. https://doi.org/10.1016/j.avb.2017.10.005

Cohen, S. (1972). *Folk devils and moral panics*. London, England: MacGibbon and Kee.

Cook, P. J. (1991). The technology of personal violence. *Crime & Justice*, *14*, 1–71.

Cook, P. J., & Ludwig, J. (2006). The social costs of gun ownership. *Journal of Public Economics*, *90*, 379–391.

Cumberbatch, G. (2008). *Mass media: Continuing controversies*. London, England: Pearson Education.

DeSoto, H. (1989). *The other path*. New York, NY: Basic Books.

Durkin, K., & Barber, B. (2002). Not so doomed: Computer game play and positive adolescent development. *Applied Developmental Psychology*, *23*, 373–392.

Eastin, M. S., & Griffiths, R. P. (2006). Beyond the shooter game: Examining presence and hostile outcomes among male game players. *Communication Research*, *33*(6), 448–466.

Etchells, P. J., Gage, S. H., Rutherford, A. D., & Munafò, M. R. (2016). Prospective investigation of video game use in children and subsequent conduct disorder and depression using data from the Avon longitudinal study of parents and children. *PLoS One*, *11*(1), e0147732.

Ferguson, C. J., & Olson, C. K. (2014). Video game violence use among "vulnerable" populations: The impact of violent games on delinquency and bullying among children with clinically elevated depression or attention deficit symptoms. *Journal of Youth and Adolescence*, *43*, 127–136.

Ferguson, C. J., & Wang, J. C. K. (2019). Aggressive video games are not a risk factor for future aggression in youth: A longitudinal study. *Journal of Youth and Adolescence*, *48*(8), 1439–1451. https://doi.org/10.1007/s10964-019-01069-0

Furuya-Kanamori, L., & Doi, S. A. (2016). Angry birds, angry children, and angry metaanalysts: A reanalysis. *Perspectives on Psychological Science*, *11*(3), 408–414.

Gauthier, J. M., Zuromski, K. L., Gitter, S. A., Witte, T. K., Cero, I. J., Gordon, K. H., Ribeiro, J., Anestis, M., & Joiner, T. (2014). The interpersonal-psychological theory of suicide and exposure to video game violence. *Journal of Social and Clinical Psychology*, *33*(6), 512–535. https://doi.org/10.1521/jscp.2014.33.6.512

Giumetti, G. W., & Markey, P. M. (2007). Violent video games and anger as predictors of aggression. *Journal of Research in Personality*, *41*, 1234–1243.

Hannon, L., & DeFina, R. (2005). Violent crime in African American and White neighborhoods: Is poverty's detrimental effect race-specific? *Journal of Poverty*, *9*(3), 49–67.

Hemenway, D., Shinoda-Tagawa, T., & Miller, M. (2002). Firearm availability and female homicide victimization rates among 25 populous high-income countries. *Journal of the American Medical Women's Association*, *57*(2), 100–104.

Hilgard, J. (2019). Comment on Chang & Bushman (2019): Effects of outlier exclusion. *Crystal Prison Zone*. Retrieved from https://crystalprisonzone.blogspot.com/2019/06/comment-on-chang-bushman-2019-effects.html

Hilgard, J., Engelhardt, C. R., Rouder, J. N., Segert, I. L., & Bartholow, B. D. (2019). Null effects of game violence, game difficulty, and 2D:4D digit ratio on aggressive behavior. *Psychological Science*, *30*(4), 606–616. https://doi.org/10.1177/0956797619829688

Huesmann, L. (2007). The impact of electronic media violence: Scientific theory and research. *Journal of Adolescent Health*, *41*(6), 6–13.

Jones, C. M., Scholes, L., Johnson, D., Katsikitis, M., & Carras, C. M. (2014). Gaming well: Links between video games and flourishing mental health. *Frontiers in Psychology*, *5*, 260.

Justino, P. (2009). Poverty and violent conflict: A micro-level perspective on the causes and duration of warfare. *Journal of Peace Research*, *46*(3), 315–333.

Kennedy, B. P., Kawachi, I., Prothrow-Stith, D., Lochner, K., & Gupta, V. (1998). Social capital, income inequality, and firearm violent crime. *Social Science & Medicine*, *47*(1), 7–17.

Killias, M., & Markwalder, N. (2012). Firearms and homicide in Europe. In M. Liem & W. Pridemore (Eds.), *Handbook of European homicide research*. New York, NY: Springer.

Kirsh, S. (1998). Seeing the world through mortal Kombat-colored glasses: Violent video games and the development of a short-term hostile attribution bias. *Childhood: A Global Journal of Child Research*, *5*(2), 177–184.

Kleck, G. (1997). *Targeting guns: Firearms and their control*. New York, NY: Walter de Gruyter Inc.

Kovess-Masfety, V., Keyes, K., Hamilton, A., Hanson, G., Bitfoi, A., Golitz, D., Koç, C., Kuijpers, R., Lesinskiene, S., Mihova, Z., Otten, R., Fermanian, C., & Pez, O. (2016). Is time spent playing video games associated with mental health, cognitive and social skills in young children? *Social Psychiatry and Psychiatric Epidemiology*, *51*, 349–357.

Krcmar, M., & Lachlan, K. (2009). Aggressive outcomes and videogame play: The role of length of play and the mechanisms at work. *Media Psychology*, *12*(3), 249–267.

Kutner, L., & Olson, C. (2008). *Grand theft childhood: The surprising truth about violent video games and what parents can do*. New York, NY: Simon & Schuster.

Lankford, A. (2016). Public mass shooters and firearms: A cross-national study of 171 countries. *Violence and Victims*, *31*(2), 1–13.

Larsson, D. (2006). Exposure to property crime as a consequence of poverty. *Journal of Scandinavian Studies in Criminology and Crime Prevention*, *7*, 45–60.

Lott, J. R. J. (2000). *More guns less crime: Understanding crime and gun control laws*. Chicago, IL: University of Chicago Press.

Lott, J. R. J., & Mustard, D. B. (1997). Crime, deterrence, and right to carry concealed handguns. *The Journal of Legal Studies*, *26*, 1–68.

Markey, P. M., Ivory, J. D., Slotter, E. B., Oliver, M. B., & Maglalang, O. (2019). He does not look like video games

made him do it: Racial stereotypes and school shootings. *Psychology of Popular Media Culture*, *9*, 493–498 https://doi.org/10.1037/ppm0000255

Markey, P. M., Markey, C. N., & French, J. E. (2015). Violent video games and real-world violence: Rhetoric versus data. *Psychology of Popular Media Culture*, *4*(4), 277–295. https://doi.org/10.1037/ppm0000030

Markey, P. M., & Scherer, K. (2009). An examination of psychoticism and motion capture controls as moderators of the effects of violent video games. *Computers in Human Behavior*, *25*, 407–411.

McCarthy, R. J., Coley, S. L., Wagner, M. F., Zengel, B., & Basham, A. (2016). Does playing video games with violent content temporarily increase aggressive inclinations? A pre-registered experimental study. *Journal of Experimental Social Psychology*, *67*, 13–19. https://doi.org/10.1016/j.jesp.2015.10.009

McCown, W., Keiser, R., Mulhearn, S., & Williamson, D. (1997). The role of personality and gender in preferences for exaggerated bass in music. *Personality and Individual Differences*, *23*, 543–547.

McGloin, R., Farrar, K. M., & Fishlock, J. (2015). Triple whammy! Violent games and violent controllers: Investigating the use of realistic gun controllers on perceptions of realism, immersion, and outcome aggression. *Journal of Communication*, *65*(2), 280–299.

McGloin, R., Farrar, K. M., & Krcmar, M. (2013). Video games, immersion, and cognitive aggression: Does the controller matter? *Media Psychology*, *16*(1), 65–87.

Miller, M., Hemenway, D., & Azrael, D. (2007). State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003. *Social Science & Medicine*, *64*(3), 656–664.

Mitrofan, O., Paul, M., & Spencer, N. (2009). Is aggression in children with behavioral and emotional difficulties associated with television viewing and video game playing? A systematic review. *Child: Care, Health and Development*, *35*(1), 5–15.

Moore, M. D. (2017). Firearm prevalence and homicide: An examination of urban and suburban counties. *Criminal Justice Review*, *42*(3), 315–326.

Moore, M. D., & Bergner, C. M. (2016). The relationship between firearm ownership and violent crime. *Justice Policy Journal*, *13*(1), 1–20.

Nikkelen, S. W., Vossen, H. G., Valkenburg, P. M., Velders, F. P., Windhorst, D. A., Jaddoe, V. W., & Tiemeier, H. (2014). Media violence and children's ADHD-related behaviors: A genetic susceptibility perspective. *Journal of Communication*, *64*(1), 42–60.

Nikulina, V., Widom, C. S., & Czaja, S. (2011). The role of childhood neglect and childhood poverty in predicting mental health, academic achievement, and crime in adulthood. *American Journal of Community Psychology*, *48*, 309–321.

Olson, C. (2004). Media violence research and youth violence data: Why do they conflict? *Academic Psychiatry*, *28*, 144–150.

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*(6251), 1–8.

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist*, *17*(11), 776–783. https://doi.org/10.1037/h0043424

Pashler, H., Coburn, N., & Harris, C. R. (2012). Priming of social distance? Failure to replicate effects on social and food judgments. *PLoS ONE*, *7*(8), e42510. https://doi.org/10.1371/journal.pone.0042510

Rengert, G., & Wasilchick, J. (1985). *Suburban burglary: A time and place*. Springfield, IL: Charles Thomas.

Rentfrow, P. J., & Gosling, S. D. (2003). The do re Mi's of everyday life: The structure and personality orrelates of music preferences. *Journal of Personality and Social Psychology*, *84*(6), 1236–1256.

Rossegger, A., Wetli, N., Urbaniok, F., Elbert, T., Cortoni, F., & Endrass, J. (2009). Women convicted for violent offenses: Adverse childhood experiences, low level of education and poor mental health. *BMC Psychiatry*, *9*, 1–7. https://doi.org/10.1186/1471-244X-9-8

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime. *Science*, *277*, 918–924.

Savage, J. (2004). Does viewing violent media really cause criminal violence? A methodological review. *Aggression and Violent Behavior*, *10*, 99–128.

Schwartz, J. A., & Beaver, K. M. (2016). Revisiting the association between television viewing in adolescence and contact with the criminal justice system in adulthood. *Journal of Interpersonal Violence*, *31*(14), 2387–2411.

Sen, A. (2008). Violence, identity, and poverty. *Journal of Peace Research*, *45*(1), 5–15.

Small Arms Survey. (2020). *Civilian firearms holdings, 2017*. Retrieved from http://www.smallarmssurvey.org/fileadmin/docs/Weapons_and_Markets/Tools/Firearms_holdings/SAS-BP-Civilian-held-firearms-annexe.pdf

Smith, S. L., Ferguson, C. J., & Beaver, K. M. (2018a). A longitudinal analysis of shooter games and their relationship with conduct disorder and cself-reported delinquency. *International Journal of Law and Psychiatry*, *58*, 48–53.

Smith, S. L., Ferguson, C. J., & Beaver, K. M. (2018b). Learning to blast a way into crime, or just good clean fun? Examining aggressive play with toy weapons and its relation with crime. *Criminal Behavior and Mental Health*, *28*(4), 313–323.

Spano, R., & Bolland, J. (2010). Disentangling the effects of violent victimization, violent behavior, and gun carrying for minority inner-city youth living in extreme poverty. *Crime & Delinquency*, *59*(2), 191–213.

Stretesky, P. B., Schuck, A. M., & Hogan, M. J. (2006). Space matters: An analysis of poverty, poverty clustering, and violent crime. *Justice Quarterly*, *21*(4), 817–841.

Tark, J., & Kleck, G. (2004). Resisting crime: The effects of victim action on the outcomes of crimes. *Criminology*, *42*(4), 861–909.

United Nations Office on Drugs and Crime. (2020). *Global study on homicide*. Retrieved from https://dataunodc.un.org/GSH_app

Unsworth, G., Devilly, G., & Ward, T. (2007). The effect of playing violent videogames on adolescents: Should parents be quaking in their boots? *Psychology, Crime & Law*, *13*, 383–394.

Van Dijk, J. J. M. (2008). *The world of crime: Breaking the silence on problems of security, justice and development across the world*. Thousand Oaks, CA: Sage.

Van Kesteren, J. N. (2014). Revisiting the gun ownership and violence link: A multilevel analysis of victimization survey data. *British Journal of Criminology*, *54*, 53–72.

Von Hippel, K. (2002). The roots of terrorism: Probing the myths. *The Political Quarterly*, *73*, 25–39.

We PC. (2020). *2020 video game industry statistics, trends & data*. Retrieved from https://www.wepc.com/news/video-game-statistics/#video-game-monetization

Wolfgang, M. E. (1958). *Patterns in criminal homicide*. Philadelphia: University of Pennsylvania Press.

World Bank. (2020a). *Gini index*. Retrieved from https://data.worldbank.org/indicator/SI.POV.GINI

World Bank. (2020b). *Countries and economies*. Retrieved from https://data.worldbank.org/country

World Health Organization. (2017). *Suicide rate estimates, age-standardized, estimates by country*. Retrieved from https://apps.who.int/gho/data/node.main.MHSUICIDEASDR?lang=en

Wu, B. (2003). Testing the stream analogy for lethal violence: A macro study of suicide and homicide. *Western Criminology Review*, *4*(3), 215–225.