Smart Guns, the Law, and the Second Amendment

Dru Stevenson*

ABSTRACT

Smart guns, which originally meant personalized guns that only the owner could fire, had a false start as a promising new technology several years ago. Nevertheless, policymakers have shown renewed interest in the wake of highly publicized incidents of gun violence, as well as advances in technology. The first generation of smart guns foundered on problems with the reliability of the technology, as well as a legislative misstep that would have banned all other guns as soon as smart guns appeared in the retail market. This proposal triggered massive boycotts of certain manufacturers and dealers and a subsequent abandonment of the project by the gun industry overall. Newer technologies, however, such as improved biometric grip identifiers, precision-guided rifles that rarely miss, blockchain or "glockchain" automated tracking, and optical scopes that send videos to smartphones, have revived interest in smart gun products. At least one state in 2019 (New Jersey) passed carefully drafted legislation promoting the introduction of personalized guns, while another (Arizona) passed legislation discouraging the adoption of digital ledgering technology for firearms. In addition, some leading candidates in the 2020 primary advocated for smart guns as a solution to gun violence. This paper will explore the emerging second-generation smart gun technology, its potential for adoption by the military, law enforcement, and civilian markets, and the realistic prospects for improvements in safety or reduction in gun violence. This discussion will include the disconnect between policy agendas regarding firearm safety and technological enhancements driven by current consumer demand—and the murky moral assumptions that undergird both.

*Professor of Law, South Texas College of Law – Houston. The author would like to thank the editors of the *Penn State Law Review* for the opportunity to publish and for their excellent editorial work, which significantly improved the manuscript. Research assistants Greta Carlson and Sofia Colorado provided invaluable assistance with this project.

Table of Contents

> Constructive debate about gun policy continues to falter in part because of basic disagreement over what the right to keep and bear arms is for. Consider "smart guns" – weapons that work only when activated by an authorized user. Reaction to even the availability of such weapons, much less their requirement, and been swift and caustic.[1]

I. INTRODUCTION

Imagine a gun that cannot miss, or a gun that only the owner can fire. Imagine decentralized, blockchain-based background checks for gun purchases, as well as owner registration and concealed carry permits, not controlled by any individual, but more reliable than the current FBI-administered system.[2] Technological improvements to existing products and tools can make guns safer, more effective, or more interactive for the user or with other tools and products. Emerging technology for firearms—so-called "smart guns" and related electronic firearm accessories—run along these same three lines. Some smart gun technology is meant to enhance safety, as with personalized guns shootable only by a designated user, or computerized gun safes or locking holsters.[3] Other smart gun technology does the opposite, at least arguably, by making firearms more lethal, through enhanced accuracy and power.[4] A third emerging line of

1. JOSEPH BLOCHER & DARRELL A. H. MILLER, THE POSITIVE SECOND AMENDMENT: RIGHTS, REGULATION, AND THE FUTURE OF *HELLER* 151 (2018).

2. *See* Anthony W. Metzler, Note, *Triggered: Mass Shootings, Smart Gun Technology and the Search for Solutions*, 19 J. HIGH TECH. L. 103, 111 (2018).

3. *See* Matt Schroeder, *New Technologies and Small Arms Control: Preventing Unauthorized Acquisition and Use*, *in* BEHIND THE CURVE: NEW TECHNOLOGIES, NEW CONTROL CHALLENGES 75, 82–88 (Benjamin King & Glenn McDonald eds., Small Arms Survey 2015), *available at* https://bit.ly/2UDeKau; *see also* FRANK MINITER, THE FUTURE OF THE GUN 227–33 (2014) (discussing personalized smart guns).

4. *See* MINITER, *supra* note 3, at 48–53 (describing TrackingPoint rifles).

smart gun technology permits interactivity, such as live-streaming the view from the gun's scope,[5] or by tracking discharges, location, and gun possession through online blockchain ledgers.[6] Interactivity, in turn, paves the way for a fourth line of emerging firearm technology: automated recording, memorializing, and archiving events for subsequent replay, which can enhance accountability (say, for police shootings of unarmed suspects)[7] and justification, corroborating an otherwise disputable claim that a shooting was in self-defense. All these technologies are potentially disruptive for the legal regime governing firearm possession and use—a legal arena already fraught with intense controversy.

Reforming gun policy, and gun culture, in the United States is a source of ongoing political divisiveness and acrimony. Firearm technology interacts in complex ways with the Second Amendment,[8] the evolving common law surrounding the Second Amendment in the lower courts, and in statutes, administrative regulations, and law enforcement. Congressional enactments in the last two decades have elevated gun rights over other legal rules and legal authorities, such as common law tort liability,[9] meaning the prospect of tort liability and the duty of care has not driven the introduction of safety features with firearms as it has with other consumer products. From a market standpoint, some of the emerging firearm technologies are dependent on proposed statutory or regulatory mandates for the adoption of new safety features. Alternatively, rather than depending on legal requirements to encourage its adoption, other emerging technology functions either as a workaround to existing legal restrictions and bottlenecks or as a means for thwarting existing laws or policy. The academic literature to date about "smart guns" focuses exclusively on personalized firearms or electronically controlled safety mechanisms (ECSMs)—weapons that only the owner or a designated user can fire.[10] The technology has existed in various forms for many years, but it has been evolving, and other "smart" technologies for firearms have now emerged.

---

5. *See id.* at 22–24.

6. *See* Robin Kester, *Demystifying the Internet of Things: Industry Impact, Standardization Problems, and Legal Considerations*, 8 ELON L. REV. 205, 215 (2016) (discussing this technology as adopted by two police departments).

7. *See* MINITER, *supra* note 3, at 232–33.

8. *See* U.S. CONST. amend. II.

9. *See* Stephen P. Teret, *Key Perspectives and Insights on Personalized Guns, in* PERSONALIZED FIREARMS AND ELECTRONIC SAFETY DEVICES: PERSPECTIVES 24, 28 (Small Arms Survey 2013), *available at* https://bit.ly/2ycfEmN.

10. *See* DAVID HEMENWAY, PRIVATE GUNS, PUBLIC HEALTH 226 (2d ed. 2017) ("The regulatory agency should actively promote new technology that will make society safer. For example, 'smart' or personalized guns that cannot be fired except by authorized users can help prevent unintentional injuries of children and adolescents and limit criminal use of stolen guns.").

Weapons, considered a type of technology, inherently pose both moral hazard and adverse selection issues, as do some other technologies. From a moral hazard standpoint, having a gun brings feelings of confidence, security,[11] and sometimes even dominance. Depending on your position on gun rights, this feeling is either the essence of "freedom,"[12] or a dangerous delusion. Either way, whether consciously or unconsciously, those who believe they have reduced or eliminated their odds of injury or premature death will take more risks than they would otherwise. With guns, this might mean walking alone in high-crime neighborhoods after dark;[13] standing up for yourself in an argument or, in the face of an affront, intervening to help others who seem to be in danger; or to give vent to your indignation at rude drivers on the road. When we insure or ensure ourselves against some harm, we simply do not need to be as careful to avoid it. Adverse selection is a screening effect: suppose, hypothetically, that the people you would least want to have guns are the most likely to want them, and are disproportionately likely to obtain them. There are individual exceptions, of course, in any moral hazard or adverse selection scenario—some individuals will continue to be cautious even when their risks are low, and some low-risk individuals will opt into the risk pool. Some cautious, safe, self-controlled, dispassionate people own guns. Moral hazard and adverse selections are about the general tendency of a group taken together.

The four smart gun technologies discussed below each purport to either make guns safer by preventing misuse, making guns more lethal by maximizing accuracy, or validating the legitimacy of firing a gun for after-the-fact inquiries. The ensuing discussion attempts to explain each of these emerging smart gun technologies, and to situate them in their legal and social context. A secondary, more normative agenda is also present: notwithstanding the advantages these new technologies afford, each one can intensify the moral hazard and adverse selection problems that are inherent in firearm ownership. For example, a smart gun with electronic safeguards against theft or misuse allows the owner to be more carefree about her gun than she would otherwise be (the moral hazard problem). Similarly, by reducing the likelihood of theft, the accidental death of one's children, or a grab-away shooting, it further skews the me-versus-others internal calculus that drives adverse selection. Additionally, a gun with electronics to make it infallibly accurate, and therefore super-lethal, will appeal the most to those who are most bent on killing (adverse selection), and ratchet up the confidence boost or power trip that guns already provide (moral hazard). Further, a gun that vindicates the shooter after a killing

11. *See* MINITER, *supra* note 3, at 233–34.
12. *See id.*
13. *See id.*

would do the same—making the owner less hesitant to shoot and appealing disproportionately to those most likely to shoot.

The following discussion will arrange topics by type of technology: personalized smart guns (authorized-user trigger locks), sophisticated precision-guided firearms, recordkeeping guns, and "glockchain" (blockchain ledgering) guns. Part II focuses on personalized smart guns, the most-discussed type of smart gun technology. Given the longstanding and ongoing controversy over this type of smart gun, and the repeated but unsuccessful incidents of government intervention to spur the development of these products, this will be the longest section of the article. Most academic and legal literature up to now uses the term "smart gun" synonymously with electronically personalized guns;[14] the technical term in international military contexts for these weapons is ECSMs.[15] The promise these devices have for reducing firearm injuries and fatalities makes their deficiencies and unmarketability all the more frustrating.

One of the goals of this symposium contribution is to expand the common understanding of "smart guns" to include other emerging firearm technologies that could prove just as disruptive to the industry—and to firearm policy—as ECSMs or personalized smart guns. In this vein, Part III discusses a newer and far less familiar type of smart gun, what I will call "Guns That Cannot Miss"[16] (though the technical terminology would be precision-guided firearms),[17] a subset of autonomous weapons systems

14. *See, e.g.*, Patrick J. Charles, *The Second Amendment in the Twenty-First Century: What Hath* Heller *Wrought?*, 23 WM. & MARY BILL RTS. J. 1143, 1175–76 (2015); Philip J. Cook & James A. Leitzel, *"Smart" Guns: A Technological Fix for Regulating the Secondary Market*, 20 CONTEMP. ECON. POL'Y 38, 39 (2002); Adam Crepelle, *Concealed Carry to Reduce Sexual Violence Against American Indian Women*, 26 KAN. J. L. & PUB. POL'Y 236, 254–55 (2017) (advocating arming Native American women with smart guns to defend themselves against sexual violence); Barack Obama, *The President's Role in Advancing Criminal Justice Reform*, 130 HARV. L. REV. 811, 857–58 (2017) ("We've also jumpstarted the development of smart gun technology. As long as we've got technology to prevent a criminal from stealing and using your smartphone, then we should be able to prevent the wrong person – including kids – from pulling the trigger on a gun."); William F. Godbold IV, Note, *Constitutional Law – Shooting Blanks: Smart Gun Mandates and Their Concomitant Constitutional, Regulatory, Public Policy, and Practical Issues*, 37 U. ARK. LITTLE ROCK L. REV. 167, 169 (2014); Tyler J. Kimberly, Comment, *A Higher Caliber of Regulation: Is Making Smart-Gun Technology Mandatory Constitutionally Permissible?*, 65 CASE W. RES. L. REV. 251, 253–54 (2014); Jessica M. Lujan, Note, *Half-Cocked: "Smart Gun" Mandates Are Premature and Unconstitutional Under the Prevailing "Undue Burden" Test*, 24 B.U. J. SCI. & TECH. L. 500, 501–05 (2018); BLOCHER & MILLER, *supra* note 1 at 151; HEMENWAY, *supra* note 10 at 226; Metzler, *supra* note 2, at 111.

15. *See* Schroeder, *supra* note 3, at 82.

16. *See* Mark Dewey, *A New 'Smart Rifle' Decides When to Shoot and Rarely Misses*, NPR: ALL THINGS CONSIDERED (May 15, 2013), https://n.pr/2UIW1tY.

17. *See* Mike Gassaway, *Touring Trackingpoint's Facility, Where Precision Guided Firearms Are Made [Videos]*, GUNS.COM (Aug. 14, 2018, 8:00 AM), https://bit.ly/39pOS7g (video tour of facilities of the manufacturer of civilian-marketed precision-guided firearms, with discussion of the weapons).

(AWS).[18] These sophisticated weapons use computer processing and advanced optics to lock on targets—including moving targets—and to correct for wind, humidity, Coriolis effect, rifle cant, weight of the cartridge, and even the absence of light. High-end models can hit a moving target in the dark at 1400 yards (about eight-tenths of a mile),[19] even with an unskilled shooter. They also enable an operator at a remote location to fire the gun while another person merely carries it on location and points it toward the target. Naturally, such weapons are especially appealing for military use,[20] but they are available for the civilian market, though outside the price range of most gun purchasers. Even so, these next-generation weapons with super-lethality could force our legal system to revisit long-held assumptions about the proper line between intentional and unintentional homicides, attempted versus completed crimes, the right of self-defense, police shootings of fleeing suspects, and even the presumed sporting virtues of hunting.[21]

Part IV discusses the emerging technology of guns that track everything—not only audio/video uploads from the scope, but also nuanced movement tracking, similar to the "black box" in an automobile that constantly records speed, acceleration, braking, and turns. These guns record (often in encrypted form) every discharge, but also the angle and location at the instant of discharge, every movement of the gun before and after discharge, and so on. Creating such a record presents enhanced accountability for law enforcement, similar to the policy rationales for police bodycams, and could also assist with documenting the justifications for shootings, thus validating a subsequent claim of self-defense by a civilian gun owner. Finally, Part V will briefly address emerging gun blockchain or "glockchain" technology, which of course overlaps with Part IV on recording the location and usage of the gun—but the online, anonymous blockchain ledgers could assist with owner registration, tracing crime guns (chain of custody), locating stolen guns, and even with

18. *See* Christopher P. Toscano, *"Friend of Humans": An Argument for Developing Autonomous Weapons Systems*, 8 J. NAT'L SECURITY L. & POL'Y 189, 232 (2015).

19. *See ShadowTrax8*, TRACKINGPOINT, https://bit.ly/2QNPLjD (last visited May 19, 2020) ("If you need knock-down power for brown bears or African cats, this is your gun. If you need battalion-level sniper capabilities in a combat zone, this is your gun. Whatever your need, with a precision-guided lock range of more than ¾ of a mile, pulling the trigger on the ShadowTrax8 is like calling in an airstrike.").

20. *See* Kyle Mizokami, *The U.S. Army's New Rifle Comes With Tech Found in Tanks and iPhones*, POPULAR MECHS. (June 3, 2019), https://bit.ly/2JjsMbW; Peter Suciu, *U.S. Army Takes Aim at Developing Smart Gun Technology*, CLEARANCEJOBS (Oct. 29, 2019), https://bit.ly/2WLFpo1 ("The Army's specifications for this next-gen firearm are that it would be equipped with a "smart rail" system that could provide communications and power interface between the actual weapon and a computerized onboard system.").

21. For a thoughtful background discussion about the relationship between lethality and Second Amendment rights, see Joseph Blocher & Darrell A.H. Miller, *Lethality, Public Carry, and Adequate Alternatives,* 53 HARV. J. ON LEGIS. 279, 294–300 (2016) [hereinafter Blocher & Miller, *Lethality*].

concealed carry permits, hunting licenses, and firearm purchase background checks.

There are other new or emerging technologies *related* to firearms that also fall outside the scope of this Article, even though they deserve more academic commentary. These are 3D-printed guns (which are rudimentary, not technologically sophisticated, weapons),[22] microstamping (serial number imprints on bullet casings that tie each bullet fired to the gun that discharged it),[23] and gunshot or gun detection technology,[24] which uses AI and other technologies to recognize and alert security or law enforcement personnel instantly to the presence of guns or where shots have been fired.[25] In addition, it seems appropriate at the

22. *See, e.g.*, Washington v. U.S. Dep't of State, 420 F.Supp.3d 1130, 1136–38 (W.D. Wash. Nov. 12, 2019) (invalidating Trump Administration decision to remove online 3D gun designs from the United State Munitions List). *See generally* Jessica Berkowitz, *Computer-Aided Destruction: Regulating 3D-Printed Firearms Without Infringing on Individual Liberties*, 33 BERKELEY TECH. L.J. 51, 81–84 (2018) (proposing expansion of background checks to cover ammunition purchases as the best remedy to the regulatory challenges posed by 3D-printed firearms); James B. Jacobs & Alex Haberman, *3D-Printed Firearms, Do-It-Yourself Guns, & The Second Amendment*, 80 L. & CONTEMP. PROBS. 129 (2017) (focusing on Second Amendment challenge to the government's attempt to keep 3D printing firearms software off the Internet); Rory K. Little, *Guns Don't Kill People, 3D Printing Does? Why the Technology Is a Distraction from Effective Gun Controls*, 65 HASTINGS L.J. 1505 (2014) (arguing that gun control advocates should focus primarily on regulating criminal use of guns, and not on the technology used to manufacture them); Michael L. Smith, *The Second Amendment Implications of Regulating 3D Printed Firearms*, 31 SYRACUSE J. SCI. & TECH. L. 60 (2015) (arguing that most restrictions on 3D printed firearms will survive Second Amendment challenges).

23. *See generally* Pena v. Lindley, 898 F.3d 969, 981–86 (9th Cir. 2018) (upholding California's microstamping requirement, with a detailed explanation of the technology).

24. *See generally* Amanda Busljeta, Comment, *How an Acoustic Sensor Can Catch a Gunman*, 32 J. MARSHALL J. INFO. TECH. & PRIVACY L. 211 (2016) (discussing the acoustic sensor technology and its applications); Daniel S. Lawrence et al., *Evaluation of Gunshot Detection Technology to Aid in the Reduction of Firearms Violence*, URBAN INST. (Oct. 2019) https://bit.ly/2X7Hj2s; Kester, *supra* note 6, at 215 ("ShotSpotter™ is able to determine when and where gunshots are fired in public using connected microphones that are installed throughout a city, town, or college campus. As a result, police may be able to quickly determine an active shooter's location . . . [though] this technology is currently limited to outdoor gunfire . . . ."). *See also* SHOTSPOTTER INC., https://bit.ly/2JioPV9 (last visited May 19, 2020).

25. *See, e.g.*, Javed Iqbal et al., *Orientation Aware Object Detection with Application to Firearms* (Apr. 22, 2019), *available at* https://bit.ly/33RyhrG. Numerous courts have already issued opinions pertaining to police use of the technology. *See, e.g.,* State v. Harvey, 932 N.W.2d 792, 797 (Minn. 2019) ("A ShotSpotter device detected eleven gunshots between 12:06:52 a.m. and 12:07:34 a.m. on July 27."); United States v. Johnson, 365 F.Supp.3d 89, 93 (D.D.C. 2019) (discussing police dispatch based on ShotSpotter alerting authorities to moving (drive-by) shooter); United States v. Wilcher, 744 F.App'x. 604, 605 (11th Cir. 2018) ("A few minutes later, police officers, 911 callers, and the city's Shot Spotter system heard gunfire from a high-powered weapon."); Commonwealth v. Raglin, 178 A.3d 868, 872–74 (Pa. Super. Ct. 2018) (holding that police had reasonable suspicion to detain defendant for shooting detected by shot spotter); Commonwealth v. Holnesss, 101 N.E.3d 310, 313 (Mass. App. Ct. 2018) ("At 4:10 A.M., six minutes after the report of the shooting at 92 Wales Street, Boston police were dispatched to respond to

outset to mention that advanced electronics are not the only technological advancements happening in the firearm industry. My twelve-month review of manufacturers' catalogs or websites and gun enthusiast blogs that review new gun models suggests that manufacturers are innovating to meet intense consumer demand for firearms optimized for concealed carrying, now that all states permit the practice. This means engineering with new materials and new designs to make guns smaller, lighter, and still lethal with one shot. Of course, Hollywood depictions of gunslingers continue to feature large, imposing pistols and rifles for dramatic effect. Yet pocket-size guns dominate the new product lines from manufacturers because of the mushrooming number of concealed carriers. On the other end of the gun companies' product line are the ever-popular assault rifles, and for these, the holy grail of manufacturing research and development might now be larger and larger capacity magazines. Imagine a dependable, widely-available 200-round magazine for a semi-automatic assault rifle—a shooter could fire 200 times without reloading. It is on the horizon. The U.S. Patent and Trademark Office may have a more significant role in the future of guns in America than the Bureau of Alcohol, Tobacco, Firearms and Explosives ("ATF") does now.

II. PERSONALIZED SMART GUNS (ELECTRONICALLY CONTROLLED SAFETY MECHANISMS)

Personalized firearms, to which the words "smart guns" usually refer, use internal technology to limit use of the gun to authorized users. Advocates of personalized smart gun technology contend that it could save many lives by preventing unauthorized usage by criminals and unsupervised children.[26] In theory, if only the owner or other designated users could fire a gun, then that gun would be rendered useless if stolen or resold on the black market.[27] Unsupervised children could not injure themselves or others if they find or access an adult's firearms, and older adolescents could not take their parents' or older siblings' firearms to school to perpetrate a mass shooting or even settle a score with a rival classmate.[28] In addition, police officers would not be at risk of injury from

a 'ShotSpotter' device activation at 276 Talbot Avenue . . . ."); State v. Hill, 851 N.W.2d 670, 774–78 (Neb. 2014) (finding SpotShotter reliable and alerting admissible as evidence at trial); United States v. Devers, 530 F.App'x. 608, 608 (8th Cir. 2013) ("As relevant, the trial included the testimony of two police officers who were dispatched to an Omaha residence after the city's Shot Spotter system indicated that approximately four shots had been fired there.").

26. *See* HEMENWAY, *supra* note 10, at 138.

27. *See Smart Guns*, GIFFORDS LAW CTR., https://bit.ly/3dvYiRT ([last visited]).

28. *See id.*

their own firearms if arrestees wrestle or grab the gun away from the officer.[29]

A. The Desire to Save Lives

The concept of an electronically-personalized firearm first appeared in the mid-1990s as a possible solution to police weapon "takeaways," where a police officer is "injured or killed when a criminal wrestles the officer's firearm away and uses it against the officer."[30] Such a safeguard could be especially useful for law enforcement officers—16% of all officers killed in the line of duty are due to "takeaways" (snatching the officer's service weapon and turning it on the officer), or that of another officer, during an attempted arrest.[31] Nevertheless, 20 years after the invention of the first smart gun, the technology remains underdeveloped and underused.[32]

The same authorized-user features would also reduce accident-related gun death as well as the suicide rate among youths, and curtail the number of guns available on the black market. Accidental shootings make up 18% of all gun injuries and 1.3% of all gun deaths.[33] The increasing demands for ease of use and lower trigger weights in handguns in recent years have made modern handguns "child's play" to operate and create a "greater potential hazard if they end up in the wrong hands."[34] With personalized smart guns, unintended discharges during cleaning or regular handling of the gun would be drastically reduced because the weapon would not be authorized to fire unless held correctly.[35] One study of gun

29. *See id.*; *see also* HEMENWAY, *supra* note 10, at 138 ("A smart gun might also help police, who are sometimes killed with their own service firearms.").

30. *See* NAT'L. SHOOTING SPORTS FOUND., "AUTHORIZED USER RECOGNITION" (A.K.A. "SMART GUN") TECHNOLOGY (2013), https://bit.ly/3dAudAT; Schroeder, *supra* note 3, at 83 ("Equipping firearms with ECSMs could reduce the number of security officers injured or killed by assailants who gain access to their weapons (or the weapon of another security officer).").

31. *See* D. R. Weiss, *Smart Gun Technology Project Final Report*, SANDIA NAT'L LABS., May 1996, at 2, *available at* https://bit.ly/2Ul9IjQ.

32. *See* Amy Fawcett, *Is Smart Gun Technology Viable? Smart Gun Symposium Recap*, WASH. TECH. INDUSTRY ASS'N (Feb. 4, 2015) https://bit.ly/3btTASY; s*ee also* Schroeder, *supra* note 3, at 83 ("Nonetheless, sales of firearms equipped with ECSMs have been modest to date. Some promising technologies are still in development, and it may be many years before they are available for purchase. Of the 13 ECSMs assessed for their technological maturity . . . only three were categorized as an 'Advanced Prototype or Production-Ready Design.'").

33. *See Gun Violence Statistics*, GIFFORDS LAW CTR., https://bit.ly/2vUCL4z (last visited May 19, 2020).

34. Günter Maximilian Hefner & Karl Friedrich Giebel, *Electronic Firearm Safety Devices*, *in* SMALL ARMS SURVEY, PERSONALIZED FIREARMS AND ELECTRONIC SAFETY DEVICES: PERSPECTIVES 6, 6 (2013).

35. Unintentional discharges occur most often when the gun owner is cleaning the gun. (Necessary since already explained cleaning the gun above the line?) *See* VIOLENCE POL'Y CTR., "SMART GUNS" BACKGROUNDER 2 (2016).

deaths in Maryland and Wisconsin found that approximately 37% of unintended deaths would have been avoided had the guns in question been personalized.[36] Personalized smart guns could also help reduce the number of childhood gun-related deaths.[37] The majority of unintentional shooting deaths involve people under the age of 24.[38] Given that most firearm injuries to younger children involve guns belonging to their parents or relatives,[39] these shootings could be preventable, as most children would not be authorized users of a smart gun.[40] If only a designated user could fire any individual gun, then presumably children would be unable to play with or discharge the guns while unsupervised, and therefore would not accidentally shoot themselves, their siblings, or friends.[41] As Harvard public health professor, David Hemenway, explains, fewer children would suffer firearm injuries "if guns were 'personalized' or designed so that only authorized users could fire them. To this end, manufacturers could incorporate current technology—such as magnetic devices, radio frequency transponders, and combination locks—into guns."[42] Regarding youth suicides by gun, research indicates that suicide attempts correlate to firearm access; suicidal teens without a gun readily available usually do not simply find another means.[43] For example, researchers have found that nine out of ten suicide attempts by firearm are fatal, but all other (non-firearm) suicide attempts are fatal only 8.5% of the time.[44]

Devices that prevent the unauthorized use of firearms could potentially prevent criminal gangs and other unlawful possessors from using them as trafficked or diverted weapons.[45] A personalized smart gun would be unusable when stolen, which over time could reduce the number

36. *See* Teret, *supra* note 9, at 25; *see also Smart Guns*, *supra* note 27.

37. *See* HEMENWAY, *supra* note 10, at 138 ("Some manufacturers are developing 'smart' or 'personalized' guns that cannot be fired except by authorized users. These guns can help prevent unintentional injury to children and adolescents as well as the criminal use of stolen guns (which will also reduce the likelihood of firearm theft).").

38. *Gun Violence Statistics*, *supra* note 33.

39. *Smart Guns*, *supra* note 27.

40. *See* HEMENWAY, *supra* note 10, at 33 ("Most shootings of younger children involve firearms belonging to parents and grandparents. Here, too, tragedies could be prevented . . . .").

41. *See id.* ("[C]hildren [are] finding improperly stored firearms and shooting themselves or other people or adolescents shooting each other when they believe guns to be unloaded – [Physicians] know that there are readily available technological solutions, such as childproof firearms, smart guns, and magazine safeties.").

42. *Id.*

43. *See* Teret, *supra* note 9, at 24 ("Some skeptics might suggest that the absence of an operable gun would just cause a depressed teenager to find another means of suicide, but research shows that substitution or displacement of means of suicide frequently does not occur.").

44. *See* Andrew Conner et al., *Suicide Case-Fatality Rates in the United States, 2007 to 2014: A Nationwide Population-Based Study*, 171 ANNALS OF INTERNAL MED. __ (Dec. 2019), *available at* https://bit.ly/3bMW921.

45. *See* Schroeder, *supra* note 3, at 82.

of stolen guns on the black market.[46] Fewer black market guns should reduce the number of gun-related deaths and injuries that occur using stolen weapons.[47] Firearms stolen from homes and cars (numbering in the hundreds of thousands per year) often go directly into the black market and become crime guns.[48] Personalized smart guns would be inoperable by thieves or buyers on the black market, reducing the rate of gun crime resulting in death.[49]

Legally, there are currently no federal regulations for firearm safety or design standards, except for the National Firearms Act ban on machine guns.[50] In fact, a federal statute[51] prohibits the Consumer Product Safety Commission (CPSC), the unit of government that normally regulates safety for consumer items, from promulgating any rules or specifications for firearms or ammunition. This means there are no laws in place that incentivize gun manufacturers to develop or market smart guns. Three states—Maryland,[52] Massachusetts,[53] and New Jersey[54]—have statutes that address smart gun technology in some way, but none of these are regulatory mandates.[55] Some academic commentators have called for a federal agency, whether a new bureau or a newly-authorized agency that already exists, to have the authority to regulate firearm safety, including making rules and giving grants to develop smart guns and foster their widespread adoption by consumers.[56] "The agency should have the funds

46. *See id.* at 138 ("These guns can help prevent unintentional injury to children and adolescents as well as the criminal use of stolen guns (which will also reduce the likelihood of firearm theft).").

47. *See* David Hemenway, *Reducing Firearm Violence*, 46 CRIME & JUST. 201, 211–12 (2017) ("Personalized guns (also known as smart guns) make it more difficult for unauthorized people to use them. Having such guns rather than the normal firearm reduces the likelihood of accidents, suicides, and thefts. Personalized guns for police would stop criminals from seizing and using officers' guns against them.").

48. *See id.*; *see also* Michael L. Rich*, Limits on the Perfect Preventive State*, 46 CONN. L. REV. 883, 890 (2014) ("The implementation of so-called 'smart gun' technologies, which make a gun capable of being fired only by its lawful owner, could make it so that many violent criminals would be unable to obtain a usable firearm.").

49. *See* Hemenway, *supra* note 47, at 211–12.

50. *See Smart Guns*, *supra* note 27.

51. *See* 15 U.S.C. § 2052(a)(1)(ii)(E) (2018).

52. *See* MD. CODE ANN., PUB. SAFETY § 5–132 (West 2020); Philip J. Cook et al., *Gun Control After Heller: Threats and Sideshows from a Social Welfare Perspective,* 56 UCLA L. REV. 1041, 1054 (2009) ("And the Maryland legislature recently adopted a pioneering requirement: All handguns manufactured after 2003 and sold in the state must be 'personalized' with a built-in locking device that requires a key or combination to release.").

53. *See* MASS. GEN. LAWS ch. 140, § 131K (2019).

54. *See* N.J. STAT. ANN. §§ 2C:58-2.10, :58-2.7, :58-2.8, 2C:39-1dd (West 2020).

55. See Metzler, *supra* note 2, at 117–18 for a detailed commentary on the statutes in these three states.

56. *See* HEMENWAY, *supra* note 10, at 212–27.

to promote research on personalized or 'smart guns' and on less lethal ammunition and weapons,"[57] contends David Hemenway.

Personalized smart guns have two main types: (1) biometrics-based trigger locks (fingerprint or palm-grip readers, mostly); and (2) radiofrequency identification ("RFID")-token trigger locks (which work only when the shooter is wearing an electronically matched ring, key fob, or pendant).[58] These two lines of technology have advanced in other arenas in the last two decades and have become commonplace, but they have not caught on for guns, partly for market reasons and partly for legal-political reasons. A third but far less common version of this technology uses a PIN touchpad—the user types a three- or four-digit code into a keypad on the handle to enable the gun. Smart guns are, predictably, more expensive than their electronics-free counterparts.[59] But this is mostly due to the lack of scaling in production (i.e., mass production). The technologies "work" in a general sense—personalized guns are available for purchase—but like most technology, they are not foolproof.[60] Biometric guns may not work if the user wears gloves, as police often do,[61] or if the user has dirty or sweaty hands, or simply because the device is buggy that day. RFID trigger locks may be unusable even by the owner if the paired token (usually a pendant or ring) happens to be in another location, or even another room.[62] Both technologies present potential battery issues, and both are susceptible to (malicious) overrides or workarounds. RFID guns with longer range token capability could also be susceptible to sophisticated hackers.[63]

---

57. *Id.* at 214.

58. *See* Crepelle, *supra* note 14, at 254.

59. *See* Schroeder, *supra* note 3, at 83 ("In reality, the net effect on trafficking and unauthorized use depends on several factors, including the difficulty of circumventing or otherwise defeating the ECSMs, the security of tokens and PIN codes for token-based technologies, and the false positive rate of biometric technologies.").

60. *See* Michael Recce, *Using Computer Technology to Increase Gun Safety*, *in* PERSONALIZED FIREARMS AND ELECTRONIC SAFETY DEVICES: PERSPECTIVES 35, 37 (Small Arms Survey 2013); *see also* Crepelle, *supra* note 14, at 255 ("The even bigger concern, though, is the potential for the user recognition mechanism to fail and block the authorized user from firing the weapon at the crucial moment. Displaying a gun is often enough to stop an attacker, but threats are not always sufficient.").

61. *See* Metzler, *supra* note 2, at 128 ("Federal officers are often in situations where their fingerprint would be dirty or wet, and if this technology is implemented a firearm may not work when it is needed most . . . then they jeopardize the safety of the people they are meant to protect.").

62. *See* Metzler, *supra* note 2, at 110:

> In 2015, Mossberg, a leader in the market of firearms for home defense, released an RFID shotgun that can only be fired if the gun owner is wearing a ring. Mossberg says that his company, O.F. Mossberg & Sons, the oldest family owned gun company in the United States, is vigorously integrating the RFID technology under his authority in the name of safety for the gun owner.

63. *See* Yu-Ju Tu & Selwyn Piramuthu, *On Addressing RFID/NFC-Based Relay Attacks: An Overview*, DECISION SUPPORT SYSTEMS, Feb. 2020, at 1.

There are technological tradeoffs: biometric smart guns do not rely on radio signals and tokens, thereby eliminating the risk of hacking and misplacing the secondary token. But, at the same time, biometric readers present other reliability issues.[64] The reliability of fingerprint scanners depends on "variables such as finger positioning, residue, gloves, moisture, and battery failure."[65] One solution to this issue is the use of dynamic grip recognition,[66] rather than a fingerprint scanner. Dynamic grip recognition would work with gloves and relies on less expensive sensors, because it measures relative pressure at numerous points from the person's grip, rather than reading grooves on the surface of the skin (like a fingerprint reader).

Battery life could see improvement with newer prototypes that use the internal batteries only when the trigger is pulled.[67] Growth in the personalized electronics industry continues to reduce the cost and power consumption associated with these small electronics.[68] Some still express concerns that a smart gun may nonetheless be left in its "locked" setting if the battery fails, potentially leaving them defenseless in an emergency.[69] In the long run, smart guns may need to have a design feature that makes the gun default to a traditional, workable firearm whenever the electronics fail.

Biometric sensors, such as fingerprint and palmprint scanners, are the most common type of biometric ECSMs, but emerging technological variations include grip, voice, facial recognition, and even skin spectroscopy.[70] Biometrics can be physical or behavioral. Physical biometrics are some unique properties of the authorized user, such as their "fingerprints, DNA, iris patterns, or facial features."[71] Alternatively, behavioral biometrics are unique properties of an individual's behavior, like the characteristics of their voice or grip.

RFID, on the other hand, requires an external device for operation.[72] The token or key in an RFID is often a wearable device containing tiny

64. *See* Schroeder, *supra* note 3, at 86 ("Concerns about the maturity and reliability of new technologies also explain why some individuals and institutions are reluctant to adopt them, particularly ECSMs. There are fears that adverse physical conditions, battery failure, electromagnetic interference, or sabotage could render the devices inoperable during an armed engagement."); *see also* Hemenway, *supra* note 47, at 212.

65. *5 Things to Know About Smart Guns*, POLICEONE (Aug. 3, 2017), https://bit.ly/2UlIb1O.

66. *See* Crepelle, *supra* note 14, at 254.

67. *See 5 Things to Know About Smart Guns*, *supra* note 65.

68. *See id.*

69. *See id.*

70. *See* Schroeder, *supra* note 3, at 82.

71. Caitlin Hoffman, *Survey: Most Gun Owners Support Sale of 'Smart' Guns But Aren't Likely to Buy Them*, HUB (June 10, 2019) https://bit.ly/3aK3Kim.

72. *See* Schroeder, *supra* note 3, at 83 ("Token-based technologies differ from biometric technologies in that the device that enables the weapon is contained in a separate

electromagnetic transmitters, like a bracelet or ring, that emits a signal that unlocks the gun.[73] The token or key must be near the gun to unlock it. RFID is already commonly in use for "allowing for controlled building access, vehicle parking access, and library book theft prevention, among many other uses."[74]

LodeStar, a newer smart gun startup, chose to use RFID technology instead of fingerprint readers, as it explains on its website: "RFID is a proven, reliable approach and involves a simple "digital handshake" across a narrow gap between a small digital chip worn by the owner (e.g., embedded in a ring or wristband) and another chip embedded in the firearm."[75] LodeStar claims that smart guns could reduce gun deaths by 25%, that is, saving 100,000 lives per decade.[76] Like other proponents, the company contends that smart guns could reduce child gun accidents that occur when children find and play with their parents' guns, could prevent teenagers from using parents' guns in school shootings, would be unusable as crime guns if stolen, and would reduce suicides by those who have access to a friend or relative's guns.[77] Some earlier academic studies suggest similar conclusions. One oft-cited article from the early 2000s analyzed a sample of unintentional and undetermined firearm deaths and concluded that 37% of these deaths would not have occurred if the firearms involved had been smart guns.[78] The simplicity of RFID devices makes them overall less susceptible to user error. Nevertheless, the authorized user would be responsible for two devices, the firearm and the token. A gun owner may misplace the token, making it unavailable in an emergency. Alternatively, a gun owner may be inclined to store the token and the weapon together, rendering it "active" and negating the safety benefits. Additionally, RFID devices are susceptible to electromagnetic interference.

---

object, or token, which may or may not be personalized. Most token-based ECSMs employ RFID technology, consisting of an RFID reader and tag.").

73. *See id.* ("The reader is typically installed in the firearm and the tag is placed in the token, which takes many forms, including rings, gloves, wristbands, and wrist watches."); *see also* Recce, *supra* note 60, at 38–39.

74. Teret, *supra* note 9, at 29.

75. *See* LODESTAR, https://bit.ly/3aImmiR (last visited May 19, 2020). LodeStar claims its company "is by far the most ambitious developer of smart guns and is working with German developers to have a 9mm RFID smart gun prototype available in the spring of 2019 and available for marketplace availability later in 2020." *Id.*

76. *See id.*

77. *See id.*

78. *See* Jon S. Vernick et al., *Unintentional and Undetermined Firearm Related Deaths: A Preventable Death Analysis for Three Safety Devices*, 9 INJURY PREV. 307, 308 (2003).

B. A History of Missteps

Thorny legal and political issues have beset smart gun technology since its inception.[79] Smart guns saw an initial phase of interest, investment, and then fizzled-out in the 1990s and early 2000s, and then another wave of interest, investment, and fizzle-out after the horrific elementary school massacre in Newtown, CT.[80] The Clinton[81] and Obama[82] Administrations each tried to encourage, or even force, the development of smart guns—again, spurring initial interest that petered out soon thereafter. In the Clinton years, the National Institutes of Justice (with Congressional support) provided grants to some gun manufacturers and the New Jersey Institute of Technology for research on smart gun technology to prevent unauthorized use of police-issued handguns.[83] By the end of the 1990s, Colt Industries had completed the Z40, a new type of pistol that included an RFID chip and worked with a matching wristband.[84] This development proved so controversial among gun-rights advocates that Colt abandoned the project abruptly.[85]

Initial research into smart gun technology resulted from grants offered by the U.S. government to gun manufacturers in the mid-1990s and early 2000s.[86] In May 2000, President Clinton announced a grant of $300,000 to Smith & Wesson ("S&W") to support research into smart gun technologies and the development of smart gun prototypes.[87] At the time,

79. *See* Steven P. Teret & Adam D. Mernit, *Personalized Guns: Using Technology to Save Lives*, *in* REDUCING GUN VIOLENCE IN AMERICA: INFORMING POL'Y WITH EVIDENCE AND ANALYSIS 174–81 (Daniel W. Webster & Jon S. Vernick eds., 2013).

80. *See Smart Guns*, *supra* note 27.

81. *See* James B. Jacobs, *Zimring/Hawkins Citizen's Guide to Gun Control: A Retrospective*, 23 BERKELEY J. CRIM. L. 75, 89 (2018) ("The Clinton Administration joined the lawsuit and, in 2000, negotiated a settlement with Smith & Wesson, under which the company promised . . . to invest in research on 'smart-gun technology' so that a gun could only be fired by the persons to whom it had been programmed.").

82. *See* Obama, *supra* note 14, at 857–58.

83. *See* Nancy Rodriguez, *Strengthening Justice in the U.S.: The Impact of Scientific Research*, 14 OHIO ST. J. CRIM. L. 289, 299–300 (2016) ("NIJ is holding a Gun Safety Technology Challenge to conduct an objective demonstration through testing and evaluation of the reliability of firearms and firearm accessories available today that are typically known by various terms such as smart guns, user-authorized handguns, childproof guns, and personalized firearms.").

84. *See* Lacey Nicole Wallace, *American Preferences for "Smart" Guns Versus Traditional Weapons: Results from a Nationwide Survey*, 4 PREV. MED. REP. 11, 12 (2016). The Colt Z40 is like the current Armatrix smart gun models. *See id.*

85. *See* Sophia Agathis, *Private Equity's Overleveraging of Portfolio Companies*, 21 FORDHAM J. CORP. & FIN. L. 607, 629 (2016) (discussing Colt's financial troubles and relationships with investors in the wake of its smart gun debacle).

86. *See* SMALL ARMS SURVEY, PERSONALIZED FIREARMS AND ELECTRONIC SAFETY DEVICES: PERSPECTIVES 1, 4 (2013).

87. *See* Press Release, The White House, Office of the Press Sec'y, Clinton Admin. Reaches Historic Agreement with Smith and Wesson, (Mar. 17, 2000) (on file with author); *see also* Daniel P. Rosner, *In Guns We Entrust: Targeting Negligent Firearms Distribution*, 11 DREXEL L. REV. 421, 439 (2018) ("With respect to manufacturing, Smith & Wesson

S&W was being sued by various levels of the U.S. government for "not taking adequate care in their distribution systems to keep guns out of the hands of criminals . . . [and not] designing their guns as safely as was feasible."[88] S&W accepted the grant and agreed to make changes to the design of its guns to settle the lawsuits against it.[89] Contemporaneously, in the late 1990s, researchers at the Johns Hopkins Center for Gun Policy and Research published *A Model Handgun Safety Standard Act* (Model Act),[90] which proposed a statutory mandate that licensed firearm dealers could sell *only* personalized smart guns once such guns were available on the retail market.[91] Based on the *Model Handgun Safety Standard Act*, which recommended that state governments establish performance standards for all newly manufactured handguns,[92] New Jersey enacted the New Jersey Childproof Handgun Law.[93] The law mandated that, three years after smart guns were commercially available in the state, only smart guns could be sold. This legislative action merely confirmed the fears of many gun-rights groups that the availability of smart gun technology would result in state and federal mandates prohibiting the manufacture, and eventually the ownership, of traditional guns. Critics, such as the National Rifle Association ("NRA"), argued that such legislation would effectively be a handgun ban, which would implicate Second Amendment rights.[94] Even today, smart gun advocates consider the New Jersey bill "a debilitating blow for the smart gun movement" because it virtually halted all development in smart technology in the U.S.[95] S&W was in the process of developing a product to bring to market, and the New Jersey enactment prompted the NRA to call for the boycott of S&W, and as a result, the company temporarily closed two factories and ultimately laid off 125

agreed to implement safety features—such as child proof handguns, locking devices, and chamber load indicators—that would mitigate the risk of accidental shootings. Other measures included promises to invest resources into researching and developing smart gun technology that would enhance firearm safety.").

88. Teret, *supra* note 9, at 29–30.

89. *See id.*

90. *See* SUSAN DEFRANCESCO ET AL., A MODEL HANDGUN SAFETY STANDARD ACT (2d ed. 1998). All the authors of the Model Act have a J.D. and an M.P.H. *See id.*

91. For pre-*Heller* unfavorable discussion of the proposed mandate, *see generally* Cynthia Leonardatos et al., *Smart Guns/Foolish Legislators: Finding the Right Public Safety Laws, And Avoiding the Wrong Ones*, 34 CONN. L. REV. 157 (2001) (criticizing proposed mandate).

92. *See* Teret, *supra* note 9, at 28.

93. *See* Cody J. Jacobs, *End the Popularity Contest: A Proposal for Second Amendment "Type Of Weapon" Analysis*, 83 TENN. L. REV. 231, 269 (2015) ("A more ambitious law in New Jersey will require all handguns that are sold after a certain date to be equipped with 'smart gun' or 'owner authorization' technology that allows the gun only to be fired by its authorized owner, once such technology is available.").

94. For legal commentary arguing along these lines, see Lujan, *supra* note 14, at 501–10; *see also Murphy Signs Bill Aimed at Making Smart Guns Available*, U.S. NEWS (July 16, 2019), https://bit.ly/2UrOVeB; Charles, *supra* note 14, at 1176.

95. *See* Metzler, *supra* note 2, at 118.

employees.[96] The boycott was successful, financially crippling for S&W, who abandoned the product. By the following year, Tompkins, the company that bought S&W for $112 million 14 years prior, sold it for $15 million, plus debt absorption.[97]

Around the same time, smart guns appeared in a wave of reformist-minded litigation against firearm manufacturers[98]—also trying to make smart guns mandatory—but through tort liability-based duties rather than through statute. Municipalities, states, nonprofit organizations, and some individual plaintiffs brought (largely unsuccessful) public nuisance claims against gun makers over the widespread violence that resulted from their products. Many of these claims included an assertion that gun makers had a duty to produce firearms with better safety features, i.e., smart guns.[99] The attempt to mandate personalized smart guns through litigation proved unsuccessful in case after case, but these cases were part of the larger litigation trend that prompted Congress to enact a federal statute, the Protection of Lawful Commerce in Arms Act ("PLCAA")[100], shielding gun manufacturers from liability in such cases—that is, providing immunity to tort actions. The PLCAA blocked subsequent litigation attempts to compel gun manufacturers to develop and market personalized guns.[101] However, a 2019 decision by the Indiana Court of Appeals may

96. *See* Roger Parloff, *Smart Guns: They're Ready. Are We?*, FORTUNE (Apr. 22, 2015), https://bit.ly/2UnGTDA.

97. *See id.*

98. For an overview, see *City Cases*, BRADY UNITED (2019), https://bit.ly/3bz4sz6.

99. *See, e.g.*, People v. Arcadia Machine & Tool, Inc., No. 4095, 2003 WL 21184117, at *4 (Cal. App. Dep't Super. Ct. Apr. 10, 2003) ("According to defendants, the gist of plaintiffs' design claims is that defendants have engaged in unfair business practices and created a public nuisance by failing to incorporate certain design features into their respective firearms—such as magazine disconnect safeties, chamber-loaded indicators, and 'personalized gun' or 'unauthorized user' technology, including integral locks. Defendants submit that causation is also an essential element of these claims."); NAACP v. A.A. Arms, Inc., Nos. 99 CV 3999, 99 CV 7037, 2003 WL 2003788, at *1–*3 (E.D.N.Y. Apr. 7, 2003); Halliday v. Sturm, Ruger & Co., Inc., 792 A.2d 1145, 1148 (Md. 2002) ("Petitioner alleged . . . personalized gun technology that would have substantially reduced the likelihood that a child could fire the gun . . . ."); City of Boston v. Smith & Wesson Corp., 12 Mass.L.Rptr. 225 (July 13, 2000) ("Plaintiffs [unsuccessfully] claim that failure to incorporate 'personalized' gun technology (to prevent unauthorized or prohibited persons from obtaining access to and using guns) results in homicides and other crimes, some of which occur in Boston . . . Defendants are in the best position to conduct research to correct the design of their guns."); Whitfield v. Heckler & Koch Co., No. EC023122, 1998 WL 1769748, at *19 (Cal. App. Dep't Super. Ct. Feb. 26, 1998) ("'At this point in time, no electronic "Smart Gun" technology has been demonstrated which would be effective enough to be commercially viable.'").

100. *See* Protection of Lawful Commerce in Arms Act, 15 U.S.C. §§ 7901–7903 (2018).

101. *See* Adames v. Sheahan, 909 N.E.2d 742, 750–51 (Ill. 2009) (claim against manufacturer was barred by Protection of Lawful Commerce in Arms Act); *see also* Cody J. Jacobs, *The Second Amendment and Private Law*, 90 S. CAL. L. REV. 945, 986 (2017) (discussing liability-based duties for firearm manufacturers to include smart gun safety technology but conceding, "[t]he ability to bring suits under these kinds of theories has

have revived one part of this litigation under an exception in the PLCAA.[102]

A similar story unfolded again in the Obama years, in the wake of the Newtown atrocity.[103] A directive from President Obama led the Departments of Defense, Justice, and Homeland Security in 2016 to issue a report that concluded gun manufacturers need government financial incentives or mandates to develop smart gun technology and bring it to market.[104] The Report proposed a plan to form partnerships between the federal government and state and local law enforcement agencies to "establish the specific conditions under which they would consider purchasing firearms with advanced gun safety technology."[105] A few months later, in November 2016, the Obama Administration published baseline specifications for police service pistols, which included smart gun personalization technology.[106] One RFID smart gun, the Armatix iP1, was briefly planned to be offered at stores in the U.S. but was ultimately withdrawn in the wake of death threats and violent intimidation against gun dealers by gun owners.[107] Gun rights advocates feared its introduction into the American market would trigger the New Jersey Childproof

been severely limited by the federal Protection of Lawful Commerce in Arms Act (PLCAA), which immunizes gun manufacturers from suits relating to the 'criminal or unlawful misuse' of their products.").

102. *See* City of Gary v. Smith & Wesson Corp., 126 N.E.3d 813, 823–34 (Ind. Ct. App. 2019); *see also* Stephen D. Sugarman, *Torts and Guns*, 10 J. TORT L. 3, 6 n.15 (2017) (explaining that a "design defect" claim based on the duty to incorporate smart gun technology as a child safety feature would not fall under the PLCAA, but a claim for criminal homicides that would not have occurred if the weapons were smart guns would come under the statute).

103. *See, e.g.*, Lujan, *supra* note 14, at 502.

104. *See* DEP'TS. OF DEF., JUSTICE, & HOMELAND SEC., Report to the President Outlining a Strategy to Expedite Deployment of Gun Safety Technology (April 2016), *available at* https://bit.ly/2wI9Qko [hereinafter Gun Safety Technology Report]; *see also* Allen Rostron, *A New State Ice Age for Gun Policy*, 10 HARV. L. & POL'Y REV. 327, 338 (2016) ("Suggesting that federal purchasing power could be a lever to encourage development of new safety innovations, the Obama administration directed federal agencies 'to review the availability of smart gun technology on a regular basis' and 'to consider whether including such technology in specifications for acquisition of firearms would be consistent with operational needs.'").

105. *See* Gun Safety Technology Report, *supra* note 104.

106. *See* NAT'L INST. OF JUSTICE, U.S. DEP'T OF JUSTICE, NCJ 250377, BASELINE SPECIFICATIONS FOR LAW ENFORCEMENT SERVICE PISTOLS WITH SECURITY TECHNOLOGY (2016).

107. *See* Michael S. Rosenwald, *Maryland Dealer, Under Pressure from Gun-Rights Activists, Drops Plan to Sell Smart Gun*, WASH. POST (May 2, 2014), https://wapo.st/2J7v3a7; *see also* Schroeder, *supra* note 3, at 87 ("Fire-arms retailers in California and Maryland stopped selling the Armatix iP1 after receiving threats of physical violence and store boycotts from gun rights advocates, who feared that sale of ECSM-equipped handguns would lead to a ban on their conventional counterparts.").

Handgun Law.[108] "In the ensuing uproar, [some] went so far as to threaten stores that attempted to stock the IP1."[109]

Soon thereafter, a hobbyist-hacker posted a video online showing that the Armatix iP1 smart gun was easy to hack in three different ways, often using technology that costs $20 or less.[110] The hacker intercepted and diverted the RFID control with a radio device, used the radio signal to jam the RFID signal so the gun could not fire, and used inexpensive magnets placed on the gun to override the RFID trigger lock, so the gun would fire without it.[111] The video was devastating for Armatix.

C. Policy Objections and Consumer Reluctance

The NRA[112] and other gun rights advocates[113] question whether smart guns would have any sort of meaningful effect on suicide, homicide, and unintentional injuries. Some point out that smart guns would do little to address adult suicide—the leading cause of firearm death.[114] Others argue that smart guns would do little to reduce the risk of accidental discharges by children in homes for three reasons.[115] First, research shows that the gun owners who reported being likely to purchase a smart gun already engaged in safe gun storage behaviors.[116] Second, they contend that, because most gun owners own multiple firearms, most households would still have traditional firearms in addition to any newly purchased smart gun. The presence of a smart gun, therefore, would not keep a child from

---

108. *See* Rosenwald, *supra* note 107; *see also* Charles, *supra* note 14, at 1176 ("Thus, when Rockville, Maryland gun store owner Andy Raymond sought to become the nation's first smart gun dealer, gun rights activists responded fervently. Not only did gun rights activists call for the boycott of Raymond's gun store, but Raymond also received a number of death threats . . . .").

109. *5 Things to Know About Smart Guns*, *supra* note 65. For more on the use of threats and intimidation to dissuade firearm dealers from retailing smart guns, see Michael S. Rosenwald, *Threats Against Maryland Gun Dealer Raise Doubts about Future of Smart Guns*, WASH. POST (May 2, 2014), https://wapo.st/3dsx1Qx. *See also* Joseph Blocher, *New Approaches to Old Questions in Gun Scholarship*, 50 TULSA L. REV. 477, 488 (2015) ("But it does no favors to political engagement when, for example, a store that bars guns on its premises, or even simply chooses to sell 'smart guns,' is denounced as violating the Second Amendment.").

110. *See* Andy Greenberg, *Anybody Can Fire This 'Locked' Smart Gun With $15 Worth of Magnets*, WIRED (July 24, 2017), https://bit.ly/3dqzFpC.

111. *See id.*

112. *See* "*Smart" Guns and Mandatory Storage: Two Bad Policy Ideas Cut from the Same Tattered Cloth*, NRA: INST. FOR LEGISLATIVE ACTION (July 27, 2019), https://bit.ly/2vHADgg; *see also* A1F STAFF, *The Truth About "Smart Guns"*, NRA: AMERICA'S 1ST FREEDOM (July 29, 2019), https://bit.ly/39ai2r2.

113. *See, e.g.*, Mike McDaniel, *Are Smart Guns Actually Smart?*, TRUTH ABOUT GUNS (Apr. 4, 2014), https://bit.ly/2WAtaL6.

114. *See* Hoffman, *supra* note 71.

115. *See id.*

116. *See id.*

accessing one of the traditional guns.[117] Finally, they point out that smart guns would do nothing to curtail homicides committed by an individual using their own gun. Even the Violence Policy Center ("VPC"), a gun control advocacy group, has alternated between criticism, skepticism, and agnosticism about smart guns[118]—partly because the VPC thinks that smart guns might appeal to people who currently would not own a firearm due to safety concerns, so that the overall number of guns in circulation increases enough to offset any reduction in injuries from the safety features.[119] Proponents, however, answer that this would be true for any safety or health device, but in the end it is better to have safer devices on the market than unsafe devices, even if the devices become more common in the process.[120]

Adverse selection effects among gun purchasers could cancel out the anti-theft and anti-accident benefits of smart guns. The gun purchasers most likely to have their guns stolen or misused by unsupervised children are the least likely to buy personalized smart guns, and those at the least risk of such outcomes are also the most likely to buy smart guns but receive little additional benefit from the purchase.

Even if gun owners traded in their traditional handgun when purchasing a smart gun, critics maintain that "the introduction of personalized guns could greatly increase the lethality of the country's privately held gun stock" because newer firearms are "primarily high-capacity, higher caliber pistols with magazines with a capacity that can range up to more than 30 rounds."[121] It is important to note, nonetheless, that currently available models are associated with lower firepower.[122] The iP1, for instance, uses .22 rounds.[123] For gun buyers focused on self-defense, they may imagine dramatic life-or-death scenarios where they draw the gun and fire fast enough to subdue a would-be assailant. For this imagined scenario, each second counts because even a slight risk of malfunction or delayed firing seems unacceptable, and low firepower is unappealing. The limited product selection for consumers (gun purchasers) is also a factor suppressing the adoption of personalized guns.

117. *See* VIOLENCE POL'Y CTR., *supra* note 35. According to the 2004 National Firearms Survey, 48% percent of all individual gun owners and 41% of gun-owning households reported owning four or more guns. *See id*.

118. *See id*.

119. *See id.*

120. Teret, *supra* note 9, at 24–25.

121. VIOLENCE POL'Y CTR., *supra* note 35. For a thorough discussion of lethality and non-lethal alternatives in the Second Amendment context, *see* Blocher & Miller, *Lethality*, *supra* note 21, at 294–300.

122. *See 5 Things to Know About Smart Guns*, *supra* note 65.

123. *See id.*

Each company has one or two models available, and gun purchasers are accustomed to an enormous range of options when buying.[124]

Personalization features could also reduce the expected resale value of the gun, which in turn reduces the value or appeal of the gun to a prospective purchaser. A used or preowned gun with a biometric trigger lock would need resetting to remove the seller as a designated user and to add the new buyer instead. Even though the smart gun manufacturers claim this is an easy thing to do, it is still a transaction cost that we would expect to affect resale prices. Moreover, the easier it is to reassign the authorized user, the easier it is for thieves or children to gain access as well. Compounding the potentially lower expected resale value of the gun is the current elevated price that results from the lack of economies of scale (not enough personalized smart guns are made and sold to capture economies of mass production). As small arms analyst Matthew Schroeder explains,

> Cost may also limit sales of firearms equipped with ECSMs, including to government agencies. The Armatix iP1 pistol and accompanying wristwatch cost USD 1,798 - considerably more than most conventional pistols on the market, including the models commonly procured by security agencies. The unit cost for large orders of iP1 pistols would be lower than the retail price for individual units, but it is unclear whether, and at what point, these economies of scale would make ECSM-equipped firearms competitive with their conventional counterparts in terms of price.[125]

Surveys indicate that if the safety features added $300 to the original price, only 18% of gun owners reported being likely to purchase a smart gun. Overall, 56% of respondents had concerns about the additional cost associated with smart gun technology and 70% were concerned about the technology working properly when needed.[126]

A more subtle price effect, impossible to quantify, is the reverse price effects of the black market on the gray (mostly legal) secondary market. Suppose that 10–15% of the guns that pass through the secondary (used gun) market eventually end up in a sale to a prohibited person or a permissible purchaser to commit crimes. If smart guns have zero market value for those eventual purchasers, this limits the pool of prospective future purchasers, and hence suppresses the expected resale value. Following this series of last antecedents, the original retail purchaser, even if she would never sell to anyone except a lawful purchaser who was also a friend or relative, still has a lower expected resale price when purchasing a gun from a licensed firearm dealer. The manufacturer's suggested retail

124. *See* Schroeder, *supra* note 3, at 84–85.
125. *Id*.
126. *See* Hoffman, *supra* note 71.

price may not account for this black-market after-effect, in which case the guns will seem overpriced even for their novel features. In addition, note that gun owners do not need to fear liability for what happens when their guns are stolen, even if the owner negligently leaves the gun in a location where it is easy prey for thieves.[127]

D. The Unflagging Proponents

Everytown for Gun Safety[128] ("Everytown") has called on the major firearms manufacturers to develop and market smart guns: "[S]afety mechanisms built into the firearm itself can be more effective at preventing unauthorized access to and unintentional discharge of firearms. Lost or stolen guns could be easily located by their owners if firearms were equipped with readily available technology."[129] Everytown proposes several tech improvements: "authorized-use technology, like the thumb scan or passcode available on many smartphones; loaded chamber indicators that show when there is a cartridge in the chamber . . . and tracking sensors to allow the authorized user to find the location of a firearm, like the 'find my phone' feature . . . ."[130]

The Giffords Law Center also advocates for the adoption of smart gun technology,[131] noting that surveys suggest there would be a viable market, and that some gun owners would prefer them, even if many object to a ban on traditional firearms being part of the policy package.[132] For example, a 2019 survey study found that 79% of gun owners say that gun stores should sell both traditional and personalized smart guns.[133] In another study, most of the survey respondents who are not currently gun owners (~63% of this group) were willing to consider buying a personalized smart gun if they were to buy a gun in the next year.[134] Similarly, a study in 2016 found that:

---

127. *See* Andrew Jay McClurg, *The Second Amendment Right to Be Negligent*, 68 FLA. L. REV. 1, 24–31 (2016).

128. Everytown is an advocacy group, largely funded by tech-billionaire-turned-philanthropist Michael Bloomberg, that has assimilated Moms Demand Action, Students Demand Action, Mayors Against Illegal Guns, the Everytown Survivors Network, Everytown Creative Council, and a litigation/lobbying unit. *See* EVERYTOWN FOR GUN SAFETY, https://every.tw/3bodS0a (last visited May 19, 2020).

129. EVERYTOWN RESEARCH, EVERYTOWN FOR GUN SAFETY SUPPORT FUND, THE TIME FOR TALK IS OVER: A CALL TO ACTION FOR GUN MANUFACTURERS (April 17, 2018) at 7, *available at* https://every.tw/2JhbNHr.

130. *See id.*

131. *See Smart Guns*, *supra* note 27.

132. *See id.*

133. *See* Cassandra K. Crifasi et al., *Desirability of Personalized Guns Among Current Gun Owners*, 57 AM. J. PREV. MED. 191, 193 (2019).

134. *See* Julia A. Wolfson et al., *The US Public's Preference for Safer Guns*, 106 AM. J. PUB. HEALTH 411, 412 (2016).

> [A]mong non-owners, older respondents and those with pro-gun attitudes are less likely to prefer smart guns to traditional firearms. Among gun owners, those with moderate political views, those with a history of victimization, and those residing in the Northeast are all more likely to prefer smart guns. Males and those with progun attitudes are less likely to prefer smart guns. Education, income, race, marital status, presence of children in the home, and comfort discussing gun ownership with a doctor had no significant association with smart gun preference.[135]

Researchers at Johns Hopkins never backed away from the proposed statutory mandate they proposed in the late 1990s.[136] As Stephen Teret explained in 2013, the industry has no incentive to develop and market the product, and consumer demand is not strong enough to force a change through normal market pressures.[137]

Even though smart gun critics argue that legislation restricting the sale of handguns to smart guns would effectively create an unconstitutional handgun ban, advocates argue it is a reasonable restriction, permissible under the Constitution.[138] Whether such a mandate would survive a Second Amendment challenge is a hotly contested question in academic literature.[139] The most plausible view was expressed by Tyler J. Kimberly, in a 2014 law review article:

> Even if smart guns impose some sort of "who" restriction, a federal court would likely uphold the restriction. First, whatever burden a court found likely would be minimal. In Chovan, the restriction was within the scope of the Second Amendment because 18 U.S.C. § 922(g)(9) placed a life ban on a class that historically had the right to bear arms for self-defense . . . . Second Amendment rights have been highly regarded and disputed, and the onset of new technology associated with those rights will not be any different. Concerns regarding smart-gun technology are understandable, but as this Comment demonstrated, there is not yet a constitutional basis for objecting to [a] smart-guns-only regime.[140]

Another category of supporters for personalized smart guns is private funding providers. The leading example is the Smart Tech Challenges Foundation,[141] a grantmaking nonprofit that provides private funds for smart gun startups whose product is in the development stage. The Smart

135. *See* Wallace, *supra* note 84, at 11, 14.
136. *See* Teret & Mernit, *supra* note 79, at 179–80.
137. *See id.*
138. *See* Metzler, *supra* note 2, at 124.
139. *See* Lujan, *supra* note 14; Godbold, *supra* note 14.
140. Kimberly, *supra* note 14, at 276–78.
141. *See* SMART TECH CHALLENGES FOUNDATION, https://bit.ly/2xUvJ00 (last visited May 19, 2020).

Tech Challenges Foundation launched in 2014 with the mission of reducing gun violence through technological innovation.[142] In its first year, it granted $1 million to 15 innovator-entrepreneurs to develop products ranging from RFID and biometric personalized smart guns to biometric attachments for existing firearms (trigger locks, pistol holsters/holders, and gun barrel locks).[143] The grant recipients form a type of industry community (the Foundation describes them as an "ecosystem") that are part competitors, part compatriots in a cause.[144] Most have not brought products to market yet, so they are not truly market rivals, though some are working on similar technologies (slightly different versions of biometric readers, for example) that could eventually compete, or are in a race to complete product development. Biofire,[145] Identilock,[146] Vara Safety,[147] and Gun Guardian are all biometric safety devices (some are guns with the feature built-in, others are attachments that would work with existing pistols). These companies stand alongside more established companies Armatix[148] and iGun,[149] which use RFID technology to accomplish the same goal.

Personalized smart guns have enough political appeal that some presidential candidates have included it in their campaign talking points or policy agenda. For example, Joe Biden, when running for the 2020 Democratic Party nomination, took the position that "we should work to eventually require that 100% of firearms sold in the U.S. are smart guns."[150] Product requirements are common in most consumer items, ranging from automobile airbags to lawnmowers. As already discussed, gun enthusiasts view smart gun mandates as a ban on the sale of the weapons that are currently popular (millions sold per year), meaning there is considerable political opposition to a new-sales mandate (what Biden calls a "requirement"). Constitutionally, under the Second Amendment,

142. *See About Us*, SMART TECH CHALLENGES FOUNDATION, https://bit.ly/34e0IR9 (last visited May 19, 2020).

143. *See id.*

144. *See id.*

145. *See* BIOFIRE, https://bit.ly/2xUvEJK (last visited May 19, 2020).

146. *See* IDENTILOCK, https://bit.ly/34d4SbH (last visited May 19, 2020).

147. *See* VARA SAFETY, https://bit.ly/2X6ObNM (last visited May 19, 2020).

148. *See* Hemenway, *supra* note 47, at 212 (discussing the Armatix gun).

149. *See* IGUN TECHNOLOGY, https://bit.ly/2XcJKB8 (last visited May 19, 2020).

150. *See The Biden Plan to End Our Gun Violence Epidemic*, JOEBIDEN.COM, https://bit.ly/39JjJvJ (last visited May 19, 2020). Biden's campaign website adds, "Put America on the path to ensuring that 100% of firearms sold in America are smart guns. Today, we have the technology to allow only authorized users to fire a gun. For example, existing smart gun technology requires a fingerprint match before use." *Id.*; *see also* Makena Kelly, *Biden pushes smart guns as solution for gun violence during primary debate*, VERGE (June 27, 2019, 11:01 PM), https://bit.ly/2U8ZLG4 ("'No gun should be able to be sold unless your biometric measure could pull that trigger,' Biden said.").

the viability of such a mandate is also a little uncertain.[151] Up to now, the Supreme Court has upheld bans on certain types of guns (machine guns and short-barrel shotguns) under the National Firearms Act, and the majority opinion in *District of Columbia v. Heller* emphasized, albeit in dicta, that restrictions on certain types of firearms could remain in place.[152] Circuit courts up to now have generally upheld state bans on semiautomatic assault rifles and large-capacity magazines. But several of these cases have pending certiorari petitions at the Supreme Court, and it is not clear which way the Court would rule given the personnel changes on the Court since *Heller*.[153] If the existing stock of traditional (non-personalized) guns continued to be legal—including private sales of these used guns—a requirement that new guns be a certain type would pose less of a potential infringement on individual's Second Amendment rights than, say, an outright ban on all guns except smart guns, which is politically unrealistic in any case. In addition, given the Court's emphasis in *Heller* on personal self-defense,[154] the reliability of personalized smart

151. For an argument that smart gun requirements are "clearly" unconstitutional, see Benjamin H. Weissman, *Regulating the Militia Well: Evaluating Choices for State and Municipal Regulators Post-Heller*, 82 FORDHAM L. REV. 3481, 3515 (2014) ("Similarly, a New Jersey statute that will restrict the sale of handguns without 'smart gun' technology once that technology is commercially available should clearly fail under the common use standard, as ordinary handguns are widely used, and explicitly protected under [*Heller*]." (internal quotations omitted)).

152. *See* Dist. of Columbia v. Heller, 554 U.S. 570, 626 (2008).

153. The authors of both the majority and main dissenting opinions in *Heller*, Justices Scalia and Stevens respectively, are no longer on the Court. Justices Kennedy and Souter have also retired since *Heller* was decided. Justices Kagan, Sotomayor, Gorsuch, and Kavanaugh have joined the Court in the meantime; Justices Kagan and Sotomayor lean toward more progressive policy positions, such as gun control, and Justice Sotomayor joined Justice Breyer's dissent in the follow-up case, *McDonald v. City of Chicago*, 561 U.S. 742, 912 (2010). Justices Gorsuch and Kavanaugh each have a reputation for being supportive of gun rights and the *Heller* decision, as indicated in their past opinions and statements. *See, e.g.*, Guedes v. Bureau of Alcohol, Tobacco, Firearms and Explosives, 140 S.Ct. 789 (Mem) (2020) (Gorsuch, J. concurring) (regarding bump-stock ban litigation). Kavanaugh indicated agreement with the Second Amendment portion of Justice Alito's dissent in New York State Rifle & Pistol Association, Inc. v. City of New York, 140 S. Ct. 1525 (2020) (Kavanaugh, J. dissenting). Gorsuch joined Thomas's dissent in Peruta v. California, 137 S. Ct. 1995, 1999 (2017) (Thomas, J. dissenting). *See also* Heller v. Dist. Of Columbia [Heller II], 670 F.3d 1244, 1271 (D.C. Cir. 2011) (Kavanaugh, J., dissenting). Although the additions of Gorsuch and Kavanaugh to the Court might portend stronger support for pro-gun policy positions, the Court's denial of certiorari in numerous Second Amendment cases in the years since *Heller* and *McDonald*, most of which involved Circuit Court decisions upholding gun restrictions, may indicate either that Justice Roberts has moderated his position in the meantime or that the Court has decided to avoid the issue. *See* Peruta v. California, 137 S. Ct. 1995, 1999 (2017) (Thomas, J. dissenting) (complaining that the Court had not accepted a Second Amendment case in seven years); Eric Ruben & Joseph Blocher, *From Theory to Doctrine: An Empirical Analysis of the Right to Keep and Bear Arms After Heller*, 67 DUKE L.J. 1433, 1460 n.123 (2018) ("The Supreme Court denied cert to more than sixty petitions in Second Amendment cases during the study period.").

154. *See Heller*, 554 U.S. at 599.

guns for self-defense, at the time such a requirement would go into effect, would, in turn, be a factor in assessing the constitutionality of such a mandate. At the same time, it would be a completely novel holding for a court to constitutionally require some degree of reliability in unplanned emergencies (self-defense), such as one hundred or even ninety percent. Recent commentators note that currently, "smart gun manufacturers claim smart guns have an expected failure rate of less than one in 10,000."[155]

A separate constitutional question is whether a state or federal government could limit the public carrying of firearms (whether open or concealed) to personalized smart guns, even if traditional firearms remained legal for home defense.[156] Professor Timothy Zick recently suggested this and avers that it would pass muster under certain understandings of the Second Amendment.[157]

Military and police are often the trendsetters for adopting new styles or types of firearms—gun makers advertise products to the civilian market as the same guns used by the Army, Marines, or major urban police departments. Adoption by the military and police would help foster consumer appeal for smart guns. I believe that personalized gun technology will not catch on until the military and police completely switch over to it. This would be an easier policy move, from a legal standpoint, than forcing the consumer market to switch first. Elected officials have a lot of control over military and police equipment purchases and upgrade policies. Here, however, is another problem: "the conservative nature of military and law-enforcement agencies and the historically slow pace of change in firearms technology."[158] As one firearms industry insider put it, "'[w]e are working in a field where there has been little significant technological innovation in 120 years.'"[159]

Regarding product development and improvement, a recent working paper published online by the National Bureau of Economic Research demonstrates a significant "crowding-in" phenomenon for defense spending on R&D—increases in government spending on R&D for a specific industry or item result in significant corresponding R&D in the private sector for the same industry or item.[160] Each 10% increase in defense spending on R&D generates at least a 4% increase (or more) in

155. *See* Crepelle, *supra* note 14, at 255.

156. *See* Blocher & Miller, *Lethality*, *supra* note 21, at 300–01 (mentioning smart gun alternatives).

157. *See* Timothy Zick, *Arming Public Protests*, 104 IOWA L. REV. 223, 267 (2018).

158. *See* Schroeder, *supra* note 3, at 87.

159. *See id.*

160. *See generally* Enrico Moretti et al., *The Intellectual Spoils of War? Defense R&D, Productivity and International Spillovers* (Nat'l Bureau of Econ. Research, Working Paper No. 26483, 2019), https://bit.ly/2yBCJiY (discussing the "crowding in" phenomenon in this context).

corresponding private sector R&D.[161] But given the relative size of each sector, this implies that a $1 increase in defense spending on R&D generates a $5 increase in corresponding private-firm spending on R&D.[162] This is not merely due to an increase in wages for personnel in that research sector, as a result of increased demand due to defense-sector hiring.[163] It is possible, of course, that some of this "crowding-in" is due to private firms obtaining defense contracts and then subcontracting the R&D for specialized components to other firms in the relevant industry. Another factor could be that defense spending on a certain type of weapon signals the firms in that sector that new contracts or Calls for Proposals (CFPs) for research or production will be forthcoming. Moreover, if one firm—say, an arms manufacturer—secures a defense contract for R&D, rival firms in the industry may commence a race to secure patents in the area. Of course, a government/military CFP or bidding competition for an R&D contract can mean that several rival firms simultaneously develop a proof-of-concept model for their bid, and even after the military awards the contract to one firm, the others may decide to continue developing their own product for the civilian market, given their existing investment in the technology. In any case, "government-funded R&D in general - and defense R&D in particular - are effective at raising a country's total expenditures on innovation in a given industry."[164] As a policy matter, spending on military R&D will probably be the most effective means to perfect the technology for personalized smart guns.

Another factor that might spur the adoption of personalized gun technology includes repackaging it as an accessory attachment for existing firearms, rather than manufacturing and selling a special type of gun. This is the approach of Kodiak Arms with its Intelligun,[165] which makes a $400 fingerprint-reader handgrip replacement for the super-popular 1911-style semiautomatic pistol.[166] There are millions of 1911 pistols in circulation, it was a longtime favorite of law enforcement and military service weapons in the twentieth century. More than one hundred manufacturers produce, or have produced, a version of this handgun. A smart gun conversion kit, like Intelligun, helps address the persistent problem (for smart gun advocates) of the existing stock of firearms in private hands. This kit also simultaneously helps address concerns by gun enthusiasts that smart guns will not work as a traditional firearm if the electronics fail, as

161. *See id.* at 27.
162. *See id.*
163. *See id.* at 28.
164. *Id.* at 36.
165. *See* Nicole Nguyen, *Here's What's Up With "Smart Guns"—And Why You Can't Buy One in the US*, BUZZFEED NEWS (Mar. 9, 2018, 5:06 PM), https://bit.ly/2UIoMIE.
166. *See id.*

an owner could simply remove the grip attachment from her 1911 and restore it to its original state as a traditional handgun.[167] In theory, this approach could potentially become much more popular. On the other hand, Intelligun includes an internal tracking/recording feature, discussed more below, that records the pinpoint GPS location, time of discharge, and other data every time the gun fires. Police unions have voiced opposition to Intelligun technology for their service weapons because of the heightened scrutiny or accountability it would provide after police shootings (similar to bodycams, but even more precise).[168]

III. GUNS THAT CANNOT MISS (SEMI-AUTONOMOUS OR PRECISION-GUIDED FIREARMS)

If the desire for gun safety or gun control has been driving the development of personalized smart gun technology, the desire for more lethality—a guaranteed kill—are driving the development of a different type of smart gun technology, precision-guided firearms that enable even a novice gun owner to shoot like a professional marksman or expert sniper. The military has developed and ordered sophisticated AWS for years, starting with the big guns on ships, tanks, and fighter jets.[169] In recent years, small arms that incorporate this technology have appeared on the civilian market as well. TrackingPoint sells guns that do not miss.[170] These guns can lock on a moving target, even in the dark, and hit it in the center of its mass. They can correct for wind, humidity, angle, spindrift, rifle cant, and the weight of the bullet. TrackingPoint's most expensive models will lock on a target and hit it from 1400 yards. If the marketplace tells us anything, it is that gun purchasers are less interested in safety than in lethality, which is not terribly surprising. Of course, such weapons are especially appealing for military use,[171] but they are already available for

167. *See* MINITER, *supra* note 3, at 230–32 (providing a lengthy description of Kodiak's Intelligun and its appeal).

168. *See id.* at 232.

169. *See* Frank Miniter, *TrackingPoint Outranged by Military Technology*, RANGE365 (June 1, 2015), https://bit.ly/3bRvEJf (describing Defense Advanced Research Projects Agency (DARPA) military technology development in recent decades for smart guns and smart bullets).

170. *See* TRACKINGPOINT, https://bit.ly/3bR7yOW (last visited May 19, 2020); *see also* Justin Peters, *The TrackingPoint "Smart Rifle" Exemplifies Everything That's Horrible About American Gun Culture*, SLATE (June 5, 2013), https://bit.ly/3dzDwRu; Gillian Tett, *'Smart' Guns and the Dangers of Trigger-Happy Technology*, FIN. TIMES (April 3, 2019), https://on.ft.com/3dxZyE1 (explaining concerns about the guns falling into "malicious hands"); Dewey, *supra* note 16; Gassaway, *supra* note 17 (describing tour of TrackingPoint's facility, and the company's history and plans); MINITER, *supra* note 3, at 48–53 (describing the TrackingPoint guns and the experience of firing one); Toscano, *supra* note 18, at 232.

171. *See* MINITER, *supra* note 3, at 49–52 (comparing the military's DARPA initiatives with smart guns and bullets with the civilian-model TrackingPoint gun). *See also* Suciu, *supra* note 20 (describing 2019 military orders for precision-guided small arms).

the retail civilian market, though outside the price range of most gun purchasers.[172] The legal issues presented by this technology partly overlap with those that surround personalized smart guns, but some distinct legal concerns also apply to partly autonomous guns that have extreme accuracy. The newness, high price, and (so far) scarcity of these weapons means they have received less attention in the legal academic literature up to now.

The TrackingPoint rifle employs a laser rangefinder to measure the distance to the target and onboard electronics to measure incline/decline, air temperature, air density, barometric pressure, and target movement.[173] It also accounts for spindrift,[174] the shooter's cant,[175] Magnus effect,[176] and the Coriolis effect,[177] caused by the Earth's rotation. The rifle scope's internal electronics already store data on the rifle's own characteristics that

172. The least expensive TrackingPoint rifles start at just under $7000, while a Glock 17, one of the most popular handguns, sells for around $500, depending on its condition. *See* TRACKINGPOINT, *supra* note 170, for current prices on their precision-guided rifles; for current prices on Glocks, see GLOCKSTORE, https://www.glockstore.com (last visited May 20, 2020).

173. *See* MINITER, *supra* note 3, at 48.

174. As the manufacturer explains,

> Spin drift is a deflection generated by the gyroscopic motion of the bullet. The direction of the deflection is toward the direction of the spin, and the amount of deflection is dependent on bullet length, flight time and, not surprisingly, spin rate. Its effect is noticeable, and must be taken into account, starting around 500yds. The metrics of spin drift vary widely, therefore it's hard to account for the exact effect of spin drift on a bullet at extended ranges when shooting. It's an environmental hazard that only the most talented pros know how to compensate.

Spin Drift, TRACKINGPOINT, https://bit.ly/3bLqQ81q (last visited May 19, 2020).

175. Cant refers to the shooter's unconscious propensity to tilt a gun at a slight angle or to pitch to one side:

> It is most commonly used to describe a situation where the shooter is positioned on a slope and the rifle is not held vertically true or straight up and down. In other words, if you look through the riflescope, the horizontal crosswire is not level. Cant is not to be confused with line-of-sight (LOS), such as when you are shooting up or downhill. There are three types of cant rifle shooters must deal with: rifle cant, scope cant and reticle cant.

Rifle Cant, TRACKINGPOINT, https://bit.ly/3bNb5h8 (last visited May 19, 2020).

176. Magnus effect or "spin drift" comes into play because a bullet leaves the barrel of a gun twirling rapidly as it hurtles forward, and air flow interacts with the spin to nudge the trajectory off course:

> The Magnus effect is an observable phenomenon that is commonly associated with a spinning object that drags air faster around one side, creating a difference in pressure that moves it in the direction of the lower-pressure side. When shooting long range, the shooter must account for the distance the bullet will drift due to wind. All other things being equal, the bullet will hit a different place if the wind is coming 90 degrees from the left versus 90 degrees to the right.

Magnus Effect, TRACKINGPOINT, https://bit.ly/2XbZdRG (last visited May 19, 2020).

177. Coriolis effect "refers to the deflection on the trajectory of the bullet generated by the spinning motion of the Earth." *Coriolis Effect*, TRACKINGPOINT, https://bit.ly/3bR9qXY (last visited May 19, 2020). At long distances, (1000 yards or more), it can affect the bullet on the horizontal and vertical planes of its trajectory. *See id.*

affect the bullet's flight pattern, such as the ballistic coefficient, muzzle velocity, lock time, ignition time, and the direction of the barrel-rifling twist.[178] The shooter pulls the trigger, but the rifle (or more properly, the smart scope) chooses the exact timing of the discharge to guarantee a hit in the center mass of the target.[179] This weapon mostly eliminates operator error; allowing an inexperienced shooter to hit small targets ten football fields away.[180] At the same time, the TrackingPoint rifle is not fully autonomous—it does not shoot unless someone pulls the trigger and initiates the sequence of instantaneous calculations and precision firing.[181] In military contexts, soldiers in the heat of battle could take out moving targets very quickly without perfectly maintaining the target in their sight.[182]

TrackingPoint has a built-in Wi-Fi transmitter that streams live video and audio to a networked device, such as a smartphone or laptop.[183] Shooters can easily record shots and post the videos online, or they can live stream their shoots to social media sites.[184] I will return to this technology later, when discussing recordkeeping guns, but for now, it is worth noting that a video live stream from a sniper rifle presents special advantages in military and law enforcement contexts, where an offsite command center could monitor everything and call the shots.[185] Of course, there are nefarious uses for live streaming as well, as when terrorists or rampage shooters want to broadcast their atrocities to garner attention or notoriety.

It is easy to imagine military and law enforcement uses for precision-guided firearms.[186] But TrackingPoint's market now includes "safari enthusiasts, the outdoorsmen . . . even ranchers, folks that don't have all day to run the fence line but need to take care of their predator population."[187] Of course, some hunters have been critical of the concept, arguing that it resembles the proverbial shooting fish in a barrel.[188] It also

178. *See* MINITER, *supra* note 3, at 49.
179. *See* Dewey, *supra* note 16.
180. *See* MINITER, *supra* note 3, at 49.
181. *See id.* at 50.
182. *See id.* at 223.
183. *See* Dewey, *supra* note 16.
184. *See id.*; *see also* MINITER, *supra* note 3, at 223–34.
185. *See* Toscano, *supra* note 18, at 232.
186. *See* Daniel Trotta, *Gun with a Chip: U.S. Army Contracts May Lead to a Smarter Firearm*, REUTERS (Oct. 18, 2019, 6:33 AM), https://reut.rs/33Rrpe5.
187. *See* Gassaway, *supra* note 17 (quoting Nelson Whiting, Vice President of Manufacturing at TrackingPoint).
188. *See* Dewey, *supra* note 16 ("It's the traditional shooting fish in a barrel or the sitting duck. I mean, there's no skill in it, right? It's just you point, you let the weapon system do its thing and you pull the trigger and now you've killed a deer. There's no skill," according to hunter Chris Wilbratte.); Peters, *supra* note 169 ("Any self-respecting hunter ought to be disgusted by something that promises to turn every hunt into a canned hunt.

seems to defeat the purpose of target practice, for those who enjoy that. For better or worse, however, leading gun experts say this is the future of firearms, or "where we're going."[189] The manufacturer plans to repackage the technology as a scope that could attach to any firearm,[190] so the millions of guns—any rifle or handgun large enough to hold a scope—that are already in private hands could become a precision-guided firearm. The greatest significance of these market disrupting new firearm technologies is working with the existing stock of traditional firearms, upgrading older guns into next-gen sophisticated firearms, and having the new high-tech guns also work as a traditional firearm if the electronics break or fail.

The military wants guns like this but even better—they want the option to override the weapon from the command center if it were being misused, and operate the gun almost like a drone, or at least see exactly what the soldier is seeing through the scope.[191] It would be useful for the military to be able to deactivate guns from a remote location if the soldier carrying it dies on the battlefield, or to have the ability to reassign the gun to another soldier in the same unit. In addition, when our troops withdrew recently and very abruptly from Syria, our military did not have time to pack up all their munitions, so they destroyed entire garages full of weapons lest ISIS seize them as soon as our forces withdrew.[192] That happens more than most people think—battalions have to withdraw, retreat, or even charge forward and leave things behind and the Pentagon wants to be able to deactivate all the weapons until our forces (or allies) retrieve them.[193]

One common theme in the legal issues surrounding these technologies is the internal turmoil, financial troubles, and resulting litigation that these companies face (though firm-level volatility may be a

---

Despite the manufacturer's claims, TrackingPoint really isn't suited for target shooting—where's the fun in shooting at a target that you know you're going to hit?").

189. *See* MINITER, *supra* note 3, at 221.

190. *See* Gassaway, *supra* note 17 ("It will come in the package set to work. You just put it on your gun, zero it the same as you normally would zero any gun and it will do much of the rest, but with your own gun, you will not have trigger control.") (quoting a TrackingPoint executive).

191. *See* Daniel Trotta, *Gun with a Chip: U.S. Army Contracts May Lead to a Smarter Firearm*, REUTERS (Oct. 18, 2019, 6:33 AM), https://reut.rs/33Rrpe5; Suciu, *supra* note 20.

192. *See* Suciu, *supra* note 20 ("Depending on how the technologies were implemented, it might also lessen or eliminate the need to destroy facilities that were being abandoned – as recently occurred when U.S. soldiers withdrew from bases in Syria. Similarly, smart tech could reduce or eliminate the value of stolen military weapons."). In addition, smart technology could alleviate legal implications of U.S. provided weapons being used against unintended targets, by providing military forces the ability to "disarm" weapons provided to resistance fighters, like the SDF in Syria. *See* Ellen Francis & Tom Perry, *Syrian Kurds Outgunned but Vow to Inflict Toll on Turkish Army*, REUTERS (Oct. 9, 2019, 7:03 PM), https://reut.rs/3arZ80f.

193. *See, e.g.*, Pierre Bienaimé, *How 'Smart Guns' Could Eventually Help Shape US Foreign Policy*, BUS. INSIDER (Jan. 7, 2015, 11:54 AM), https://bit.ly/2xz2lMF.

feature endemic to the firearms industry generally)[194] at least in the United States. The discussion above,[195] pertaining to personalized smart guns, mentioned the attendant financial problems, bankruptcy, and consumer boycotts for Colt and S&W, including the litigation between one of the lead inventors of the technology and the manufacturer. TrackingPoint had its share of troubles along these lines. After launching its product line in 2013, TrackingPoint sold more than 1,000 of its expensive rifles within the first two years. But by 2015, the company was in trouble, and at one point laid off most of its employees and temporarily stopped taking orders.[196] The company fired two of its high-profile executives, who promptly went to a competitor company and brought TrackingPoint's innovative technology with them, which in turn resulted in litigation.[197] In late 2018, Talon Precision Optics acquired TrackingPoint and took over its product line.[198] Even so, TrackingPoint is currently selling its guns (with an expanded product line), introduced more affordable prices, and is obtaining new patents.[199] News items and reviews from 2013 to 2015 describe the price as being $25,000,[200] but the prices have come down to feature an AR-15 model for around $7,000 on the company website—still pricey, but not too far afield from what other high-end assault rifles cost.[201]

TrackingPoint even experienced an embarrassing hacker video,[202] not unlike what happened to the Armatix RFID personalized gun—hackers

194. *See, e.g.,* Jesse Barron, *How America's Oldest Gun Maker Went Bankrupt: A Financial Engineering Mystery*, N.Y. TIMES MAGAZINE (May 1, 2019), https://nyti.ms/39l4JnC. Ironically, around the time Remington was going bankrupt, TrackingPoint had been counting on them either to acquire their company or pay a lucrative license for their technology. *See id.*

195. *See supra* notes 83–97 and accompanying text.

196. Colin Lecher, *Under the Gun: How the Perfect Rifle Missed Its Target*, VERGE (June 11, 2015, 11:25 AM), https://bit.ly/2WME7t7 (describing internal turmoil at the company in 2015, disgruntled employees, and dire financials).

197. *See generally* TrackingPoint, Inc. v. Silencerco LLC, No. D-1-GN-15-004646, 2015 WL 5968265 (Dist. Ct. Tex. October 13, 2015) (Trial Pleading).

198. *See* Press Release, Talon Precision Optics, Talon Precision Optics, LLC Announces Asset Purchase in Precision-Guided Firearms and Advanced Optics Technologies (Dec. 21, 2018), https://prn.to/3bvjfL6.

199. *See, e.g.*, U.S. Patent Appl. Publ No. 2019/0243230 A1 (filed Aug. 20, 2018); U.S. Patent No. 10,337,830 B2 (filed Dec. 31, 2012).

200. *See, e.g.*, Toscano, *supra* note 18, at 232.

201. *See, e.g.*, Jared Keller, *The Marine Corps' New Rifle Is Super Expensive — And No One Knows Why*, TASK & PURPOSE (Mar. 21, 2018, 11:49 AM), https://bit.ly/2WJSChi.

202. *See* Woodrow Hartzog & Evan Selinger, *The Internet of Heirlooms and Disposable Things*, 17 N.C. J. L. & TECH. 581, 592 (2016) (including the rifles in a list of Internet-connected devices that are vulnerable to hackers); Andy Greenberg & Kim Zetter, *How the Internet of Things Got Hacked*, WIRED (Dec. 28, 2015, 7:00 AM), https://bit.ly/33LWobu (describing how certain hackers demonstrated to journalists that they could "control of a Wi-Fi-enabled TrackingPoint sniper rifle. Sandvik and Auger exploited the rifle's insecure Wi-Fi to change variables in the gun's self-aiming scope system, allowing them to disable the rifle, make it miss its target, or even make it hit a target of their choosing instead of the intended one."); Andy Greenberg, *Hackers Can*

hijacked the electronics and manipulated the gun to hit the target to the left or right of the intended target. This proved less devastating for the company than the Armatix debacle—perhaps because the hackers in the video are well-known, elite hacker-researchers who give presentations at major tech conferences. It is not clear whether most hackers have the requisite expertise to do this, or that they would have the opportunity to be near one of these long-range safari-style guns when it is actually in use.

As frightening as these weapons may seem to gun control advocates,[203] as of yet there are no reported instances of TrackingPoint guns being used in crimes or shooting rampages. Despite the price drop, these rifles are still more expensive than most other guns—out of the price range for many adolescent gang members in poor neighborhoods and an unnecessary expense even for any criminal or terrorist organizations who could afford them. Additionally, the guns are enormous, not a convenient or useful tool for a close-encounter street robbery (especially if the perpetrator is on foot), or as a carry-along for a burglary. Sniper rifles in general are uncommon in homicides and interpersonal assaults—not a big contributor to crime rates overall or rates of shooting deaths specifically. Oversized, expensive, precision-guided hunting/sniper rifles are also an unlikely choice for impulsive homicides, such as domestic violence or suicide. Of course, if the predictions of experts come to fulfillment, this technology will become miniaturized, affordable, and attachable to any existing firearm, so the current natural limitations of size and price will erode over time. Moreover, the guns present some issues for certain types of crimes that can be very disruptive or destabilizing to society. Such disruptions include assassinations, whether sniper attacks on important public figures, or the drive-by shootings and targeted "hits" that are part of gang activity or street crime. Although less common than other types of homicides and assaults, assassinations can pose a special threat to democracy and culture—not only killings of elected officials, but leaders of social movements, important religious figures, and philanthropists. Similarly, there are unquantifiable economic ripple effects when violent attacks remove major financiers, technology innovators, or business leaders. Drive-by shootings in poor neighborhoods have a chilling effect on life in the public sphere, which can choke communities. Weapons optimized for targeted killings—of moving objects or from moving vehicles, from significant distances—pose special challenges for ensuring safety and security. They may thwart traditional security measures.

Disable a Sniper Rifle—Or Change Its Target, WIRED (July 29, 2015, 7:00 AM), https://bit.ly/2Uz6cBq ("the researchers were able to dial in their changes to the scope's targeting system so precisely that they could cause a bullet to hit a bullseye of the hacker's choosing rather than the one chosen by the shooter.").

203. *See* MINITER, *supra* note 3, at 51; Tett, *supra* note 169 (expressing concerns that these weapons will fall into criminals' hands).

Heightened lethality can have a ratchet effect—whatever level of lethality some "criminals" have in their weaponry, law enforcement and civilians wanting to stop criminals will demand the same firepower or lethal technology.[204] If members of criminal enterprises expect to encounter certain types of armed resistance, they in turn are more likely to bring weapons to match it with equal force. An arms race is an inherent, unavoidable feature of any firearm technology that raises lethality. Banning precision-guided firearms is permissible under courts' current Second Amendment analysis. The *Heller* decision left in place longstanding federal restrictions on machine guns and short-barrel rifles, and though nothing is certain with regards to the future of Second Amendment jurisprudence, a state or federal ban on Guns That Cannot Miss should fit into this constitutional niche. On the other hand, homicides with these weapons are likely to remain so rare for the near future, at least in comparison to other shootings, that there is unlikely to be voter demand for legislation tailored to these guns.

The majority opinion in *Heller* repeatedly references the Second Amendment as a safeguard against government tyranny[205]—that is, an armed citizenry can resort to a violent revolt and overthrow an overbearing government. This is a favorite talking point for the NRA[206] and Gun Owners of America[207]—that democratic freedoms and civil liberties depend on a fearsomely-armed private citizenry, and conversely, that gun control is historically a precursor to disarming the citizens to establish a dictatorship.[208] I find these arguments disturbing—history seems instead to demonstrate that the most oppressive, bloodthirsty, genocidal regimes are those that take power by overthrowing the established government, even though they invariably claim to be liberators at the outset.[209] Nevertheless, the safeguard-against-tyranny point has traction in Second

204. *See* Blocher & Miller, *Lethality*, *supra* note 21, at 289–90.

205. *See* Dist. of Columbia v. Heller, 554 U.S. 570, 598 (2008) ("Third, when the able-bodied men of a nation are trained in arms and organized, they are better able to resist tyranny."); *see id*. at 600 (noting the need to "safeguard against tyranny"); *see id.* at 613 (reiterating the "purpose of banding together to oppose tyranny"); *see id.* at 668 ("extolling the virtues of the militia as a bulwark against tyranny").

206. *See, e.g.*, Press Release, Nat'l Rifle Ass'n—Inst. for Legislative Action, NRA Slams Bernie Sanders' Tyrannical Assault on American Gun Rights (Mar. 21, 2019), https://bit.ly/2yce4Bm; Press Release, Nat'l Rifle Ass'n—Inst. for Legislative Action, 65% See Gun Rights as Protection Against Tyranny (Jan. 18, 2013), https://bit.ly/2WHZ88l.

207. *See, e.g.*, Kurt Hofmann, *'Gun Control': The 'Gateway Tyranny'*, GUN OWNERS OF AM. (May 27, 2013), https://bit.ly/2QP0eeD.

208. *See, e.g.*, Robert Tracinski, *How the Second Amendment Prevents Tyranny*, FEDERALIST (Mar. 18, 2018), https://bit.ly/2WNGtrQ.

209. *See* Casey Michel, *The Myth That Civilian Gun Ownership Prevents Tyranny: Do High Rates of Gun Ownership Protect Democracies? Data Points to a Resounding No*, THINK PROGRESS (Apr. 30, 2018, 8:00 AM), https://bit.ly/2JiKiNv; Mark Nuckols, *Why the 'Citizen Militia' Theory Is the Worst Pro-Gun Argument Ever*, ATLANTIC (Jan. 31, 2013), https://bit.ly/3by6sav.

Amendment jurisprudence[210] and scholarship.[211] To that extent, weapons optimized for assassinations are optimized for the Second Amendment's purported goal, and should receive special legal protection and encouragement, rather than legal restrictions. For me, specialized assassination guns simply highlight the perverseness of the anti-tyranny argument.

On a more mundane level, these next-generation weapons with super-lethality could force our criminal justice system to revisit long-held assumptions about the proper line between intentional and unintentional homicides. Would it furnish an affirmative defense, or at least a mitigating factor in the gradation of charges or sentences, if the weapon used is one that assists in completing the shot in the last instant when a regular shooter might hesitate or reconsider? Conversely, if a shooter uses a gun that guarantees death, does this create a legitimate inference (thinking in terms of jury instructions) of more or clearer premeditation and deliberateness, and therefore more culpability? The question is whether a semi-autonomous weapon undermines, or intensifies, the scienter element of the crime.

A similar conundrum may arise when judges and juries assess attempted versus completed crimes. When is the crime complete with these guns? When the shooter tags the target and pulls the trigger, or a few seconds later when the gun decides to discharge the round? If "attempt" cases turn on what constitutes enough steps in preparation, furtherance, and execution, does buying a guarantee-kill sniper rifle count as more steps toward completion than a regular gun? Can new technology function as skipping steps in executing a plan?

Precision-guided firearms also raise new questions about the right of self-defense. A specialized weapon guaranteed to kill its target might move an incident along a continuum away from a spontaneous reaction to danger and closer toward a preplanned killing that is merely waiting for an opportunity, that is, waiting for the other party to provide an imminent

210. *See, e.g.*, Teixeira v. Cty. of Alameda, 873 F.3d 670, 686 (9th Cir. 2017) ("Early American legislators and commentators understood the Second Amendment and its state predecessors as protecting Americans against tyranny and oppression."); Tyler v. Hillsdale Cty. Sheriff's Dep't, 837 F.3d 678, 707 (6th Cir. 2016) ("Less obvious to the contemporary judicial mind are the Founding-era fears of tyranny and defenselessness that provided the impetus behind the Second Amendment."); Nordyke v. King, 319 F.3d 1185, 1196–98 (2003) (discussing anti-tyranny purpose of Second Amendment).

211. *See, e.g.*, Joseph Blocher, *Categoricalism and Balancing in First and Second Amendment Analysis*, 84 N.Y.U. L. REV. 375, 426–28 (2009); Stephanie Cooper Blum, *Drying Up the Slippery Slope: A New Approach to the Second Amendment*, 67 BUFF. L. REV. 961, 967 (2019); Charles J. Dunlap, Jr., *Revolt of the Masses: Armed Civilians and the Insurrectionary Theory of the Second Amendment*, 62 TENN. L. REV. 643 (1995); Darrell A. H. Miller, *Institutions and the Second Amendment*, 66 DUKE L. J. 69, 77 (2016); Douglas Walker, Jr., *Necessary to the Security of Free States: The Second Amendment as the Auxiliary Right of Federalism*, 56 AM. J. LEGAL HIST. 365, 369–70 (2016).

threat as an excuse.[212] Joseph Blocher has observed that the laws regarding preparations for self-defense, embodied in the loose or discretionary "good cause" requirements in some states for a concealed carry permit, are less exacting than those required *ex-post* for justifying the use of lethal force in self-defense.[213] Arming oneself (in private or public) as a preparatory measure for self-defense would generally have no requirement of an imminent threat or proportional force (both of which are difficult to foresee), but one could argue that a precision-guided firearm is at the maximum or outer bounds of proportional force for self-defense. Traditional self-defense jurisprudence also included a consideration of proportionality,[214] but these guns raise a novel question about whether certainty of success is part of the proportionality question.[215] Suppose, for example, that the force (say, the caliber of weapon) is an equal match,[216]

212. *See* Joseph Blocher, *Good Cause Requirements for Carrying Guns in Public*, 127 HARV. L. REV FOR. 218, 221 (2014) ("Self-defense law is about ex post risk assessment, in the sense that the event has already happened, and the law seeks to determine whether the self-defender's actions were reasonable and proportional to the threat Good cause requirements do the same thing from an ex ante perspective . . . .").

213. *See id.* Laying a lethal trap for an anticipated assailant—such as a spring gun or a spike-bottomed pit—is not legitimate self-defense, *see* Toomer v. William C. Smith & Co., Inc., 112 A.3d 324, 326 (D.C.App. March 26, 2015); Sydnor v. State, 776 A.2d 669, 677 (Md.App. July 20, 2001); J. D. Perovich, *Use of Set Gun, Trap, or Similar Device on Defendant's Own Property*, 47 A.L.R.3d 646 (1973). On the other hand, shooting an assailant normally is. *See* Eric Ruben, *An Unstable Core: Self-Defense and the Second* Amendment, 108 CALIF. L. REV. 63, 85 (2020); Fritz Allhoff, *Self-Defense Without Imminence*, 56 AM. CRIM. L. REV. 1527, 1527-29 (2019). I am arguing that precision-guided firearms fall somewhere on the boundary between these two.

214. *See, e.g.*, Richard J. Arneson, *Self-Defense and Culpability: Fault Forfeits First*, 55 SAN DIEGO L. REV. 231, 258–59 (2018); Joseph Blocher & Darrell A.H. Miller, *The Second Amendment As Positive Law*, 13 CHARLESTON L. REV. 103, 110–11 (2018); Lisa Hecht, *Provocateurs and Their Rights to Self-Defence*, 13 CRIM. L. & PHIL. 165, 169 (2019) ("In ordinary self-defence cases, proportionality is a constraint on the permissible use of force and the forfeiture of defensive rights."); Addie C. Rolnick, *Defending White Space*, 40 CARDOZO L. REV. 1639, 1659 (2019) ("These four elements—imminence of threat, necessity, proportionality, and reasonableness—form the legal bounds of traditional self-defense doctrine."); *see also* Commonwealth v. Abubardar, 120 N.E.3d 1228, 1230 (Mass. 2019) (whether "the degree of force used was reasonable in the circumstances, with proportionality being the touchstone for assessing reasonableness."); United States v. Black, 692 F.2d 314, 318 (4th Cir. 1982) ("Under the traditional rule, the quantum of force which one may use in self-defense is proportional to the threat which he reasonably apprehends . . . . Under this notion of proportionality, a danger which is not so great as to justify an actual killing in self-defense may nevertheless be serious enough to justify an unexecuted threat to use deadly force.").

215. While the question of guaranteed success may be novel, there is a significant body of literature, especially in the field of moral philosophy, about guaranteed *failure* of defensive force negating the proportionality requirement – the traditional consensus has been that *futile* uses of force do not count as legitimate self-defense. *See* Arneson, *supra* note 213, at 258–59. This is called the "success condition" of proportionality. *See id.*

216. Force does not have to be precisely proportionate in order to satisfy the requirements for legitimate self-defense; usually the question for courts is simply the broad-brush question of lethal versus nonlethal force. *See* Rolnick, *supra* note 213, at 1681 (noting that "self-defense laws in most states relax this proportionality requirement

does the elimination of the possibility of a shooter missing a shot, or the reduced ability of the eventual victim to dodge bullets change the proportionality of force, or is it irrelevant? The *Heller* decision, which established that the Second Amendment serves a core value of individuals arming themselves for self-defense, did not introduce a doctrinal change to the law of self-defense and proportionality.[217] In practice, however, if more citizens have private arsenals post-*Heller*, defensive gun use would likely: become more common; increase the number of self-defense incidents falling at the high end of permissible proportionality (with regards to force); and increase the chances that self-defense would cross the line into disproportionate force. Some commentators have argued that trendy "stand your ground" laws eliminate or severely limit the traditional proportionality requirement for self-defense.[218] Note that Texas law allows private citizens to use lethal force (including a firearm) to stop a fleeing felon or to protect property, even when the property owner is not in danger.[219] Suppose, however, that the legislature enacted such a law in a context that included numerous tacit assumptions about probability and certainty of success. If we assume that it is a rare event for an armed civilian being in the right place at the right time to have a clear shot at a fleeing felon, and that even in such a situation the civilian may miss, the benefits of armed civilians helping catch fleeing felons in exigent circumstances might have outweighed the contemplated benefits. But what if a TrackingPoint weapon allows an armed civilian to potentially call in a small, but precision-guided missile airstrike on any fleeing felon? If the technology opens the way for many new possible scenarios, a legislature might enact a different law, or at least a differently worded law. The same would apply to shooting trespassers—if permitting lethal force to defend one's property assumed physical proximity of the property owner and the trespasser/burglar, the situation might present very different moral and policy concerns if we mean a guaranteed kill of someone 1400 yards away, at the outer edge of one's land.

If law enforcement adopts these weapons, it would raise unanswered questions about police shootings of fleeing suspects[220]—again, due to the

slightly, in that they permit the use of deadly force in response to a threat of death or certain other violent crimes, most commonly robbery, rape, and kidnapping.").

217. *See* Cody J. Jacobs, *The Second Amendment and Private Law*, 90 S. CAL. L. REV. 945, 984 (2017) ("Thus, it seems unlikely that *Heller* will ultimately be read to require any change to the self-defense proportionality requirement.").

218. *See, e.g.*, F. Patrick Hubbard, *The Value of Life: Constitutional Limits o Citizens' Use Of Deadly Force*, 21 GEO. MASON L. REV. 623, 641 (2014) ("This 'rule' effectively eliminates the traditional requirement that the use of force in self-defense be proportional to the threat (i.e., that deadly force only be used to resist an imminent threat of death or serious harm).").

219. *See* Rolnick, *supra* note 213, at 1683.

220. *See generally* Tennessee v. Garner, 471 U.S. 1, 21 (1985)(leading case on lawful use of lethal force by police to stop fleeing suspects); Nancy C. Marcus, *From Edward to*

guaranteed death of the moving target and the fleeing suspect's inability to dodge a bullet. The situation is analogous to those involving law enforcement use of armed drones or bomb-carrying robots,[221] and it changes the equation for justified use of force—the officer is far enough away to be out of immediate danger, and the likelihood of death is higher. Traditional deference to police shootings of fleeing felons may have rested partly on the usually tacit assumption that it is too difficult for police to shoot precisely at a moving target in the heat of the moment, that is, too difficult for police to ensure a shot will stop the fleeing suspect to facilitate apprehension, rather than executing the suspect. We now have technology that would enable the police to do just that, and I would argue that police should have a duty not to use a guaranteed-lethal shot. At the least, the greater the certainty that a fleeing person will die should raise the duty of the officer to have an articulable, compelling reason to execute the person. Fortunately, statistical data suggests that police killings have been on the decline overall.[222] As mentioned above, arming police with any type of lethal firearms presents the same moral hazard and adverse selection problems that guns always introduce into a situation. Police are more likely to make risky choices when they have guns, and risky people are more likely to become police when the police have guns. Guns with super-lethality simply raise the moral hazard and adverse selection quotients.

Even the presumed value or virtue of sports shooting and hunting comes into question when we consider a gun that does not miss. An assortment of state and federal laws place restrictions on hunting by methods that eliminate "fair chase" in addition to seasonal restrictions, licenses and permits, and limits on kills.[223] Federal law restricts hunting

Eric Garner and Beyond: The Importance of Constitutional Limitations on Lethal Use of Force in Police Reform, 12 DUKE J. CONST. L. & PUB. POL'Y 53 (2016) (discussing the development and legitimacy of police use of lethal force against fleeing suspects).

221. Some academic discussion of this question has arisen in the last year or two following an incident where the Dallas police used a bomb-carrying robot to blow up an armed killing-spree suspect who had barricaded himself in a building. *See generally* Melissa Hamilton, *Excessive Lethal Force*, 111 NW. U. L. REV. 1167 (2017) (criticizing the police use of lethal force from a remote location); Thomas Wanebo, *Remote Killing and the Fourth Amendment: Updating Constitutional Law to Address Expanded Police Lethality in the Robotic Age*, 65 UCLA L. REV. 976 (2018) (criticizing the police use of lethal force from a remote location); Michael C. Dorf, *Is It Proper for Cops to Use Killer Robots?*, NEWSWEEK (July 15, 2016, 7:50 AM), https://bit.ly/2xTKNel (contending that guns and remote-control explosives are equally legitimate for police use); Michael Nunez, *Should Police Use Robots to Kill?*, GIZMODO (July 8, 2016, 6:47 PM), https://bit.ly/2yty16H (quoting Professor Eugene Volokh in support of the police actions).

222. *See* Franklin E. Zimring & Brittany Arsiniega, *Trends in Killings of and by Police: A Preliminary Analysis*, 13 OHIO ST. J. CRIM. L. 247, 250 (2015).

223. *See* Irus Braverman, *Conservation And Hunting: Till Death Do They Part? A Legal Ethnography of Deer Management*, 30 J. LAND USE & ENVTL. L. 143, 148–49 (2015) (describing several laws).

from aircraft,[224] and some states have tried to limit hunting from vehicles or "canned hunting," trophy hunting of trapped or fenced-in animals.[225] These regulations do not clearly infringe on the Second Amendment.[226] As hunting technology advances, "sport hunters have had to impose voluntary restrictions on their ability to hunt to give the animal a chance to escape," which would otherwise eliminate "the essential character of the hunt."[227] Arguably, precision-guided hunting rifles—essentially guaranteed to hit the target—approach these boundaries, although hunters still have to find the prey and tag it, and would have to have made the prior decision to hunt with a TrackingPoint gun. TrackingPoint rifles would be especially useful for hunting from a vehicle or aircraft, for example, because the gun can lock on a moving target from a long distance. Some commentators have recently critiqued, or debunked, the conventional wisdom that hunting helps with wildlife conservation.[228] This is relevant for the larger discussion of the morality of sports hunting, especially with precision-guided firearms.

Modern militaries use training to overcome the instinctive aversion to killing that most people have. "Interspecies homicide," as some military psychologists call it,[229] comes easier for normal psyches if individuals can distance themselves from their own actions.[230] The concept was developed by Brigadier General S.L.A. Marshall during World War II and was outlined in his controversial book *Men Against Fire.* [231] Marshall claimed that the ratio of rounds fired compared to hits was low because the majority of soldiers were not actually aiming at their targets.[232] Though Marshall's

224. *See* Roberto Iraola, *The Airborne Hunting Act*, 41 No. 3 CRIM. LAW BULL. 280, 280 (2005).

225. Laura J. Ireland, *Canning Canned Hunts: Using State and Federal Legislation to Eliminate the Unethical Practice of Canned "Hunting"*, 8 ANIMAL L. 223, 224 (2002) ("[C]anned hunts are inhumane, unethical, and should not exist.").

226. Joseph Blocher, *Hunting and the Second Amendment*, 91 NOTRE DAME L. REV. 133, 137 (2015) (arguing that hunting and recreational uses of arms have, at best, a tenuous claim to Second Amendment protection).

227. Braverman, *supra* note 222, at 149.

228. *See, e.g.*, Myanna Dellinger, *Trophy Hunting - A Relic of the Past*, 34 J. ENVTL. L. & LITIG. 25, 26 (2019) (arguing that "the hunting of endangered and threatened species for mere 'sport' should be outlawed and that the transborder transportation of parts of trophy-hunted animals should be more closely examined and restricted than what is currently the case."); Myanna Dellinger, *Trophy Hunting Contracts: Unenforceable for Reasons of Public Policy*, 41 COLUM. J. ENVTL. L. 395, 396 (2016); *see generally* Zoe Verhoeven, Note, *The Myth of Hunting as a Conservation Tool in the Crosshairs, Facing Extinction*, 95 DENV. L. REV. ONLINE 68 (2018) (critiquing the purported conservation benefits of hunting).

229. Peter Maass, *A Bulletproof Mind*, N.Y. TIMES, Nov. 10, 2002, at 52.

230. *See* Stephen Evans, *How Soldiers Deal with the Job of Killing*, BBC NEWS (June 11, 2011), https://bbc.in/2UHFI1M.

231. *See generally* SAMUEL LYMAN ATWOOD MARSHALL, MEN AGAINST FIRE: THE PROBLEM OF BATTLE COMMAND (1947) ([parenthetical]).

232. *See id.* at 50–63.

study has largely been discredited, his premise that the lethality of a soldier is hindered by their inherent human aversion to killing remains the conventional wisdom among military trainers.[233] In response to Marshall's ideas, the military made two major changes to the way it trained soldiers.[234] First, training methods were adopted to make soldiers more comfortable with firing at humans.[235] For example, the military stopped using bullseyes for shooting practice and instead used human-shaped cut-outs.[236] Today, combat training uses targets with human faces that pop up unexpectedly. Second, exercises were modified to be more similar to combat conditions and were repeated by soldiers "until their reactions became second nature."[237] Modern combat drills are run with greater frequency, under conditions far more reflective of an actual battlefield.[238] The result of the new training methods is that firing at human targets has become an almost automatic response.[239] As Special Forces Master Sergeant Danny Leonard put it: "It's so instantaneous . . . . You don't even realize you did it."[240] The new generation of firearms is an extension of that automation. "Digital fire-control systems," like the one the Army is seeking for new weapons orders, would allow soldiers "to engage targets faster and with greater precision."[241] They can pair with goggles via a wireless link, allowing the shooter to fire from behind cover.[242] By making killing more reflexive, semi-autonomous weapons take away some of the shooter's choice. By removing a degree of human involvement, autonomous functions insulate, to an extent, the individual operator's sense of personal culpability.

Major Peter Kilner, a West Point philosophy and ethics professor, argues that allowing soldiers to avoid confronting killing on a personal level during battle "leave[s] them more prone to psychological traumas after the training is finished."[243] Further, autonomous targeting impacts the operator's risk perception and therefore influences their decision-making

233. *See* Maass, *supra* note 228, at 52.

234. *See id.*.

235. *See id.*.

236. *See* Evans, *supra* note 229.

237. *See* Greg Jaffe, *Breaking a Taboo, Army Confronts Guilt After Combat*, WALL ST. J. (Aug. 17, 2005, 12:01 AM), https://on.wsj.com/2JlvQUX; Maass, *supra* note 228, at 52.

238. *See* Maass, *supra* note 228, at 52.

239. *See id.*

240. *Id.* (internal quotation marks omitted) (quoting Interview with Master Sergeant Danny Leonard, U.S. Army Special Forces).

241. Kyle Mizokami, *The Army's Next Infantry Guns Will Have Computerized Fire Control for Unreal Accuracy*, POPULAR MECHS. (Feb. 14, 2019), https://bit.ly/33PWv5U.

242. *See id.*

243. Jaffe, *supra* note 236.

process.[244] Operators of autonomous weapons may feel empowered by the automatic targeting functions. As TrackingPoint boasts, their Precision-Guided Firearm ("PGF") takes "the stress and nerves out of shooting" and allows the shooter to focus purely on taking the shot.[245] One expert warns that individuals who possess a gun that cannot miss have less motivation to de-escalate situations and avoid violence, preferring to rely instead on the method with the assured outcome.[246] Philosopher and ethicist Jonathan Moreno, expressed concern that semi-autonomous weapons would provide authorities with a shortcut around hostage and standoff negotiations.[247] "If their intuition says this guy is not going to engage in a conversation very long . . . would that make them feel more comfortable using the weapon?"[248]

"Responsibility gap" is the term some researchers use to describe the complications of ascribing liability for injury resulting from a decision that was made in part by a person and in part by autonomous technology.[249] Autonomous weapons grant untrained, novice shooters the reflexivity and emotional distance associated with military engagement and the precision of a master marksman. Of course, as TrackingPoint points out in their promotional materials, their firearms are not *fully* autonomous.[250] After the shooter makes the initial targeting decisions, TrackingPoint firearms control the decision to take the final shot.

Before closing this section, it is worth mentioning an even newer, but more modest, variation on guns that cannot miss: another new product line by Australian gunmaker Radetec, mentioned above. Radetec makes a non-obtrusive attachment for a few popular models of firearms (such as a Glock handgun or an AR-15) that will fire only when pointed at an electronically-designated target downrange.[251] This product is meant for shooting ranges and shooting schools, and avoids stray off-target shots (by amateur shooters or accidental un-aimed discharges) from injuring others or even from wasting rounds that would not land somewhere on the target.

---

244. *See* R.J. Knighton, *The Psychology of Risk and Its Role in Military Decision-Making*, 4 DEFENCE STUD. 309, 311–13 (2004)(discussing risk and decision-making generally).

245. *See* Brian Anderson, *Long Shot: Inside the Scope of Smart Weapons*, VICE (Sept. 23, 2013, 1:05 PM), https://bit.ly/2QS5zSs.

246. *See id.*

247. *See id.*

248. *Id.* (internal quotation marks omitted) (quoting Interview with Jonathan Moreno, Philosopher & Ethicist, Ctr. For Am. Progress).

249. *See* Thompson Chengeta, *Accountability Gap: Autonomous Weapon Systems and Modes of Responsibility in International Law*, 45 DENV. J. INT'L L. & POL'Y 1, 1 (2016).

250. *See* Anderson, *supra* note 244.

251. *See Safe Shooting Range*, RADETEC, https://bit.ly/39pRa6j (last visited May 19, 2020); *see also* Andrew Tuohy, *Smart Guns Are Coming and They Scare the Crap Out of Me*, OMAHA OUTDOORS (Jan. 27, 2019), https://bit.ly/3asDDMz.

The product is affordable (a few hundred dollars). For shooting ranges and schools, Radetec has a system that allows a trainer to disable all the trainee guns in the line at once, a very useful feature when giving instructions to the group. It is easy to imagine Radetec's products having consumer appeal for armories, shootings ranges, and shooting schools (including police academies and military training bases), and there could be secondary or spillover benefits for the gun community generally.

IV. GUNS THAT TRACK EVERYTHING

Another line of emerging firearm technology is digital tracking of a gun's location, movements, and discharge. Products are already on the market that offer audio/video uploads from the scope, but the more sophisticated technology has nuanced movement tracking, similar to the "black box" in an automobile that constantly records speed, acceleration, braking, and turns. These are firearms or firearm attachments that can record the movements, location, and time/direction of discharge. Such record-creation and archiving of data could raise accountability for law enforcement, similar to the policy rationales for police bodycams,[252] and also enhance justifications for shootings, validating a subsequent claim of self-defense by a civilian gun owner. Documenting that a shooting was justified could be beneficial if it protects police, and even private gun owners, from wrongful accusations or prosecution. On the other hand, an *ex-ante* belief that it will be easier to show the legitimacy of a shooting after the fact can subconsciously make police or private gun owners less hesitant or more likely to take a questionable shot, which is not necessarily a good thing.

Some of these technologies overlap with what gun safety advocates wanted with their version of "smart guns." But the TrackingPoint guns, which also boast this technology, are clearly more lethal, but not necessarily safer. Some of these recordkeeping guns—whether market-ready, prototypes, or merely concepts—use blockchain ledger technology for recordkeeping and security, which Part V will address separately. For purposes of this section, it is enough to note that recordkeeping guns may or may not use blockchain; and that some use (or propose to use) audio-video feeds uploaded to the Internet. Conversely, blockchain technology is a core component of a wide range of firearm-related new technologies, so it deserves a separate section.

One recent legal commentator explained the usefulness for police of firearm tracking technology this way:

252. *See* Colin Neagle, *How the Internet of Things Is Transforming Law Enforcement*, NETWORK WORLD (Nov. 3, 2014, 9:33 AM), https://bit.ly/2QTyky1.

> [The Internet of Things] will also be beneficial for local law enforcement. For example, Yardarm Technologies has developed smart firearms, accessories, and sensor technology that can monitor and record data each time the weapon is discharged. Some police departments, including Santa Cruz, California, and Carrollton, Texas, have started to test these devices, and the smart guns also contain either biometric fingerprint sensor technology on the triggers, or smart bracelets that use RFID microchips, such that only the assigned officer is able to discharge the weapon.[253]

A startup called Justifire[254] has a product based on the same idea, but in reverse, as having smart guns track police use to help hold officers accountable for shootings (the gun automatically records every movement, trigger pull, angle, location, etc.). Justifire is for civilian gun owners who plan to use their guns to kill in self-defense and worry that they will face criminal charges afterward (or a wrongful death suit)[255] if nobody believes their version of what transpired. These gun attachments work with existing handguns and record everything—gun movement and location, firing, and even audio/visual.[256] There is already inferential evidence for current consumer demand for such technology: the existing market for gun owner's legal insurance.

More limited internal tracking is available from Radetec, an Australian firearm manufacturer. Radetec sells attachments (costing $139–$299) for existing 1911s, Beretta handguns, and AR-15s that provide a digital display on one side of the weapon to show how many rounds remain in the magazine,[257] or (in a replacement slide on the butt of the handgun) how many shots the gun has fired,[258] which is useful for maintenance purposes. The latter is analogous to an odometer on a car,

253. Kester, *supra* note 6, at 215 (citing Neagle, *supra* note 251).

254. *See Blackbox Environmental Recording Device*, JUSTIFIRE, https://bit.ly/2UBPqSb (last visited May 19, 2020) (calling the product a "Blackbox for your handgun").

255. *See id.*

256. Referring to Justifire's website, Erik Gibbs provided some additional information on how the device works:

> [The device] captures and funnels audio, video, barometric pressure, altitude, temperature and 3 axes of accelerometer, gyroscopic, and magnetic data at all times, it only saves this information if specific event characteristics are met. Qualifying event characteristics such as aiming at a human target or firing your weapon instantly plug Justifire[']s data funnel and the device automatically saves and encrypts all information leading up to and after an event.

Erik Gibbs, *Blockchains could revolutionize the use of firearms*, COINGEEK (July 31, 2019), https://bit.ly/2JgcX61 (quoting the Justifire webite) (internal quotation marks omitted).

257. *See Digital Counter*, RADETEC, https://bit.ly/3bkyxSD (last visited May 19, 2020).

258. *See RISC*, RADETEC, https://bit.ly/33G0RMI (last visited May 19, 2020); *see also* Ivan Loomis, *Digital Round-Count Display for Your Glock! Radetec's Smart Slide – SHOT Show 2019*, GUNS AM. DIG. (Jan. 28, 2019), https://bit.ly/3bnmy6K; Tuohy, *supra* note 250.

which helps owners stay on an optimal maintenance schedule for oil changes, tune-ups, and other parts replacement.

V. BLOCKCHAIN AND GLOCKCHAIN

Blockchain is a newer type of digital ledger technology ("DLT"), best known for its association with Bitcoin and other cryptocurrencies.[259] Like many disruptive technologies—which first capture the public imagination or garner headlines—a certain amount of hype has surrounded blockchain.[260] For readers unfamiliar with blockchain, it is a type of decentralized, verifiable digital recordkeeping, a bit like a cross between a notary public and the practice of emailing a backup of an important document to ten different trustworthy friends who are always online (an obvious oversimplification). Blockchain often incorporates encryption and multiple-location independent backups of the data to help make the information more invulnerable to malicious manipulation, data loss, or unauthorized access. Blockchain and other DLTs can function as an unalterable, automatically recorded ledger of specific events or occurrences.[261] It facilitates both trust and privacy in a world of anonymous or international transactions.

A few academic researchers have proposed ways that blockchain technology could work with firearm sales, usage, or firearm regulation.[262] Several tech blogs subsequently reported on this or promoted it,[263] and some of the next-generation smart gun startups incorporated blockchain at

259. For helpful, even-handed background on blockchain, digital ledger technologies, and cryptocurrencies, see Harish Natarajan et al., *Distributed Ledger Technology (DLT) and blockchain* (World Bank Grp., Working Paper No. 122140, 2017); *see also What is blockchain?*, IBM, https://bit.ly/3dlN3vf (last visited May 19, 2020).

260. For example, Kodak and Long Island Ice Tea both announced entrance into the cryptocurrency world and preemptively changed their names to include the word "blockchain," saw immediate jumps in their stock prices. *See* Chuck Jones, *Kodak And Long Island Ice Tea Embracing Blockchain Is Just Like Dot Com In 1999. It Didn't End Well*, FORBES (Jan. 25, 2018), https://bit.ly/2UuT93T.

261. *See* Metzler, *supra* note 2, at 111 ("Blockchain is a technology that establishes a ledger that cannot be altered after an occurrence has been recorded.").

262. *See id.*; Matt Ledder, *Capstone Project: Blockchain for Gun Safety*, 21–37 (2019) (unpublished report) (on file with the Georgetown Library Repository); Thomas F. Heston, *A Blockchain Solution to Gun Control*, 3–7 (Nov. 13, 2017) (unpublished article), *available at* https://bit.ly/3dCBz70.

263. *See* John Brixius, *Blockchain Completely Alters The Gun Debate*, MEDIUM (Mar. 8, 2019), https://bit.ly/2QDAt0A; Kristin Houser, *Here's How Blockchain Could Be Used for Gun Control*, FUTURISM (Feb. 27, 2018), https://bit.ly/2UaGm7Q; Sissi Cao, *Blockchain Could Improve Gun Control—But Lawmakers Hate the Idea*, OBSERVER (Feb. 22, 2018, 5:22 PM), https://bit.ly/39jY3Gw; Sam Mire, *Blockchain In The Firearms Industry: 6 Possible Use Cases*, DISRUPTOR DAILY (Nov. 15, 2018), https://bit.ly/2J6iD2m; *see also* Ariel Schwartz, *Every bullet this gun fires would be automatically tracked in a database–here's why*, BUS. INSIDER (July 12, 2016), https://bit.ly/2UrSIHA.

the core of their product idea.[264] One group of researchers, under the auspices of Ideo coLab, gave their project the catchy name "Glockchain,"[265] though the project is unrelated to the firearms manufacturer known as Glock.

The Glockchain project aims to incorporate DLT into a firearm so that it records each time the gun fires, along with its precise location, and the blockchain records are completely secure and accurate.[266] The developers had police in mind as the potential users of this product to augment police accountability when a police shooting occurs with a service weapon.[267] If a rampaging active shooter were using gun technology (which seems incredibly unlikely), police could theoretically have a faster response time and could more easily identify the shooter, especially if the active shooter used the feature to broadcast his shot numbers through social media during his rampage.[268] This is a type of guns-that-track-everything, discussed in the previous Part,[269] that uses blockchain technology for its recordkeeping. The most promising use for this product is for the police and the military. For the police, this could provide increased accountability and/or validation (and, hence, legitimacy) in the same way that bodycams do. This technology helps military officers and commanders see through the chaos of the battlefield and identify which of their soldiers is firing and from where; it would also help prevent or track desertions, defections, lost or stolen munitions, and so on.

Other researchers have published or circulated manuscripts detailing a blockchain-based replacement for the firearm purchase background check system in the United States.[270] The proposals each have some variations, but all include some type of blockchain registry or ledger for every firearm, either with built-in automatic recording and ledger technology or based on the existing embossed serial number system, combined with a blockchain owner or user registry or blockchain wallet. The goal of these proposals is primarily to enable law enforcement tracing of crime guns, but each of the proposals contemplates replacing the existing FBI National Instant Background Check System ("NICS"). This replacement background check system would have a decentralized

264. *See The World's First Blockchain Gun Diary*, GUNIARY, https://bit.ly/2UzLMbw (last visited May 19, 2020); *see also Blockchain completely changes the firearms debate: FAABS is a proposal for a Win-Win solution for moderates on both sides*, FAABS.ORG, https://bit.ly/2xOxhZC (last visited May 19, 2020).

265. *See* Schwartz, *supra* note 262.

266. *See* Metzler, *supra* note 2, at 111.

267. *See id.* at 11 n.53; *see also* Schwartz, *supra* note 262.

268. *See* Metzler, *supra* note 2, at 127.

269. *See supra* Part IV.

270. For the most serious examples, see Heston, *supra* note 262, at 3–7; *The World's First Blockchain Gun Diary*, *supra* note 263; Ledder, *supra* note 262, at 21–37.

blockchain verification system for ensuring that only authorized users can purchase or carry firearms,[271] although some bloggers envision a blockchain system to feed the data directly into the NICS database, making it much more accurate and comprehensive. The Firearm Accountability Auditability Blockchain Solution ("FAABS") system would create a private-sector decentralized registry of gun owners (federal statutes prohibit the federal government from creating a gun owner registry, though states may currently do this, such as California). It would also help with "police spot checks"—officers who encounter someone with a gun could immediately verify if the individual is a lawful possessor.[272] FAABS is a private nonprofit. The advantage of a private-sector voluntary registry is that no state action could implicate constitutional concerns (i.e., Second Amendment), nor would private actors violate the federal statutory prohibition on a government-operated gun registry.[273]

These proposals rest on some dubious assumptions, or simple misunderstandings, about millions of gun owners in America (many of who are vehemently opposed to any type of gun owner registry, as they believe it inevitably leads to a gun confiscation), and the number of guns already in circulation (estimated to be more than the total population of the United States). Most prohibited purchasers are convicted felons, wanted fugitives, and undocumented immigrants. Those prohibited purchasers adjudicated as mentally impaired and those dishonorably discharged from the military, grouped together, form a smaller group than the first three categories. Normally, members of these groups (especially convicted felons) know that they cannot pass a background check, and would simply steal or borrow someone's firearm or pay a premium to an aftermarket seller who would agree not to record the transaction to the blockchain ledger. Unless all current gun owners voluntarily comply with using a system of non-governmental blockchain tracking, using blockchain to trace guns requires replacing the more than 300 million firearms already in circulation with guns that have automatic blockchain recording—an unrealistic suggestion, both politically and financially. The current guns in circulation will continue in circulation for decades, unless the government undertakes a massive confiscation-buyback or an outright ban. The hostility to blockchain registries and gun tracking is evident in the 2017 Arizona statute prohibiting the implementation of any such

271. *See* Ledder, *supra* note 261, at 5–8; *see also* Heston, *supra* note 261, at 5–7 (adding the additional view that we could finally derive an accurate count of the number of guns in circulation).

272. *See* Brixius, *supra* note 262.

273. *See* 18 U.S.C. § 926(a) (2018).

system.[274] The proposals emphasize that the blockchain encryption would protect the privacy of gun owners, but not as much as if the owners simply refused to participate, that is, to stay off-grid from the blockchain ledger. Unfortunately, national gun owner registries are simply a non-starter in the United States under current laws and partisan platforms. Some of the writers on this subject even suggest that hackers could currently discover who does *not* own a gun, so that criminals could target non-owners. But this assumes that there is an existing registry of gun owners (there is not) that would allow those with access to make such a determination by elimination.

Similarly, a recurring suggestion through all the commentary about blockchain and background checks is that it would help the background check system to be hacker-proof and more accurate. However, there are no reported incidents of anyone hacking into the NICS databases, either to modify or delete unfavorable records. There is no reason for anyone to do so. A prohibited person (someone falling under one of the nine prohibiting factors in 18 U.S.C. § 922(g)) is still under the legal prohibition even if their information is missing from the NICS system—a felon-in-possession is still a felon-in-possession if they have a felony conviction and have a gun. Deleting one's information from the NICS database would not make it legal for a prohibited person to purchase or own a gun. Moreover, any prohibited persons undeterred by the legal prohibition can easily purchase used firearms from private unlicensed sellers without undergoing any background check. There is no current problem with security breaches of the NICS databases. Regarding accuracy, a 2017 report of an audit by the Office of the Inspector General found that the background checks are currently around 98% or 99% accurate, so there is room for improvement, but not much. NICS suffers from staffing shortages and underreporting of new records by courts, local law enforcement, and mental health care providers (all of which are already improving), but not from a significant percentage of mistakes.

It is easier to imagine that gun owners with large collections—especially if they buy, sell, and lend frequently—might want to use the Guniary app or Radetec Armorer Logbook[275] to keep an inventory of their weapons and ammunition. Armories, shooting ranges, and shooting schools, which often have guns available for rental or temporary use, are also easy to envision as users of a blockchain-based tracking system like Guniary or even FAABS. It also seems within the realm of possibility that

274. *See* H.B. 2216, 53d Leg., 1st Reg. Sess. (Ariz. 2017). The Arizona statute imposes criminal sanctions (felony grade) for a public official who creates a law requiring digital ledgering technology for tracking firearms. *See id.*

275. *See Armorer Logbook*, RADETEC, https://bit.ly/2QLtumv (last visited May 19, 2020). Because Radetec's Armorer Logbook does not claim to use blockchain technology, so I mention it only in passing in this section.

some states would require—either through legislation or regulation—that shooting ranges and shooting schools use such a system. Similarly, it is certainly possible that at some point the FBI would incorporate blockchain technology into its NICS databases, NICS instant background checks by licensed gun dealers, or to streamline records uploading from local law enforcement and local courts, though other automatic reporting software might accomplish the same thing more efficiently than blockchain.

Another promising application for private-sector blockchain registries is voluntary self-registration of conscientious nonowners—those conscientiously opposed to gun ownership, who want to signal their convictions and commitment to the renunciation of gun rights. A companion article[276] to this one argues for a system of voluntary self-enlistment in the NICS database for those who do not want to buy or possess guns for moral reasons. Ian Ayers and Fred Vars have argued for a similar self-registration for suicidal individuals, and their proposal has become a reality in Washington state via legislative enactment.[277] Gun rights repudiation requires a system of verification or certification to give gravitas and credibility to the decision to renounce firearm ownership permanently. This credibility and gravitas are necessary for renunciation to serve exemplary purposes for influencing social norms, fostering cohesiveness and identity within the gunless movement, and moral self-signaling. Government registration and certification of nonowners voluntarily seems to be the most powerful way to accomplish this, but a decentralized blockchain self-registry could be a viable second-best option, though it would not achieve the goal of rendering oneself unable to purchase a gun or subject to firearm forfeiture, as a government-sponsored system would.

VI. CONCLUSION

The emerging technology with firearms has branched in different directions, so that we can no longer refer to smart guns as a monolithic item. Some are safer, while others are more dangerous; some are a new type of weapon, while others are attachable and detachable with older mechanical firearms. Although consumers might prefer safety features on many products, with firearms there is a longstanding divergence between

276. *See* Drury Stevenson, *Going Gunless*, 85 BROOK. L. REV. (forthcoming 2020).

277. *See generally* Ian Ayres & Fredrick E. Vars, *Libertarian Gun Control*, 167 U. PA. L. REV. 921, 922–23 (2019) (discussing legislative implementation or proposals in various states); Fredrick E. Vars, *Not Young Guns Anymore: Dementia and the Second Amendment*, 25 ELDER L.J. 51 (2017)(discussing proposal to help elderly individuals avoid dementia-related suicide); Angela Selvaggio & Fredrick E. Vars, *"Bind Me More Tightly Still": Voluntary Restraint Against Gun Suicide*, 53 HARV. J. LEGIS. 671 (2016) (legislative proposal to allow suicidal individuals to register for a do-not-sell list for firearms); Fredrick E. Vars, *Self-Defense Against Gun Suicide*, 56 B.C. L. REV. 1465 (2015) (same).

the market-driven advances in technology and the policy-driven pushes for new development. The market demand drives the technology toward cheaper, more lethal, and more convenient to carry guns. The policy agenda, of course, moves toward reducing injuries and deaths, which impose high social costs. The tensions presented by new firearm technology are an outgrowth of the collective action problem or tragedy of the commons inherent in safety and security. Safety and security are a public good; low rates of violence are part of this public good.[278] Arming oneself for one's safety and security could maximize an individual's good, but a completely unarmed community would have less violence overall, or at least less lethal violence. If guns are good at all, it is under a Theory of Second Best, a type of necessary evil.

Electronically personalized guns—what most people mean when they refer to "smart guns"—could help reduce gun injuries and deaths, especially for children and teens, but they would certainly not solve everything, or even most of the gun deaths. It may be worth encouraging the development of the technology to save a few hundred lives per year, but advocates (and politicians) should not overpromise what the technology could achieve. Personalized smart guns would be unlikely to have much impact on the horrific rampage of shootings in schools and other places crowded with innocent, unsuspecting civilians. Personalized smart guns, even if popular, may have little impact on domestic gun violence and elderly suicides (which comprise a huge share of annual gun deaths) or on interpersonal revenge.

Technology also affects public morality by providing new comparison benchmarks. Precision-guided guns, due to their infallible lethality, might make traditional, mechanical guns seem more legitimate by comparison. It may be that the greatest harm presented by precision-guided firearms is not how the owners use them, but that they make other guns seem (deceptively) harmless, tame, and unremarkable. This would depend on the guns becoming well-known to the public and assimilated into the cultural semiotics of weaponry, which does not necessarily correlate to the number of guns in circulation. TrackingPoint guns and their progeny may remain an exotic luxury item for a long time, but if they capture a place in the public imagination, they could have an adverse influence as a comparison. Conversely, personalized smart guns could make regular guns seem reckless and unsafe by comparison, even if the smart guns never become the norm, as long as the public awareness or the salience of the item in the public's imagination about weaponry becomes entrenched.

278. For an excellent discussion of the aggregate effects of firearm prevalence or paucity on a community, see Powell v. State, No. 18-CV-6675, 2019 WL 4750265, at *2–*4 (N.D. Ill. Sept. 30, 2019).

Recordkeeping and blockchain-enabled guns are likely to become more common, both for gun hobbyists (in the same way that wristband fitness trackers are appealing for exercise enthusiasts), police, military, and private security organizations that use software for tracking and re-stocking ammunition inventory, firearm maintenance and replacement schedules, and so on. Many law enforcement and military organizations auction or sell their old firearms when they replace their inventory, so firearm features popular with these large-volume purchaser entities become familiar to gun dealers and private gun purchasers as well. I believe the main effect in the foreseeable future will be more efficiency in inventory management for such entities as well as administrative efficiency in law enforcement and military entities, bringing some savings to taxpayers. More speculatively, recordkeeping guns could eventually impact target practice behaviors and, indirectly, the shooting range industry, as these entities (as well as gun hobbyists) become more aware or self-conscious of the number of rounds they are using for practice, and the wear and tear that shooting range practice has on each firearm.

None of the emerging technologies address the underlying moral dubiousness with killing in self-defense or defense of property, the immorality of sports hunting, the immorality of playing a part in a larger breakdown in collective action, or the erosion of a public good, like a nonviolent community. Even if the majority of jurists, or the majority of voters, believe that it is morally acceptable to kill another person when confronted with an immediate, unavoidable choice between the two lives (a view I do not share), such discourse merely deflects the harder questions of whether defensive gun use is an excusable, forgivable act or a virtuous, heroic one; or whether killing to save one's own life, or the life of a loved one, is moral when nonlethal alternatives might also have worked. Gun ownership for self-defense not only presents moral hazard and adverse selection problems, but also a crowding-out phenomenon as well as an individual under-investment in nonlethal force (say, a taser or a bat), locks and alarms, cultivating cautious and circumspect habits, and having an escape plan. A legal right to use lethal force in self-defense does not equal a moral right to do so, and even a moral right to kill does not equal a moral obligation. Zero guns would be better than smart guns.