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Firearm Instrumentality: Do Guns Make Violent Situations More Lethal?

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Abstract

One of the central debates animating the interpretation of gun research for public policy is the question of whether the presence of firearms independently makes violent situations more lethal, known as an instrumentality effect, or whether determined offenders will simply substitute other weapons to affect fatalities in the absence of guns. The latter position assumes sufficient intentionality among homicide assailants to kill their victims, irrespective of the tools available to do so. Studies on the lethality of guns, the likelihood of injury by weapon type, offender intent, and firearm availability provide considerable evidence that guns contribute to fatalities that would otherwise have been nonfatal assaults. The increasing lethality of guns, based on size and technology, and identifiable gaps in existing gun control policies mean that new and innovative policy interventions are required to reduce firearm fatalities and to alleviate the substantial economic and social costs associated with gun violence.

INTRODUCTION

Weapon instrumentality is based on the straightforward idea that the type of weapon deployed in an assault influences the mortality of the victim. Logically, guns are regarded as more lethal instruments than knives, knives more lethal than blunt instruments, and so on. Yet the National Rifle Association and other progun activists often invoke the familiar slogan "guns don't kill people, people kill people" to support their arguments for more-permissive gun controls (Henigan 2016). This perspective suggests that an attacker who has a very strong determination to kill will take the necessary steps to be successful regardless of available weapons (Cook 1991, Cook et al. 2011). As such, the assailant's will to kill is reliably measured by whether the victim survives or perishes (Braga & Cook 2018, Zimring 1972). This perspective is reified in criminal law, wherein murderers are subjected to the harshest sanctions, including life without the possibility of parole or even death (Vernick & Hepburn 2003). The "people kill people" perspective further suggests that gun control is futile in reducing homicides because determined killers will simply find another way (Kleck 1997, Wolfgang 1958, Wright et al. 1983). If guns are not available, assailants will substitute knives, blunt instruments, or other means.

The alternate view is that "guns do kill people" and gun control advocates suggest that reducing firearm availability to violent people will save lives even if determined killers select other weapons instead (Cook 1991, Cook et al. 2011, Henigan 2016). Injuries in assaultive violence are often inflicted by whatever means are most available to the attacker, most commonly fists or feet followed by other objects that are close at hand (Hedeboe et al. 1985). Although a person who is determined to kill will sometimes acquire a lethal weapon, gun-inflicted deaths often ensue from varying kinds of impromptu arguments or fights (Spitzer 1995, Zimring & Hawkins 1997). Gun control advocates suggest that many of these deaths would be replaced by nonfatal injuries if guns were not available; in essence, they suggest that a more refined slogan would be "people without guns injure people; guns kill them" (Baker 1985, p. 588).

The purported strong will to kill as the key determinant of mortality is challenged by the noteworthy similarity in the characteristics and circumstances of fatal and nonfatal gun-assault incidents (Cook et al. 2019). Mortality in many gun attacks seems to be influenced by chance events, such as the number and placement of wounds, the availability and quality of medical help, and other factors (Braga & Cook 2018). The considerable overlap between fatal and nonfatal shootings is well captured by the observation of a Boston police investigator that the difference between the two events "is often only a matter of inches and luck—a lot of times a nonfatal shooting is just a failed homicide" (Braga et al. 2014, p. 119). In her in-depth examination of South Los Angeles homicides, investigative reporter Jill Leovy (2015, p. 49) notes that there were approximately five nonfatal injury shootings for every one gun homicide and, given the similarity between the events, detectives called these nonfatal shootings "*almoscides*, for 'almost homicides.'" Research on fatal and nonfatal gun assaults further suggests that mortality is influenced by the type of gun used in the attack, and the selection of the gun in these events is largely independent of other indicators of the assailant's intent (Braga & Cook 2018, Zimring 1972). As such, the types of guns deployed in assaults dramatically influence whether the intended victim lives or dies beyond the determination of the assailant to commit murder.

Firearm instrumentality is controversial among academics who study gun control policy issues. The controversy stems from disagreement over an assailant's purported intention to kill and whether a would-be killer would merely substitute other means to complete the act if guns were not available. In their recent survey of gun policy experts, the RAND Corporation discovered two distinct groups of scholars: those who favored more-restrictive gun regulations and those who favored more-permissive gun regulations (Morral et al. 2018). According to this research, "a

striking result of the survey concerns the wide disparity between estimates made by the two expert groups about means substitution. . . . That is, they disagree about the extent to which any reductions of firearm. . .homicides attributable to a policy are undermined because individuals simply use other means to achieve those ends" (Morral et al. 2018, p. xii). The average survey participant who favored more-permissive gun controls responded that if a policy successfully reduced a state's firearm homicides, 90% of the prevented homicides would still end as a homicide by some other means. In contrast, the average survey participant who preferred more-restrictive gun controls indicated that only 20% would still end in homicide. As such, gun policy experts with preferences for more-permissive gun regulations view legislative efforts to reduce gun homicides as futile since they believe would-be killers will complete their murderous acts through other means.

Firearm instrumentality is clearly a foundational issue in the great American gun control debate. Broader arguments that seek to limit the availability of guns to violence-prone individuals through the adoption of more-restrictive gun controls are based on the idea that lives would ultimately be saved (Cook et al. 2011). In this review, we examine the available scientific evidence on whether guns make situations more lethal. The review begins by examining extensive research on the lethality of gun assaults, focusing on a range of studies that attempt to determine the existence of instrumentality effects in violent gun and non-gun crimes. Extended coverage is given to two comprehensive studies that estimate whether gun caliber, killer intent, and other chance elements in gun assaults determine the likelihood of death for victims. We find strong support for gun instrumentality effects in our review of the literature. The final sections consider the policy implications of these findings and offer recommendations for further research in this area.

THE LETHALITY OF GUNS

Guns are obviously designed to be lethal instruments. And although guns in civilian hands are used for sport shooting, hunting, and dealing with animal pests, they can also be deployed against people for legal self-defense or criminal purposes. In 2018, guns were used in more than 10,000 murders, 38,000 rapes/sexual assaults, 42,000 aggravated assaults with injury, and 96,000 robberies (Bur. Justice Stat. 2019, FBI 2018). However, it is important to note that most serious violent crime victimizations do not involve guns. The 2018 US Bureau of Justice Statistics National Crime Victimization Survey (NCVS) reveals that only 5% of rapes/sexual assault, 11% of aggravated assault with injury, and 17% of robbery victimization incidents involved a firearm (**Figure 1**). When used in violent crime, guns are usually not fired; more than three-quarters of nonfatal gun crime victims do not suffer gunshot wounds (Planty & Truman 2013). Instead, as is discussed further below, guns are typically deployed by criminals to gain compliance or threaten victims rather than to injure them. Most gun crimes involve handguns, which are used in roughly two-thirds of gun homicides and 90% of nonfatal gun violence (Planty & Truman 2013).

Among those violent gun incidents that do generate injuries, whether the victim lives or dies is often dependent upon the technology (i.e., type and characteristics) of the guns used in the assaults (for an excellent overview from a public health perspective, see Karlson & Hargarten 1997). The kinetic energy of a bullet is determined by its mass and velocity when fired from a gun. In general, the larger the caliber, the more mass the bullet will have. Larger-caliber bullets (such as 0.40, 0.44, and 0.45) generate more tissue damage than smaller-caliber bullets (such as 0.22, 0.25, and 0.32) when they strike the same body parts (Hargarten et al. 1996). Jacketed bullets tend to cause perforating wounds with less tissue damage relative to bullets designed to fragment and/or mushroom (Fackler et al. 1988). Cartridge cases can vary in the amount of explosive gun powder they hold, with larger cartridges generating higher bullet velocities when fired. Rifles are considered more lethal than handguns given the higher bullet velocities generated by the

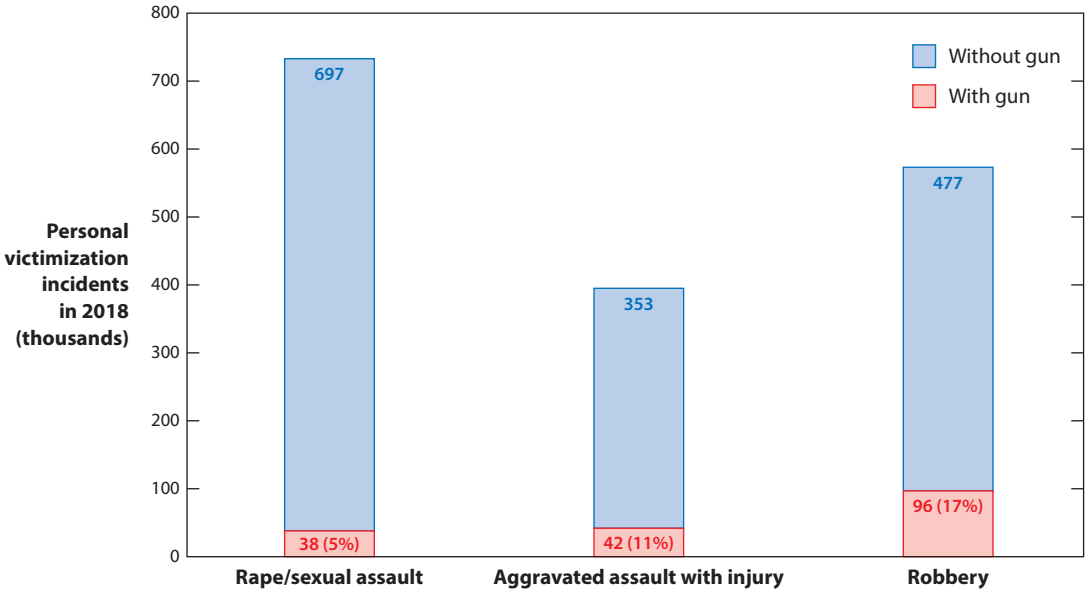

Figure 1

Personal violent victimization with and without guns, 2018. Data taken from Bureau of Justice Statistics (2019).

larger cartridges and the increased accuracy of the longer barrel lengths (which also contribute to increased bullet velocity). Shotguns generally fire shells filled with multiple small pellets (gauges represent pellet sizes with 10 and 12 gauge being the most common; shotguns can also fire a single rifled "slug") that can be quite lethal at close range because of the extensive tissue damage generated by a concentration of pellets and much less lethal at distance because of the dispersion of pellets after firing (Karlson & Hargarten 1997).

The number and location of gunshot wounds also influence the mortality of the victim in gun-assault incidents. Holding other factors constant, injuries to the head and upper spinal cord are considered the most lethal gunshot wounds followed by injuries to the chest and abdomen (depending on whether vital organs are hit) and to extremities such as arms and legs (Karlson & Hargarten 1997, Kellermann et al. 1991). The number of gunshot wounds involved in a gun assault also elevates victim mortality, as each wound represents additional traumatic tissue injury (D'Alessio 1999, Hargarten et al. 1996). Other factors, such as the availability of quality trauma care to save injured victims (Coupet et al. 2019) and the speed at which first responders locate gunshot victims also influence the lethality of gun attacks. By one estimate, almost three-fourths of gun homicide victims die before they reach the hospital (Karlson & Hargarten 1997).

Empirical evidence suggests that guns are becoming more lethal over time with larger shares featuring higher-capacity magazines and using larger-caliber bullets (D'Alessio 1999, Kellermann et al. 1991, McGonigal et al. 1993, Webster et al. 1992, Wintemute 1996). For instance, in Boston, higher-capacity semiautomatic pistols capable of shooting more bullets replaced revolvers as the most frequently recovered type of handgun beginning in the 1990s (Braga 2017). As a consequence, the share of smaller-caliber handguns among crime gun recoveries decreased over the 2000s as the prominence of larger-caliber handguns increased. According to **Table 1**, the share of semiautomatic pistols recovered by the Boston Police Department increased from only 34.6% of total handguns recovered between 1981 and 1985 to a peak of 75.7% between 2001 and 2005, before dropping to 66.6% between 2011 and 2015. **Table 1** shows that large-caliber handguns (0.40,

Table 1 Types and calibers of recovered handguns in Boston, 1981–2015

Period	*N*	Percent semiauto	Percent .22, .25, .32	Percent .38, .357	Percent .38, 9mm	Percent .40, .44, .45
1981–1985	3,134	34.6	44.9	38.6	7.5	4.3
1986–1990	3,114	41.6	44.2	33.2	14	5.1
1991–1995	3,449	60.9	38.3	23.3	30.2	4.8
1996–2000	2,008	74.2	38.9	23.9	27.5	6.8
2001–2005	2,905	75.7	29.2	20.9	29.7	12.9
2006–2010	2,195	65.7	26.4	20.6	33.4	18
2011–2015	2,352	66.6	26.7	20.7	31.7	19.9

Table adapted from Braga (2017).

0.44, and 0.45) increased almost fivefold from 4.3% of total handguns recovered between 1981 and 1985 to almost 20% of total handguns recovered between 2011 and 2015. Equally important, **Table 1** also documents the noteworthy shift away from medium-caliber bullets often used in revolvers (0.38, 0.357) toward medium-caliber bullets typically used in semiautomatic pistols (0.380, 9mm). The transition from revolvers to semiautomatic pistols and from smaller to larger-caliber handguns mirrors national trends in handgun production in the United States between the 1980s and 1990s (Wintemute 2010).

The increased killing power of handguns recovered by law enforcement agencies in the United States seems to have increased the lethality and number of wounds that gunshot victims experience over time. In epidemiology, the case-fatality rate is generally defined as the proportion of deaths (i.e., gun homicides) within a designated population of cases (total gunshot injury victims) (see Efron et al. 2006). For gun-assault victimizations, the case-fatality rate is roughly 1 in 6, wherein approximately 17% of gun-assault victims with injuries die from their wounds (Cook 1985). Furthermore, this rate has remained fairly stable since the 1980s, leading Cook and colleagues (2017) to conclude that national declines in gun homicide rates were better explained by decreases in the number of gun assaults rather than improvements in trauma care for firearm injuries. City-level studies, however, show that local case-fatality rates can diverge markedly from national trends and these differing patterns may be linked to changes in the technology of guns used in assaults. For instance, an analysis of gunshot wound patients treated in a Denver trauma center between 2000 and 2013 suggests that case-fatality rates increased over time as gunshot patients suffered more severe wounds and an increased number of serious wounds per patient (Sauaia et al. 2016). A similar study of 6,322 gunshot wound patients treated at the New Jersey Trauma Center at University Hospital in Newark reported significant increases in patients with three or more wounds from 13% to 22%, with a corresponding increase in mortality from 9% to 14%, between 2000 and 2011 (Livingston et al. 2014).

Criminological studies have shown that case-fatality rates can vary over the course of gun violence epidemics. For instance, in a classic study of the influence of the heroin epidemic on serious violence in New York City, the RAND Corporation found that the rapid increase in homicide in Harlem between 1968 and 1974 was driven by an increase in the case-fatality rate of gun assaults rather than an increase in the number of gun assaults (Swersey & Enloe 1975). More recently, Braga (2003) analyzed youth gun assaults in one police district located in a mostly black disadvantaged neighborhood in Boston between 1987 and 1995, representing the years before and during a gun violence epidemic initiated by the emergence of crack cocaine in the city. He found that the nature of youth gun assaults changed over time in several noteworthy ways: Larger-caliber semiautomatic pistols were more likely to be fired in gun attacks, incidents were likely to occur in public

places, a larger share of youth gun assaults resulted in a wound, and, for those assaults that involved a wound, a larger share involved multiple gunshot injuries. Most importantly, although the absolute number of youth gun assaults in 1995 was essentially the same as 1987, the case-fatality rate in this high-risk policing district tripled over the study period. Braga (2003) identified changes in both firearm instrumentality effects, as indicated by increased use of more powerful handguns with higher-capacity magazines, and shooters' intent to kill, as indicated by the increased number of wounds on youth gun-assault victims.

The empirical evidence reviewed above shows that there are several factors associated with the lethality of guns deployed in criminal assaults. In sum, it is not controversial in public health and medical research that mortality increases with the power of the gun deployed in assaults. As such, this research suggests the existence of firearm instrumentality effects. However, some observers argue that the selection of the firearm used in gun attacks is simply a reflection of the shooters' intent to kill and determined killers will complete their acts by substituting other deadly means if guns are unavailable. The next section considers findings of the criminological research on firearm instrumentality, intentionality, and the lethality of possible weapon substitution effects.

Intention Versus Instrumentality

There is considerable evidence that the risk of death is elevated when a violent incident involves a gun. In particular, Cook (2018) found that crime victims who suffered gunshot wounds were more than seven times as likely to die when compared to knife attack victims who were seriously injured. In the case of robbery, the greatest difference between fatal and nonfatal robberies was the perpetrator's choice of weapon, wherein the likelihood of victim death in gun robberies (0.41% or approximately 1 in 250) was three times higher than knife robberies (0.13% or approximately 1 in 750) and 10 times higher than robberies committed with other weapons (0.04% or approximately 1 in 2,500), such as blunt instruments (Cook 1987). The likelihood of death in an unarmed robbery was approximately 1 in 5,000 (or 0.02%). Given that only 17% of total robberies involve firearms, but 65% of robbery murders are committed with a gun, the choice of weapon appears to have a significant and independent effect on the likelihood of victim fatality (Cook 1987). Cook (1987) found further evidence of firearm instrumentality effects in his panel analysis of changes in crime rates across 43 US cities; in this case, an additional 100 gun robberies increased the robbery-murder rate by three times as much as an additional 100 non-gun robberies. Cook (2018) observed that the 3:1 ratio was congruent with the difference in case-fatality rates for robbery and suggested a possible causal impact where robbery-murder was a by-product of robbery that occurred with a likelihood determined by the intrinsic lethality of the weapon deployed.

Using data from the National Incident-Based Reporting System (NIBRS), Libby & Corzine (2007) investigated the impact of weapon type on the lethality of violent interpersonal encounters. Controlling for incident circumstance, the relationship between the offender and victim, and their respective characteristics, firearms were found to have the strongest effect on the lethality of violent encounters, with handguns and shotguns representing the most lethal weapons overall (Libby & Corzine 2007). Similarly, Weaver et al. (2004) found that incidents involving firearms were 11 times more likely to result in victim homicide compared to unarmed assaults, whereas the use of knives was only approximately 2.5 times more likely to result in victim homicide. These findings support previous research in demonstrating independent weapon instrumentality effects, even when controlling for approximate measures of offender motive and intent (Wells & Horney 2002).

Weapon type has also been shown to influence victim mortality in family and intimate assaults. Research by Saltzman et al. (1992) showed that firearm assaults were three times as likely to result

in death as assaults involving knives or other cutting weapons, and approximately 23 times as likely to result in death as assaults involving other weapons or bodily force. Overall, family and intimate assaults with a firearm were 12 times more likely to result in death than non-firearm assaults. Additionally, approximately 50% of assaults with firearms resulted in a nonfatal injury, compared to 66% of assaults with knives, indicating that firearm attacks were less likely to result in nonfatal injuries than were knife attacks (Saltzman et al. 1992).

These findings reinforce other research in demonstrating that gun assaults are particularly lethal. For example, Felson & Messner (1996) found that offenders who used a gun were more than 40 times more likely to kill the victim than offenders who did not use a weapon; comparatively, offenders who used a knife were only 4.4 times more likely to kill the victim than offenders without weapons. Additionally, guns were more strongly associated with homicides when the initiating offense was an assault compared to a robbery, suggesting that guns facilitate homicide for offenders with a determination to kill, as offenders engaging in assault are more likely than offenders engaging in robbery to harbor lethal intent (Felson & Messner 1996).

This question of intent motivated some of the earliest studies related to firearm instrumentality. Wolfgang's (1958) seminal study of homicide in Philadelphia posited that few homicides would be prevented solely by eliminating the presence of firearms, as determined offenders would likely substitute other weapons to achieve the same result. Wright et al. (1983) concur with this observation and suggest that firearms simply make the act of killing easier. If no guns were available and the assailant was committed to completing the act, they would find another method of achieving it. But it was roughly 50 years ago that Zimring (1968, 1972) offered the first critical tests of the extent of overlap between fatal and nonfatal attacks in an effort to disentangle whether instrumentality or intentionality distinguished homicides from serious assaults (either with guns or with other weapons). Although he could not directly measure intentionality with existing official data, he suggested that it could be inferred if firearm homicides exhibit different features—such as victim–offender relationship, motive, location of wounds, number of wounds, etc.—from nonfatal attacks. Contrary to Wolfgang (1958), Zimring (1968, p. 722) believed that at least some homicides may be ambiguously motivated rather than "deliberate and determined," and "if the probable substitute for firearms in these situations is less likely to lead to death, then the elimination of guns would reduce the number of homicides." His research showed substantial similarities between the profiles of homicides and serious assaults, implying an ambiguity in intent to kill and leading him to conclude that what distinguishes a homicide from an assault is simply that the victim does not survive the attack.

As noted earlier, intentionality may be evaluated even more directly on the basis of the location of the wound (Braga & Cook 2018; Zimring 1968, 1972). Those determined to commit homicide should target vital organs or areas of the body, including the trunk of the body or the head, rather than extremities, like arms or legs. Yet Zimring (1968) found that nearly half of all gun attacks (44%) in Chicago resulted in wounds to nonvital parts of the victim's body, whereas a majority of knife attacks known to police resulted in wounds to the head, neck, chest, or back. This means that attackers with a gun appear to no more intend a fatal outcome than do attackers using other weapons, and because "the rate of knife deaths per 100 reported knife attacks was less than 1/5 the rate of gun deaths per 100 reported gun attacks" (Zimring 1968, p. 728), substituting knife attacks for gun attacks should drive the homicide rate down by a large margin. If intention is relatively even across attacks that end in fatalities and those that do not, then the major factor distinguishing homicides from assaults is the dangerousness of the weapon. This is particularly problematic, as guns can be fired from longer ranges, more easily, and with less skill than can other weapons of choice for assailants.

Even among only those attacks committed with a gun, if larger-caliber guns produce a greater proportion of homicides versus assaults under similar circumstances, then the dangerousness of the weapon can be said to independently contribute to fatalities. Excluding shotguns and large-caliber rifles, Zimring's (1972, p. 105) analyses showed that 0.38 caliber attacks to the head and chest, in particular, but also the abdomen, back, and neck were "more than twice as deadly as 0.22 caliber attacks" to the same areas, providing additional support for an instrumentality argument. Based on these two influential studies, Zimring (1972, p. 110) concluded that patterns in fatal and nonfatal gun attacks are highly similar in "structure, intention, and motivational background" and, furthermore, that intent to kill is largely ambiguous across gun homicides and serious but nonfatal gun assaults. The results of this early work and later replications (Sarvesvaran & Jayewardene 1985, Vinson 1974) provide direct support for the instrumentality effect, wherein guns influence the lethality of attacks primarily as a function of their dangerousness (see also Braga & Cook 2018, Cook 1991, Cook & Ludwig 2000, Cook et al. 2019, Zimring & Hawkins 1997).

In a more recent and comprehensive study on weapon instrumentality and intentionality, Braga & Cook (2018) demonstrated that, compared to smaller-caliber firearms, larger-caliber guns produce substantially more fatalities among shooting victims in Boston. Their research showed that the circumstances, neighborhood, prior criminal history, and demographic characteristics of fatal and nonfatal shootings are indistinguishable. Given the substantial overlap in the features of gun homicides and nonfatal shootings, and mirroring the findings in Zimring's 1970s Chicago studies, Braga & Cook (2018) argued that there was little evidence to support the contention that fatal and nonfatal shootings are qualitatively distinct. They then examined a subset of those cases in which the caliber of the weapon used in the shooting was known to police. Compared to nonfatal shootings, gun homicides were found to be significantly more likely to involve large-caliber handguns, to be characterized by a greater number of shots fired, to result in multiple gunshot wounds to victims, and to wound the victim in the head or neck relative to peripheral parts of the body (Braga & Cook 2018).

If the selection of a more powerful, larger-caliber handgun were dependent on the attacker's intention to kill, however, then the characteristics of shootings involving small-caliber handguns should differ from the features of shootings involving medium- and large-caliber handguns respectively. Yet Braga & Cook's (2018, p. 1) research illustrated that "caliber was not significantly correlated with other observable characteristics of the assault, including indicators of intent and determination to kill," such as the number of wounds, the location of wounds, and victim characteristics. In effect, there was no evidence that sex, race, age, criminal history, circumstances of the shooting, the skill and determination of the shooter, or other features of incidents were associated with the caliber of the handgun used in the attack. Consequently, shooters do not appear to be selecting a more powerful handgun according to their intent to kill. This "lack of systematic association is what would be expected if caliber were assigned at random, as in an experiment" (Braga & Cook 2018, p. 6).

The overlap in profiles of fatal and nonfatal shootings combined with the failure of incident-specific characteristics to distinguish shootings involving small- versus large-caliber guns enables a strict test of weapons instrumentality. That is, if the size and power of the handgun used in a shooting influence the likelihood of death independent of other features of the violence, and there is no direct effect of those features on the selection of the type of handgun, then the argument for instrumentality is considerably stronger. In a model predicting fatal versus nonfatal shootings, Braga & Cook (2018) found that victims of attackers who use a medium-caliber handgun are more than twice as likely to die as a consequence of the shooting as those who are shot with a small-caliber handgun, and those odds double for victims shot with large-caliber handguns. They conclude that "if the medium- and large-caliber guns had been replaced with small-caliber (assuming everything

else unchanged), the result would have been a 39.5% reduction in gun homicides" (Braga & Cook 2018, p. 7). Importantly, then, gun fatalities are substantially elevated in the context of attacks with more powerful firearms, holding other features of the shooting constant.

Collectively, the studies that most directly focus on intentionality and instrumentality in gun violence point to a relatively clear conclusion: the dangerousness of the instrument used in violent attacks plays a critical role in producing fatal outcomes. Attackers using larger-caliber guns conduct attacks that bear striking similarities to those who use smaller-caliber guns in circumstance, accuracy, number of shots fired, and the location of wounds to victims (Braga & Cook 2018; Zimring 1968, 1972). Yet the likelihood of death increases with the power of the firearm used in the attack; larger-caliber weapons are increasingly likely to produce lethal consequences. Ultimately, then, "whether the victim of a serious assault lives or dies is to a large extent a matter of chance, rather than a question of the assailant's intent. The probability of death is connected to the intrinsic power and lethality of the weapon" (Braga & Cook 2018, p. 8). From a public health perspective, reducing the objective dangerousness of gun violence could be accomplished more readily by controlling the size and power of firearms available to the public than by assuming intentionality on the part of the offender on the basis of what amount to chance outcomes in shooting incidents.

Offender Firearm Use, Victim Compliance, and Injury Incidence Rates

Weapon instrumentality effects also appear to influence the likelihood that violent incidents result in any injury to victims. Using data from the 1979–1985 National Crime Victimization Survey (NCVS) and the FBI's 1982 Supplementary Homicide Report, Kleck & McElrath (1991) assessed the impact of various weapon types on the likelihood that a threatening situation escalated into a physical attack, whether the attack resulted in an injury, and whether the injury resulted in the death of the victim. Regarding the likelihood of injurious attacks on victims, the study suggested that the net effect of the presence of deadly weapons—firearms and, to a lesser extent, knives—in threatening situations is to reduce the probability that the possessors of the weapons attack. As the lethality of the weapon present increases, the probability of a physical and injurious attack decreases (Kleck & McElrath 1991). In effect, the threat alone is sufficient to subdue the victim. Libby (2009) attempted to replicate these findings using National Incident-Based Reporting System (NIBRS) data for 2003–2005 and generally confirmed the results of Kleck & McElrath (1991). His analysis indicated that the chances of nonlethal victim injury decreased by approximately 80% in incidents featuring a firearm. However, when firearms were used in the commission of a crime, the likelihood of death was substantially greater (Libby 2009).

Research suggests the source of these more nuanced instrumentality effects of guns on injury incidence may be rooted in offender decision-making processes and victim resistance in violent attacks. Criminal offenders may use firearms to facilitate the successful commission of their intended crimes (Jacobs 2000, Kleck & McElrath 1991, Wright & Decker 1997, Wright & Rossi 1994). Guns also tend to be used when offenders are planning robberies that involve larger amounts of cash and/or more expensive items (Cook 2009). Robbers report their desire to use the overwhelming force made possible through firearms to secure victim compliance via the threat of serious injury and death (Feeney 1986, Jacobs 2000, Wright & Decker 1997). In noncommercial robbery cases, the standard technique is to threaten victims and take their valuables without actually attacking them [78% of gun robberies and 64% of knife robberies Cook 1980)]. In contrast, 74% of unarmed noncommercial robberies and 60% of blunt instrument noncommercial robberies involved physical attacks on victims followed by attempts to take their valuables by force (Cook 1980). The likelihood of injury followed the same pattern, ranging from only 11% of gun

robberies to 36% of robberies with blunt instruments (Cook 1980). As described earlier, when guns are present and fired, victim injuries are far more likely to be lethal.

Although less developed than the empirical evidence on weapon use in robbery, qualitative interviews with sexual assault offenders similarly show that they use weapons like guns to control their victims, discourage resistance, and secure compliance (Beauregard & Leclerc 2007, Reid & Beauregard 2017). As one serial sex offender noted, "It was better to threaten a victim with a gun when she was further away; she knew I could shoot her from that distance, which isn't the case with a knife" (Beauregard & Leclerc 2007, p. 123). Offender views on the subduing power of guns seem to be well supported, as victims were less likely to resist and offenders were more likely to complete the robbery or sexual assault successfully when a firearm was present (Cook 1980, 2009; Kleck & DeLone 1993; Libby 2009; Tillyer & Tillyer 2014).

Physical assaults sometimes serve as an inappropriate outlet for negative emotions or deep frustrations held by violent offenders (Langhinrichsen-Rohling et al. 2012). Kleck & McElrath (1991) considered a broad spectrum of assaults ranging from mere threats to homicides at multiple stages of the incident to explore this hypothesis. They suggest that offenders can successfully threaten or intimidate their intended target with the mere presence of a firearm, whereas they may need to objectively demonstrate their power through actual physical harm if in possession of another weapon type. Using event history analysis, Wells & Horney (2002) extended this line of inquiry by assessing how possession of a weapon influenced the likelihood of an attack and subsequent injury while controlling for offender intent. Their results indicated that persons armed with a firearm were more likely to confront a victim than those armed with another type of weapon; however, incidents featuring firearms were substantially less likely to result in any injury to victims.

Despite some contradictory evidence (Tark & Kleck 2004), the available research generally suggests that the mere threat of gun injury assists offenders in achieving their aims and often nullifies the need to use deadly force. As such, offenders do not typically employ firearms in an effort to inflict maximum harm against their victims (Zimring 1968) but rather to avoid potential confrontation and injury through implicit assertions of dominance. However, in cases in which the victim is attacked and injured, the likelihood of death in violent gun crimes is far higher than with knives or blunt objects, which accounts for the relatively high case-fatality rate for incidents featuring guns.

POLICY IMPLICATIONS

The most important implication of instrumentality effects is that policies that decrease gun use in violent crime should reduce the homicide rate even if the overall volume of violent crime was unchanged (Cook et al. 2011). A variety of law enforcement approaches attempt to reduce gun violence by incapacitating those who have been convicted of gun crimes and deterring future gun crimes. Others suggest that policies designed to deprive potentially violent people of guns could save lives (Cook et al. 2011). This is a central element of the argument to restrict gun availability. In this section, we first discuss criminal justice approaches to reduce gun use by violent criminals, briefly review the existing evidence on the relationship between gun availability and violent crime, and summarize the impacts of gun control legislation designed to reduce gun availability on violence.

Firearm sentence-enhancement laws require minimum mandatory sentences or additional time in prison for gun felonies. To many observers, gun use in robberies and assaults deserves harsher punishments because of the increased chance that victims are killed (Cook & Nagin 1979). Sentencing enhancements are intended to reduce gun use in violence, encourage desistance from violent gun crimes, and induce prospective gun offenders to substitute less-lethal weapons. What

is more, stiffer prison penalties for gun crimes do not impact the ability of law-abiding citizens to own guns for recreational and self-defense purposes. As such, this approach is supported by gun control and gun rights advocates alike. Although there is some evidence to the contrary (e.g., Marvell & Moody 1995), the available research evidence suggests firearm sentence-enhancement laws generally seem to work in reducing gun violence (see, e.g., McDowall et al. 1992, Pierce & Bowers 1981). In a careful analysis of state-level firearms sentence enhancements, Abrams (2012) found that the introduction of these laws in several states reduced gun robberies by 5% without any discernible impact on non-gun robberies.

A more controversial approach to reducing gun violence involves focusing local law enforcement agencies on deterring illegal gun possession and carrying in public spaces. Police departments need to ensure that such approaches safeguard against illegal searches and seizures and do not devolve into harassment of citizens, especially young minority men, lawfully present in public places (Moore 1980). However, the available empirical evidence suggests gun-oriented patrols can reduce gun violence (Cohen & Ludwig 2002, McGarrell et al. 2001, Sherman 2000). Gun violence tends to concentrate in very small hot-spot locations in urban environments (Braga et al. 2010). Hot-spots policing programs designed to increase gun seizures have been shown to generate significant reductions in gun violence without causing negative externalities such as crime displacement or police-community relations problems (Braga et al. 2019, Sherman & Rogan 1995).

Another criminal justice–led intervention attempts to deter groups of high-rate offenders from using guns to settle ongoing disputes with other criminally active groups. Focused deterrence, sometimes called pulling-levers policing, follows an action research model that tailors the strategy to specific gun violence problems and builds upon local operational capacities to deliver sanctions and mobilize support to control those high-rate offenders who drive persistent gun violence (Braga et al. 2001, Kennedy 2011). Focused deterrence attempts to prevent gang and group-involved violence by making group members believe that gun use by any one member of the group would result in legal problems for all members. The intent is to create an incentive for group members to discourage each other from gunplay, thus reversing the usual group norm in support of violence. A key element of the strategy involves the delivery of a direct and explicit "retail deterrence" message to a relatively small target audience regarding what kind of behavior would provoke a special law enforcement response and detailing what that response would be. Social services are provided to gang and criminally active group members who want to change their life trajectories. The deterrence message is delivered by talking to gang members on the street, handing out fliers in the hot-spot areas explaining the enforcement actions, and organizing forums between violent group members and representatives (Kennedy 2011). A growing body of rigorous program evaluation evidence suggests focused deterrence programs are effective in reducing gang and group-involved gun violence problems (Braga et al. 2018).

Reducing firearm availability can make violent events less lethal. The difficulty and legal risks associated with obtaining and using guns influence offender decisions on what weapon to use when committing a crime (Wright & Rossi 1994). Reducing firearm availability should, in turn, reduce the prevalence of guns used in violent crimes. However, to some observers, widespread access to guns induces a deterrent effect on criminal behavior as offenders' fear of confronting potentially armed victims should dissuade them from crime (Kates & Mauser 2006, Lott 2010). The proposed negative relationship between firearm availability and crime reduction (or "more guns, less crime") has been generally unsubstantiated when sound measurement and methodological strategies are utilized (Cook & Ludwig 2006a, Kleck 2015). And although guns certainly give some law-abiding citizens the opportunity to escape injury at the hands of violent criminals, it remains unclear how often guns are actually used in self-protection. Definitional issues about what constitutes defensive

gun use make it difficult to develop reliable and valid estimates of the annual frequency of such events (Cook et al. 2011, Natl. Res. Counc. 2005).

Attempts to analyze the relationship between firearm availability and violent crime are characterized by substantial variation in the methodological approaches used by analysts. The current state-of-the-art considers how temporal and spatial differences in community gun ownership affect the extent and nature of violent crime. The United States exhibits the highest rate of civilian gun ownership in the world with more than 350 million guns in private hands (Inst. Med. & Natl. Res. Counc. 2013). However, gun prevalence varies markedly across communities—e.g., states, counties, and cities—and over time (Cook et al. 2011). Comparisons across place, time, or both afford researchers insight into the relationship between community gun availability and violent crime. However, such analyses are often complicated by unreliable measures of community firearm prevalence. Although a precise measure of gun prevalence proves elusive due to the lack of centralized administrative data on gun ownership, the proportion of suicides that involve a firearm [firearm suicides/total suicides (FS/S)] is generally regarded as a well-validated proxy measure (for a discussion, see Natl. Res. Counc. 2005). Analyses of survey data generally find that FS/S is highly correlated with gun ownership rates and, furthermore, these data can be used to reliably track trends in gun prevalence over both space and time (Azrael et al. 2004, Cook et al. 2011, Kleck 2004).

The preponderance of empirical evidence indicates that higher levels of firearm ownership do not have any effect or, at best, only modest effects on overall violent crime rates (Cook & Ludwig 2006b, Cook & Pollack 2017, Duggan 2001). Firearms do not necessarily intensify the prevalence of violent crime, as rates of assaults and robberies appear largely unaffected by the availability of guns. However, examining the effects of gun availability on homicides demonstrates their critical role in shaping the outcomes of violent encounters. Whereas the connection between firearms and the general incidence of violence appears weak, strong and positive associations between community gun ownership rates and homicide rates indicate that guns do increase the intensity and lethality of violence. These positive associations are observable across regions (Miller et al. 2002), states (Siegel et al. 2013), counties (Duggan 2001), and cities (Cook 1979). Furthermore, studies using longitudinal methods and appropriate measures of gun prevalence suggests that this increase in lethality is restricted to just the firearm homicide rate, as non-firearm homicides, like general levels of nonlethal crime, appear unrelated (Cook & Ludwig 2006b, Miller et al. 2002, Siegel et al. 2013). Consistent with the instrumentality hypothesis, firearms alter the quality and lethality of violence but not its quantity.

Recent studies indicate that high levels of community gun ownership may extend to other forms of lethal violence such as police use of deadly force and the homicide of on-duty police officers. The majority of persons shot at and/or killed by the police were in possession of a firearm at the time of the incident and the majority of felonious killings of police officers are committed with a firearm (Klinger et al. 2016, Zimring 2017). State-level analyses document significant and positive associations between state gun ownership rates and both rates of fatal police-involved shootings and homicides of law enforcement officers, independent of other contextual factors (Hemenway et al. 2019, Swedler et al. 2015). In the case of police use of deadly force, gun prevalence was positively associated with the shooting rate of citizens armed with guns and, to a lesser degree, citizens armed with other types of weapons. Nagin (2020) similarly found positive associations between firearm ownership and the prevalence of fatal police shootings, demonstrating that this relationship was observed across race.

Finally, some studies have also examined this issue by evaluating the impacts of gun control legislation and gun ownership levels on violent crime rates. For instance, a cross-sectional analysis of 170 cities with a 1980 population of 100,000 residents or greater found that gun prevalence

levels generally had no net positive effect on total violence rates; homicide, gun-assault, and rape rates increased gun prevalence; gun control restrictions had no net effect on gun prevalence levels; and most gun control restrictions generally had no net effect on violence rates (Kleck & Patterson 1993). These findings provide some support to the notion that more-restrictive gun laws merely force offenders to shift from guns to other weapons in their criminal pursuits while failing to reduce overall homicide or crime rates (Kleck & Patterson 1993). Relatedly, Kleck (1984) suggests that criminals might substitute rifles and shotguns in response to handgun control policies, and the use of more powerful firearms could ultimately serve to increase the death rate.

Other research, however, supports the use of policies that are aimed at restricting the accessibility of handguns to high-risk individuals (Cook et al. 2011). For instance, Wright et al. (1999) assessed whether denial of handgun purchase can influence an individual's subsequent risk for crimes involving guns or violence. Specifically, individuals with a prior felony conviction who were denied the purchase of a handgun were compared over a 3-year period to individuals with prior felony arrests who purchased handguns. The results indicate that the denial of handgun purchase was associated with a 20% to 30% reduction of risk for new crimes involving guns or violence (Wright et al. 1999), supporting the findings of other research (Wintemute et al. 1999). Indeed, much of the gun violence problem is concentrated among prohibited possessors and other high-risk individuals and gun control policies designed to keep firearms out of the wrong hands could be used to good effect in reducing serious violence (Braga & Cook 2018, Cook et al. 2005).

CONCLUSION

The potential lethality of gun violence has motivated vigorous debate about the utility of gun control for reducing fatalities. From a dangerousness perspective, if the weapons used in assaults were less deadly (hands, knives, etc.), fewer people would die. But this premise rests on the assumption that there is nothing distinctive about gun violence vis-à-vis non-gun violence, save for the weapon of choice. That is, those intent on committing assault may be more likely to cause fatal injuries to the victim if they attack with a gun; however, their intent to injure is no different than had they opted for a knife or stick or any other available weapon. The outcome may vary, but the goal does not. Consequently, the instrumentality of firearms, or their heightened potential for causing fatal injury relative to other kinds of weapons, elevates the chances of death (Braga & Cook 2018; Cook et al. 2019; Zimring 1968, 1972). Alternatively, if gun violence represents a clear intent to kill that is absent in other types of assault or attack, the features of assaults with guns versus assaults with other weapons should be distinctive. In this latter scenario, intentionality drives the attack; fatal outcomes are more likely not because guns are more dangerous but rather because the attacker chooses a more dangerous weapon to achieve the result they intend.

Our review of the available scientific evidence suggests that guns do indeed make violent situations more lethal. It is important to note that the type of weapon used in violent situations matters in several ways. Guns are usually not fired and the victims of most gun assaults and gun robberies are not injured. Criminals deploy guns to control violent encounters and intimidate their victims without actually firing bullets and generating gunshot wounds. Victims are much more likely to resist attackers who use knives, blunt instruments, and other means. As such, victims in non-gun assaults are more likely to suffer injuries. However, when gun assaults and gun robberies result in injuries, victims are much more likely to die. Many factors influence mortality in injurious gun assaults; the number and placement of gunshots wounds on victims significantly influence the lethality of gun attacks, as do factors such as how quickly first responders provide initial aid and the proximity of high-quality trauma care centers. Finally, the technology of the guns deployed

in injurious assaults influences mortality, wherein firearms with higher-capacity magazines and larger-caliber bullets are more deadly than guns without these features.

The guns used in violent crime are becoming more deadly over time, with the police recovering increasing shares of higher-capacity, large-caliber semiautomatic pistols. Yet case-fatality rates have stabilized, despite the more lethal technology of contemporary firearms, at roughly one gun homicide for every six victims with nonfatal gunshot injuries. Some evidence suggests that improved trauma care may be offsetting the increased lethality of handguns available to violence-prone individuals. Unfortunately, one-third of roughly 74,000 annual emergency department admissions for gunshot injuries are treated in community hospitals that do not have high-quality trauma centers (Coupet et al. 2019). Increasing the number of hospitals that can provide life-saving care for traumatic gunshot injuries may save lives and decrease case-fatality rates in underserved areas. It is also tempting to consider increasing the use of new technologies, such as Shotspotter acoustic gunshot detection systems, that get first responders to life-threatening gun assault scenes quickly so short-term care can be administered immediately and patients can be transported to trauma centers more rapidly.

The available program evaluation evidence suggests that criminal justice interventions designed to change offender decisions to use guns in violent crimes, such as firearm sentencing enhancements and proactive policing efforts, are effective in reducing gun violence. Another policy issue that undergirds consideration of firearm instrumentality effects, however, is whether interventions that reduce the availability of guns to potentially violent people reduce the homicide rate. To gun rights advocates, gun controls are futile, as determined killers will simply complete their acts via the substitution of other means. Research highlighted here appears to provide a strong counter to this enduring argument made by gun rights activists by challenging the notion that gun-assault outcomes are determined by the intent of the shooter. Zimring's (1968, 1972) seminal studies and the Braga & Cook (2018) update indicate enhanced gun controls could indeed reduce homicide. These studies suggest that gun homicides and nonfatal gun assaults with injury are very similar in terms of incident circumstances and the characteristics of offenders and victims. Furthermore, mortality in gun assaults seems to be strongly influenced by chance events rather than indicators of assailant intent to kill. Importantly, the research finds that the likelihood of death was systematically associated with the caliber of the gun deployed in the attack: More powerful handguns were more likely to result in the death of the gunshot victim. The selection of gun caliber in these violent events was not correlated with available indicators of shooter determination to kill, such as the location and number of wounds. In sum, reducing the lethality of the weapons available to would-be killers may result in fewer fatalities in gun-assault events.

The existence of firearm instrumentality effects supports a wide range of gun control efforts to reduce the availability of firearms to high-risk people (Cook et al. 2011). These policy interventions include tax initiatives to raise the price of guns and ammunition to dissuade violence-prone individuals from making purchases (Cook & Leitzel 1996), screening out high-risk purchasers via background checks (Ludwig & Cook 2000, Wintemute et al. 1999), regulating secondary firearms markets (Cook et al. 1995), and reducing illegal gun trafficking (Braga et al. 2012). Unfortunately, we do not currently have much guidance on what works in reducing the availability of guns to high-risk individuals (Inst. Med. & Natl. Res. Counc. 2013, Natl. Res. Counc. 2005). Like others, we think that it is time to experiment with alternative gun control measures in an effort to develop more effective interventions than the current array of policies and programs. And, in doing so, we should be mindful of potential substitution effects in which prohibited persons acquire guns through other mechanisms. For instance, a longitudinal study found that the passage of the Brady Handgun Violence Prevention Act of 1994, intended to screen out prohibited handgun purchasers through mandatory criminal history background checks at licensed gun dealers, had a negligible

effect on homicide rates (Ludwig & Cook 2000). However, the study authors suggested the homicide reduction impact of the Brady Act may have been undermined by continued criminal access to firearms through unregulated transactions made by unlicensed private sellers.

The potential impacts of developing such a portfolio of evidence-based gun control interventions could be quite large. One estimate suggests gun violence in the United States costs roughly US$100 billion per year (Cook & Ludwig 2006b). In their simulation of the impacts of the effects of replacing medium- and large-caliber handguns with small-caliber handguns on gun-assault outcomes, Braga & Cook (2018) estimate a near 40% homicide reduction if all shootings were committed with small-caliber handguns rather than the existing mix of large, medium, and small-caliber handguns. The RAND Corporation estimates that each murder costs some US$8.6 million and each aggravated assault costs roughly US$87,000 (RAND 2010). In 2018, there were approximately 10,265 gun murders in the United States (FBI 2018). If we were able to achieve a 40% reduction in gun deaths, the monetary savings would be in the range of US$35 billion. And, more importantly, such an intervention would spare families and friends the devastation of losing loved ones to senseless gun violence. As such, expenditures to test new interventions could ultimately prove to be highly cost-effective and reduce the tragic human costs perpetuated by ongoing gun violence in the United States.

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