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Common Use, Lineage, and Lethality

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Political and legal debates over assault rifles, large-capacity magazines, and other lethal technology are characterized by increasing rancor and hostility. Lack of a common vocabulary to describe the topics of debate, much less facilitate a constructive dialogue, only aggravates this trend. For example, gun rights advocates often disparage the term “assault rifle” as reflecting a practical illiteracy about firearms or treat it as some kind of “hoplophobic” smear.¹ Regulators sometimes

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^{**} Associate Professor of History, Wesleyan University. Thanks to Joseph Blocher and Jake Charles for discussing or reviewing previous versions of this essay. Thanks especially to Peter Rutland, who is working on a broader study on Trevor Dupuy, for bringing Dupuy’s Theoretical Lethality Index to our attention.

¹ Stephen P. Halbrook, *Banning America’s Rifle: An Assault on the Second Amendment?*, 22 FEDERALIST SOC’Y REV. 152, 152 (2021) (“The term ‘assault weapon,’ while usually applied to some kind of rifle, is actually a pejorative term without a

class weapons based on features that gun-rights advocates say are purely cosmetic, leading to charges that these regulations are grotesquely over- or under-inclusive.²

The doctrine defining constitutionally protected arms is advancing without a clear sense of the object of Second Amendment protections. *District of Columbia v. Heller* — the first Supreme Court case to hold that the Second Amendment protects an individual right to keep firearms for personal purposes like self-defense — uses various terminology for arms in its opinion. At its most general, the Court states that the constitution protects weapons in “common use” for “lawful purposes,” as distinct from “arms” that are “dangerous and unusual.”³ But it doesn’t take long for those broad categories to become muddled. *Heller* says that handguns capable of concealment are protected, but that short-barreled shotguns (which are modified specifically to be carried in one hand and concealed) are “dangerous and unusual” weapons that may be prohibited.⁴ It suggests that “M-16s and the like” may be banned; but also that “the Second Amendment extends, prima facie, to all instruments that constitute bearable arms” — which would include not only M-16s, but “weapons useful in warfare” such as rocket launchers, hand grenades, and more exotic and deadly weaponry.⁵ Some lower court judges, those who eschew conventional tailoring and are receptive to a “text-history-and-tradition-only” approach to Second Amendment questions, have begun to suggest that weapons that are “lineal descendants” of Founding Era arms are protected by the Second

definite meaning.”). Gun violence prevention advocates respond that the term is an accurate reflection of gun manufacturers’ own marketing materials, which emphasized “the military pedigree of its products.” VIOLENCE POL’Y CTR., *THE MILITARIZED MARKETING OF BUSHMASTER ASSAULT RIFLES* 5 (2018), <https://vpc.org/wp-content/uploads/2018/04/Bushmaster2018.pdf> [<https://perma.cc/U8N8-G6E5>]. “Hoplophobia” is a neologism that roughly translates to “fear of weapons.” For more on the idea of anti-gun animus, see Jacob D. Charles, *Second Amendment Animus*, 116 NW. U. L. REV. 1, 14-32 (2021).

² See Erica Goode, *Even Defining ‘Assault Rifles’ Is Complicated*, N.Y. TIMES (Jan. 16, 2013), <https://www.nytimes.com/2013/01/17/us/even-defining-assault-weapons-is-complicated.html> [<https://perma.cc/A3M8-GDEW>]; see also Allen Rostron, *Style, Substance, and the Right to Keep and Bear Assault Weapons*, 40 CAMPBELL L. REV. 301, 303 (2018) (“Critics of assault weapon bans complain that these laws irrationally draw distinctions among firearms based on cosmetic features . . .”). But see E. Gregory Wallace, *“Assault Weapon” Lethality*, 88 TENN. L. REV. 1, 14 & n.64 (2020) (arguing for functionality of certain features).

³ *District of Columbia v. Heller*, 554 U.S. 570, 627 (2008). Elsewhere, the Court uses the phrase “dangerous or unusual.” *Id.* at 623 (emphasis added).

⁴ *Id.*

⁵ See *id.* at 624.

Amendment,⁶ despite the fact that such familial metaphors more often obscure than illuminate historical relationships between technologies of different periods.⁷

Sorely missing from the current debate is a shared vocabulary for what the public policy and the constitutional doctrine is aiming to achieve. Terms like “common use,” “dangerous and unusual,” “lineal descendants” or “employed in civilized warfare”⁸ cannot adequately discipline doctrine or debate without some common denominator for the task. This Article suggests that focusing on lethality is one way to converge on a shared metric for the discussion.⁹

The late Trevor N. Dupuy, a senior U.S. Army officer during World War II who later became a respected and prolific military historian, developed one such metric in the middle of the twentieth century — the Theoretical Lethality Index (“TLI”). In 1964, the United States Army contracted with Dupuy to analyze how the killing power of weapons had increased over time — he created the TLI to measure how many people a particular weapon could kill in one hour.¹⁰ Dupuy

⁶ See, e.g., *Ass’n of N.J. Rifle & Pistol Clubs Inc. v. Att’y Gen. N.J.*, 974 F.3d 237, 257 (3d Cir. 2020) (Matey, J., dissenting) (stating that “I believe the proper interpretive approach is to reason by analogy from history and tradition” and citing the “lineal descendant” language from *Heller* oral argument (internal quotation marks omitted and citations omitted)); *Parker v. District of Columbia*, 478 F.3d 370, 398 (D.C. Cir. 2007) (“The modern handgun — and for that matter the rifle and long-barreled shotgun — is undoubtedly quite improved over its colonial-era predecessor, but it is, after all, a lineal descendant of that founding-era weapon . . .”).

⁷ See Joseph Blocher, *Bans*, 129 *YALE L.J.* 308, 363 (2019) (“Is the modern AR-15 a ‘lineal descendant’ of the colonial-era musket? Guns have no progeny, so one cannot trace their lineage directly through some kind of family tree.”); see also Eugene Volokh, *Implementing the Right to Keep and Bear Arms for Self-Defense: An Analytical Framework and a Research Agenda*, 56 *UCLA L. REV.* 1443, 1478 (2009) (describing this analytical technique as “largely indeterminate”).

⁸ *Aymette v. State*, 21 *Tenn.* 154, 158 (1840).

⁹ See Jennifer Tucker, *Now That Guns Can Kill Hundreds in Minutes, Supreme Court Should Rethink the Rights Question*, CNN (Oct. 20, 2021, 7:31 AM EDT) <https://www.cnn.com/2021/10/20/opinions/supreme-court-gun-rights-case-lethality-tucker/index.html> [<https://perma.cc/8JMV-XR48>]. We are not the first to identify lethality as a potential metric. See Wallace, *supra* note 2, at 17. We have a number of disagreements with Professor Wallace’s assessment of lethality in his piece, as well his estimation of comparative lethality. For purposes of this Article, however, we differ in particular with his belief that lethality of a technology cannot be reduced to a single number — the TLI is proof of concept that it can — and his skepticism of the utility of such a metric within and between time periods.

¹⁰ HIST. EVALUATION & RSCH. ORG., FINAL REPORT ON HISTORICAL TRENDS RELATED TO WEAPON LETHALITY (1964), <https://apps.dtic.mil/sti/pdfs/AD0458760.pdf> [<https://perma.cc/K48C-FKDD>]; see also TREVOR N. DUPUY, THE EVOLUTION OF WEAPONS AND WARFARE 92 (1980) [hereinafter *EVOLUTION*] (reprinting Theoretical Lethality Index table).

worked on this project for a non-partisan entity which had an interest in the accuracy and utility of his formula — the United States military. As such, Dupuy’s Theoretical Lethality Index offers a useful metric for quantifying the lethality of firearms in historical terms. His index can provide at least a starting point to construct a common scale to assess the functionality of weapons both within and across various time periods.

Part I of this Article outlines the state of Second Amendment doctrine with respect to which and what type of arms are protected, and the confused language and goals of that doctrine. Part II provides a short biography of Dupuy and his development of the TLI. Part III demonstrates how Dupuy’s TLI can help guide policy makers and judges as they engage with the right to keep and bear arms in a post-*Heller* world.

I. LACK OF A COMMON METRIC FOR ARMS

In *District of Columbia v. Heller*, the Supreme Court held for the first time that individuals have a right to keep arms in their home for lawful purposes such as self-defense, without regard to participation in any organized military unit such as the National Guard.¹¹ Key to that case was how to define the word “arms” in the Second Amendment.¹² It is indisputable that a strict dictionary-definition of the word “arms” in 1791 is radically over-inclusive. Justice Antonin Scalia states in *Heller* that “[t]he 18th-century meaning [of arms] is no different from the meaning today” and that “arms” simply means “weapons.”¹³ Indeed, he continues, it “borders on the frivolous” to suggest that only those arms that existed in 1791 are protected now: “[t]he Second Amendment extends, prima facie, to all instruments that constitute bearable arms, even those that were not in existence at the time of the founding.”¹⁴ But no one really believes that. Not even Justice Scalia believes that.

There are numerous modern weapons that “constitute bearable arms” that are categorically outside the Second Amendment’s coverage — no matter what “bearable arms” literally means. Let’s start with bearable arms of catastrophic lethality — vials of weaponized smallpox or VX nerve agent, for example. These are indubitably weapons; they also are

¹¹ See *District of Columbia v. Heller*, 554 U.S. 570, 635 (2008).

¹² The Second Amendment states in full: “A well regulated Militia, being necessary to the security of a free State, the right of the people to keep and bear Arms, shall not be infringed.” U.S. CONST. amend. II.

¹³ *Heller*, 554 U.S. at 581.

¹⁴ *Id.* at 582.

capable of being carried, but no one treats these weapons of mass destruction as raising any *prima facie* Second Amendment question.¹⁵ Moving down the spectrum of lethality, *Heller* itself categorically excludes from Second Amendment coverage machine guns, “M-16 rifles and the like,” and short-barreled shotguns, notwithstanding Justice Scalia’s assertion that the Second Amendment extends *prima facie* to these types of weapons.¹⁶ Lower courts have followed suit, excepting weapons like hand grenades from Second Amendment coverage, despite their falling within a literal class of “bearable arms.”¹⁷

Instead of a radically over-inclusive textual definition of “weapons,” Justice Scalia concedes the Second Amendment really doesn’t protect all “bearable arms,” but only those arms in “common use,” and in particular, those weapons “typically possessed by law-abiding citizens for lawful purposes.”¹⁸ Handguns, according to the majority, are a popular form of self-defense technology, commonly owned by individuals for self-defense, and therefore are protected by the Second Amendment. But this common use test sets up a vicious circularity, one that Justice Stephen Breyer in his *Heller* dissent exposed. *Heller*’s common use test means that “if tomorrow someone invents a particularly useful, highly dangerous self-defense weapon, Congress . . . had better ban it immediately, for once it becomes popular Congress will no longer possess the constitutional authority to do so.”¹⁹ It can’t be, according to Justice Breyer, that the only permissible regulations are those regulations that currently exist.²⁰

For a decade now, lower courts and scholars have struggled to break out of this circularity. Some try to identify a reference group from which to assess “common use.”²¹ At its most crude, this can reduce to comparing the inventory of a certain weapon to that of another

¹⁵ See *Nordyke v. King*, 644 F.3d 776, 797 n.6 (9th Cir. 2011) (Gould, J., concurring in part) (“[T]o me it is obvious that the Second Amendment does not protect the right to keep a nuclear weapon in one’s basement, or a chemical or biological weapons in one’s attic, or a tank in one’s backyard.”), *reh’g en banc*, 681 F.3d 1041 (9th Cir. 2012).

¹⁶ See *Heller*, 554 U.S. at 572.

¹⁷ See *Hollis v. Lynch*, 827 F.3d 436, 448 (5th Cir. 2016) (acknowledging that hand grenades and machine guns are unprotected “dangerous and unusual weapons for the purposes of the Second Amendment”).

¹⁸ *District of Columbia v. Heller*, 554 U.S. 570, 625 (2008).

¹⁹ *Id.* at 721 (Breyer, J., dissenting).

²⁰ *Id.*

²¹ For a discussion of this effort, see Cody J. Jacobs, *End the Popularity Contest: A Proposal for Second Amendment “Type of Weapon” Analysis*, 83 TENN. L. REV. 231, 278-83 (2015).

commercial product — like a pickup truck.²² The presumption here is that a weapon as widely possessed as this other product must be in “common use.”²³ Other, more sophisticated approaches attempt to identify a more relevant reference set. For example, scholars such as Michael O’Shea and Nelson Lund have suggested the measure for common use should be the weapons possessed by ordinary law enforcement.²⁴ Others have argued that civilians should be capable of owning even *more* firepower than the police.²⁵ Still others believe the reference group for common use should be some kind of military body, such as the National Guard, or at the most extreme, the standing army.²⁶

A recent development in Second Amendment doctrine is to analogize modern weapons to historical ones. This move first appeared in the District of Columbia Circuit Court opinion that eventually became *Heller*. In that case, *Parker v. District of Columbia*, the court suggested that “[t]he modern handgun — and for that matter the rifle and long-barreled shotgun — is undoubtedly quite improved over its colonial-era predecessor, but it is, after all, a lineal descendant of that founding-era

²² *Kolbe v. Hogan*, 813 F.3d 160, 174 (4th Cir. 2016) (“[W]e note that in 2012, the number of AR- and AK-style weapons manufactured and imported into the United States was more than double the number of Ford F-150 trucks sold, the most commonly sold vehicle in the United States.”), *reh’g en banc*, 849 F.3d 114 (4th Cir. 2017).

²³ Nicholas J. Johnson, *Supply Restrictions at the Margins of Heller and the Abortion Analogue: Stenberg Principles, Assault Weapons, and the Attitudinalist Critique*, 60 HASTINGS L.J. 1285, 1293 (2009) (“A gun might be common because it is widely owned . . .”).

²⁴ Michael P. O’Shea, *The Right to Defensive Arms After District of Columbia v. Heller*, 111 W. VA. L. REV. 349, 392 (2009); *see also* Craig S. Lerner & Nelson Lund, *Heller and Nonlethal Weapons*, 60 HASTINGS L.J. 1387, 1411 (2009) (arguing for a rebuttable presumption “that civilians have a right to use weapons commonly used by the police”).

²⁵ Brief of Pink Pistols in Support of Plaintiff-Appellants at 16, *Fyock v. City of Sunnysvale*, 779 F.3d 991 (9th Cir. 2014) (No. 14-15408) (“If police need standard-issue magazines holding 15 to 17 rounds, a fortiori law-abiding citizens need the same firepower, if not more.”).

²⁶ Andrew P. Napolitano, *The Right to Shoot Tyrants, Not Deer*, WASH. TIMES (Jan. 10, 2013), <http://www.washingtontimes.com/news/2013/jan/10/the-right-to-shoot-tyrants-not-deer> [https://perma.cc/WW48-S9WP] (“[The Second Amendment] protects the right to shoot tyrants, and it protects the right to shoot at them effectively, with the same instruments they would use upon us.”). Part of the reason for this confusion is *Heller*’s unwillingness to expressly overrule *United States v. Miller*. In *Miller*, the Court held that short-barreled shotguns were not Second Amendment weapons because they were not suitable for military use. *United States v. Miller*, 307 U.S. 174, 178 (1939). However, in *Heller* the Court held that military application of a weapon was not required, and indeed, if a weapon was suitable only for military use that’s a reason why it is *not* protected. *District of Columbia v. Heller*, 554 U.S. 570, 589, 624-25 (2008).

weapon.”²⁷ Chief Justice John Roberts echoed this “lineal descendant” line during *Heller* oral argument when he speculated: “[W]e are talking about lineal descendants of the arms but presumably there are lineal descendants of the restrictions as well.”²⁸ Some lower courts and advocates have picked up on this strain of reasoning. Occasionally, this search for “lineal descendants” of modern weapons can become arcane. For example, in 1718, an Englishman named James Puckle patented a multi-round “Puckle gun.” The weapon was never widely produced and contemporaries ridiculed it for its impracticality.²⁹ Nevertheless, some argue that today’s 100 round magazines must be constitutionally protected, because someone patented this curio in England in the eighteenth century.³⁰

None of these attempts to break out of *Heller*’s definitional morass is satisfactory, and that’s partially because these tests tend to focus on epiphenomenal rather than functional factors. Searching for answers in analogs from automotive sales or eighteenth-century patent applications fails to consider what rule of relevance makes the analogy analytically sound.³¹ What makes weapons relevantly similar is their lethality.³² Comparing the sales of AR-15s to pickup trucks or asking what features of an AR-15 resemble those of a Founding era flintlock is far less useful for assessing utility or dangerousness than focusing on how lethal an AR-15 is compared to some other kind of weapon. Lethality may not resolve all the definitional problems of what an “arm”

²⁷ *Parker v. District of Columbia*, 478 F.3d 370, 398 (D.C. Cir. 2007).

²⁸ Transcript of Oral Argument at 77, *District of Columbia v. Heller*, 554 U.S. 570 (2008) (No. 07-290).

²⁹ David B. Kopel, Clayton E. Cramer & Scott G. Hattrop, *A Tale of Three Cities: The Right to Bear Arms in State Supreme Courts*, 68 TEMP. L. REV. 1177, 1195 (1995). Other arcana common in briefing has to do with a multi round weapon taken by Meriwether Lewis and William Clark on the Corps of Discovery. See Halbrook, *supra* note 1, at 165.

³⁰ *Duncan v. Becerra*, 970 F.3d 1133, 1147 (9th Cir. 2020) (“Semi-automatic and multi-shot firearms were not novel or unforeseen inventions to the Founders, as the first firearm that could fire more than ten rounds without reloading was invented around 1580. Rapid fire guns, like the famous Puckle Gun, were patented as early as 1718 in London.”), *reh’g en banc granted, opinion vacated*, 988 F.3d 1209 (9th Cir. 2021), *reh’g en banc sub nom. Duncan v. Bonta*, No. 19-55376, 2021 WL 5577267 (9th Cir. Nov. 30, 2021).

³¹ See Cass R. Sunstein, *Analogical Reasoning* 10 (Harvard Pub. L., Working Paper No. 21-39, 2021), <https://ssrn.com/abstract=3938546> [<https://perma.cc/C9V8-FYHY>] (“For analogical reasoning to operate properly, we have to know that cases A and B are ‘relevantly’ similar, and that there are not ‘relevant’ differences between them.”).

³² DUPUY, EVOLUTION, *supra* note 10, at 286.

is under the Second Amendment,³³ but it has the advantage of being relevant, functional, and unitary.³⁴

II. TREVOR DUPUY AND THE THEORETICAL LETHALITY INDEX

A. Brief Biography of Dupuy

In the middle of the twentieth century, a retired colonel named Trevor Nevitt Dupuy developed a metric to measure a weapon's lethality. Dupuy was one of the most respected and prolific American military thinkers of the last century.³⁵ Combat during World War II gave him a practical bent, which, combined with his analytical approach to military history provided a new outlook on the study of weapons and warfare. He developed sophisticated combat models that drew on his extensive archival research as well as his personal experience as a World War II commander.³⁶ His derivation of a theory of combat and

³³ A more rational test for a protected weapon would be not whether the weapon is in "common use" but whether the weapon is "unreasonably dangerous" — that is, whether its utility for something like self-defense is outweighed by its risks on other margins. The notion of "dangerous and unusual" seems to contemplate such a cost-benefit analysis. Joseph Blocher & Darrell A. H. Miller, *Lethality, Public Carry, and Adequate Alternatives*, 53 HARV. J. ON LEGIS. 279, 297 (2016).

³⁴ In this sense, our argument takes issue with a lower court judge who has suggested that "[n]othing in the Second Amendment makes lethality a factor to consider because a gun's lethality, or dangerousness, is assumed." *Duncan v. Becerra*, 366 F. Supp. 3d 1131, 1145-46 (S.D. Cal. 2019), *aff'd*, 970 F.3d 1133 (9th Cir. 2020), *reh'g en banc granted, opinion vacated*, 988 F.3d 1209 (9th Cir. 2021), *reh'g en banc sub nom. Duncan v. Bonta*, 19 F.4th 1087 (9th Cir. 2021), *rev'd and remanded sub nom. Duncan v. Bonta*, 19 F.4th 1087 (9th Cir. 2021). This is patently false, as the increased lethality of any arm (such as a hand grenade or landmine) is *certainly* relevant to whether it may be prohibited.

³⁵ Robert Mcg. Thomas, Jr., *Trevor N. Dupuy, 79, Prolific Military Historian*, N.Y. TIMES, June 9, 1995, at B11, <https://www.nytimes.com/1995/06/09/obituaries/trevor-n-dupuy-79-prolific-military-historian.html> [<https://perma.cc/DAE6-93J9>]; Jack Walker, *Trevor N. Dupuy Dead at 79*, PHALANX, Sept. 1995, at 33; Susan Rich, *Trevor N. Dupuy*, DUPUY INST., <http://www.dupuyinstitute.org/ndupuy.htm> (last visited Feb. 10, 2022) [<https://perma.cc/YNF7-R4N5>]. On Dupuy's contributions to military history, see CHRISTOPHER A. LAWRENCE, WAR BY NUMBERS: UNDERSTANDING CONVENTIONAL COMBAT, at ix-17 (2017).

³⁶ See Rich, *supra* note 35; Thomas, *supra* note 35, at B11. Dupuy regarded his chief contribution as integrating military theory with historical experience. See LAWRENCE, *supra* note 35, at ix-xii. See generally T.N. DUPUY, NUMBERS, PREDICTIONS AND WAR: USING HISTORY TO EVALUATE COMBAT FACTORS AND PREDICT THE OUTCOME OF BATTLES (1979) [hereinafter NUMBERS] (exemplifying Dupuy's commitment to integrating military theory and history); T.N. DUPUY, UNDERSTANDING WAR: HISTORY AND THEORY OF COMBAT (1987) [hereinafter UNDERSTANDING] (same).

philosophy of war from these materials was unusual and widely praised inside the military. By the time of his death, he had published scores of books and articles in military and professional journals across the globe.³⁷

Dupuy was born in New York, the son of Richard Ernest Dupuy, who was himself a military historian and veteran. After graduating from the U.S. Military Academy at West Point in 1938, the younger Dupuy fought in Burma during the war and by age twenty-seven had been promoted to lieutenant colonel.³⁸ He commanded artillery units across several military theaters for the United States, the United Kingdom, and the Chinese military,³⁹ and received honors for service and valor from all three governments.⁴⁰

Following the war, after a stint working for the military in Europe and Washington, Dupuy began his academic career, first at Harvard and then at the Ohio State University. His writing began in earnest while teaching at Harvard. Seeing no text on military science that he could use to teach his students, he approached the elder Dupuy to assist in writing a textbook. What began as a mimeographed set of class materials⁴¹ eventually turned into a two-volume publication, *Military Heritage of America*, one of many projects father and son would complete together.⁴²

Dupuy focused on understanding the complexities of modern warfare through the review of massive amounts of historical data.⁴³ Roughly contemporaneously, major military institutions began to invest heavily in a discipline called “operations research” that sought to bring quantitative tools to bear on military strategy. Analytical centers and think tanks,⁴⁴ like RAND (for “research and development”), as well as other “civilian defense planners” became an “integral part” of United

³⁷ Walker, *supra* note 35, at 33.

³⁸ Thomas, *supra* note 35, at B11.

³⁹ Rich, *supra* note 35.

⁴⁰ *Id.*

⁴¹ Rich, *supra* note 35. On Dupuy’s contributions to military history, see LAWRENCE, *supra* note 35, at ix-17.

⁴² Rich, *supra* note 35. See DUPUY, UNDERSTANDING, *supra* note 36, at X; see also DUPUY, NUMBERS, *supra* note 36, at xv; LAWRENCE, *supra* note 35, at ix-xii.

⁴³ LAWRENCE, *supra* note 35, at x. For more information about the research on tactical weapons in the 1950s and 1960s, see, for example, James Fallows, *M-16: A Bureaucratic Horror Story Why the Rifles Jammed*, ATLANTIC (June 1981), <https://www.theatlantic.com/magazine/archive/1981/06/m-16-a-bureaucratic-horror-story/545153> [https://perma.cc/QHN5-LE7E].

⁴⁴ See CHARLES R. SHRADER, HISTORY OF OPERATIONS RESEARCH IN THE U.S. ARMY VOLUME 1: 1942-1962, at iii (2006).

States security planning at this time.⁴⁵ However, “even after 3,300 years of recorded military history” reliable data was hard to come by.⁴⁶ This lack of hard data led Dupuy to reach for new techniques on which to base operational analysis and combat modeling. His research attempted to link combat modelers who needed reliable data on combat operations with the existing information present in the unit records of actual historical engagements.⁴⁷

Intense, professional, and tenacious, Dupuy believed that the study of historical combat could and should be used to prepare for future conflicts.⁴⁸ In more than two dozen works, he analyzed the patterns of warfare from ancient times to the present. He summarized his historical approach in his book, *The Evolution of Weapons and Warfare*.⁴⁹ While Dupuy was a great believer in quantifying the dynamics of warfare, he thought that the data should be drawn from the history of past wars.⁵⁰ He was skeptical about the value of war-gaming and simulation exercises divorced from what Carl von Clausewitz described as the “fog” and “friction” of war.⁵¹

From 1960 to 1962, Dupuy worked for the Institute of Defense Analysis, where he was frequently consulted for advice and expertise. For the next thirty years, he published books and gave lectures to military audiences about the role of technology in war. He documented a historical cycle for weapons technology: stagnant for long periods, followed by bursts of intense change. He understood that it could take decades — even centuries — for new technologies to be incorporated into the tactics and organizational structure of armies.⁵² His research documented technological change (from the stirrup to the gun) — and showed that the pace of that change accelerated exponentially with the nineteenth-century industrial revolution and then again with the intense state-led innovations of the two world wars.⁵³

In part to study these technological and military dynamics, in 1962 Dupuy formed the Historical Evaluation and Research Organization

⁴⁵ LAWRENCE, *supra* note 35, at ix.

⁴⁶ *Id.*

⁴⁷ LAWRENCE, *supra* note 35, at ix; DUPUY, *EVOLUTION*, *supra* note 10, at vii.

⁴⁸ Rich, *supra* note 35; Walker, *supra* note 35, at 33.

⁴⁹ DUPUY, *EVOLUTION*, *supra* note 10, at vii.

⁵⁰ *Id.*

⁵¹ I CARL VON CLAUSEWITZ, *ON WAR* 39-40, 106 (J.J. Graham trans. 1873) On the Pentagon's reliance on wargaming, see JOHN PRADOS, *PENTAGON GAMES: WARGAMING AND THE AMERICAN MILITARY* 4 (1987).

⁵² DUPUY, *EVOLUTION*, *supra* note 10, at 300-05; *see also* LAWRENCE, *supra* note 35, at 6-7.

⁵³ DUPUY, *EVOLUTION*, *supra* note 10, at 287-94.

(HERO) and would serve as its President and Executive Director for the next two decades. At HERO, he conducted many studies for the U.S. Army, for which he accumulated detailed, recorded data from actual battlefield experience. As he often remarked, military history was the true “laboratory of the soldier.”⁵⁴

In the process Dupuy developed an analytic procedure for comparing, quantitatively, the lethality of individual weapons (the Theoretical Lethality Index), described below.⁵⁵ He also continued his work as an author, lecturer, and military analyst until the end of his life. American diplomats and military leaders consulted with him during the first Gulf War, and he testified before Congress several times. He kept up a steady media schedule, appearing on over thirty television and radio programs, including spots on all of the major networks, C-Span, and CNN.⁵⁶

Dupuy died at the age of seventy-nine on June 5, 1995, of a self-inflicted gunshot wound, three weeks after being diagnosed with terminal pancreatic cancer.⁵⁷ At the time of his death he was considered “one of the world’s leading military historians.”⁵⁸ He left behind several unfinished projects, including his own autobiography, which he planned to call “A Footnote to History.”⁵⁹

The metrics on lethality that Dupuy pioneered are still being used in policy papers and military history projects as well as in analysis of modern military operations and combat.⁶⁰ Dupuy’s work showed that even military planners — whose profession is the study of weapons — have repeatedly struggled to fully understand the impact of new, improved weaponry on combat and society. Despite his prominence as a military commander and military historian, little has been written

⁵⁴ Shawn Woodford, “Human Factors in Warfare: Fear in a Lethal Environment,” THE DUPUY INST.: MYSTICS & STATISTICS BLOG (Nov. 2, 2018), [https://urldefense.com/v3/_http://www.dupuyinstitute.org/blog/2018/11/02/human-factors-in-warfare-fear-in-a-lethal-environment/_;!OToaGQ!-mUY72ZfkYxHD9d0dFNBpg31R_LGM5aZ8X6i7U0SGha2GUuyOLcaw_FlFfjmj7Hk2yg\\$](https://urldefense.com/v3/_http://www.dupuyinstitute.org/blog/2018/11/02/human-factors-in-warfare-fear-in-a-lethal-environment/_;!OToaGQ!-mUY72ZfkYxHD9d0dFNBpg31R_LGM5aZ8X6i7U0SGha2GUuyOLcaw_FlFfjmj7Hk2yg$) [https://perma.cc/Z7YJ-2K6L] (quoting Dupuy).

⁵⁵ HIST. EVALUATION & RSCH. ORG., *supra* note 10.

⁵⁶ Rich, *supra* note 35.

⁵⁷ Walker, *supra* note 35, at 79.

⁵⁸ Rich, *supra* note 35.

⁵⁹ *Id.*; see also Thomas, *supra* note 35, at B11.

⁶⁰ See, e.g., N.K. JAISWAL, MILITARY OPERATIONS RESEARCH: QUANTITATIVE DECISION MAKING 317-18 (1997); CARL MOSK, NATIONALISM AND ECONOMIC DEVELOPMENT IN MODERN EURASIA 91 (2013); James J. Schneider, *The Theory of the Empty Battlefield*, 132 J. ROYAL UNITED SERV. INST. 37, 37 (1987). The most recent validations of combat models are described in Volume I, Nos 4, 5, and 6 and Volume III, Nos 1 and 2 of The Dupuy Institute’s International Tactical, Numerical, Deterministic Model (“TNDM”) Newsletter. *International TNDM Newsletter*, TDI: PUBLICATIONS (last visited Feb. 21, 2022) <http://www.dupuyinstitute.org/tdipub4.htm> [https://perma.cc/36PD-Z4NW].

about him, leaving a gap in our historical understanding of this important figure.

B. *The Theoretical Lethality Index*

A significant and underappreciated contribution of Dupuy is his creation of a single metric, the Theoretical Lethality Index (“TLI”) that provides apples-to-apples comparisons of the lethality of weaponry across time. As he wrote in his *Evolution of Weapons and Warfare*, “All weapons have at least one common characteristic: lethality — the ability to injure and if possible to kill people.”⁶¹ The TLI reduced to a single value how many persons a particular weapon could theoretically kill in one hour, considering a spectrum of different technological factors, including range, rate of fire, accuracy, reliability, mobility, “radius of action” and vulnerability.⁶²

Dupuy constructed the TLI by exhaustively examining the historical record of real battles across time, where the lethal capacity of the weapon was one among a host of other factors, including weather, terrain, and the defensive and offensive capabilities of opposing forces. His TLI represented an attempt to isolate, in one number, the lethality of technology alone, based primarily on the characteristics of that technology. Hence, the TLI number is not influenced by a military or civilian context; it does not take into account factors like combat tactics, how dispersed or bunched the targets may be or what defensive positions they occupy. Nor does it account for the social or psychological state of the individual using the weapon.⁶³ The TLI is solely about the lethality of the weapon as a technology designed to kill.

In contrast to those who analyzed warfare with abstract calculations based on combat modelling and wargaming, Dupuy based his analysis on scrupulous investigation of actual historical military engagements. As he put it, “The history of warfare is a review of the manner in which groups of men have . . . [used] their weapons more effectively than the opponents, or in other words, by realizing, or at least approaching, the ultimate degree of lethality of their weapons.”⁶⁴ He explained: “Lethality

⁶¹ DUPUY, *EVOLUTION*, *supra* note 10, at 286.

⁶² *Id.* at 92, 309-10.

⁶³ To account for these other factors, along with the TLI, Dupuy calculated an Operational Lethality Index (“OLI”). *Id.* at 309-10. A fruitful research question would be to construct a civilian version of the OLI with respect to different weapons. But that project is outside the scope of this paper.

⁶⁴ *Id.* at 286.

is necessarily a comparative thing.”⁶⁵ A sword wielded by a trained combatant is lethal, “[b]ut its comparative lethality is limited by the factors of time, range, and the physical limitations of the man who wields it.”⁶⁶ Dupuy recognized that “[b]y assigning values to these factors it is feasible to compare the lethality of the sword with the lethality of the hydrogen bomb, or the tank, or whatever other weapon one pleases.”⁶⁷

Dupuy divided world history into three primary eras of weapons technology. The “Age of Muscle” (c. 350 BC to 13th century) was the era of the short sword and longbow. The “Age of Gunpowder” (14th century to middle of the 19th century) introduced the bayonet, the flintlock and the first cannons. But it was the “Age of Technological Change” (middle of 19th century to middle of 20th century), he thought, that ushered in major advances in weaponry. “The weapons of this period constitute a quantum jump in lethality over their predecessors of the age of gunpowder.”⁶⁸ This era saw the development of the conoidal rifle bullet (Minie ball) (1841); the breech-loading rifle (c. 1848); the Maxim machine gun (1883); the bolt-operated magazine rifle (1895); the tank (1916); the fighter-bomber (1917); the ballistic missile (1944); and the atomic bomb (1945).⁶⁹ Dupuy identified one of the most profound changes in combat occurred between 1850 and 1860, when firearms became both more common and more deadly.⁷⁰

Under contract with the U.S. Army, Dupuy and HERO analyzed the relationship between weapons and military doctrine from the fourth century BC to the end of the Korean War.⁷¹ The four-volume report that he and his team produced included the TLI as a unitary metric for lethality.

The report demonstrated that the TLI of weapons increased exponentially in the past 200 years. While an eighteenth century soldier with a flintlock musket could kill 43 people an hour, a soldier in the Civil War era using the Minie ball could kill 102 people per hour: a

⁶⁵ *Id.* at 286.

⁶⁶ *Id.* at 286.

⁶⁷ *Id.* at 286.

⁶⁸ *Id.* at 292.

⁶⁹ *See id.* at 292-94. In the age of technological change, there were many other ancillary developments, including: the percussion cap, electronic communication, barbed wire (first adapted to military purposes in 1874), smokeless powder (1885), recoil mechanism, quick-firing artillery (1890-1910); radar (1938), and earth satellites in space. *See id.* at 296-98.

⁷⁰ DUPUY, NUMBERS *supra* note 36, at 6.

⁷¹ The process of introduction and assimilation of these new weapons is described in a report that he produced, consisting of four volumes (342 pages).

more than twofold increase.⁷² Breech-loading rifles, metal cartridges, and magazines boosted the TLI of infantry rifles even higher, to 495 by the end of the nineteenth century: a ten-fold increase over the flintlock musket. The introduction of automatic fire machine guns at the end of the nineteenth century again vastly increased the kill rate. The TLI of a World War I machine gun was 3,463, and that of World War II, 4,973.⁷³

Dupuy's Theoretical Lethality Index⁷⁴

Weapon	TLI
Sword, pike, etc.	23
Longbow	36
17th c. musket	19
18th c. flintlock	43
Early 19th c. rifle	36
Mid-19th c. rifle/conoidal bullet	102
Late 19th c. breech-loading rifle	153
Springfield Model 1903 rifle (magazine)	495
World War I machine gun	3,463
World War II machine gun	4,973
16th century 12-pdr cannon	43
17th century 12-pdr cannon	224
Gribeauval 18th century 12-pdr cannon	940
World War I tank	6,926
World War II medium tank	575,000
One-megaton nuclear airburst	695,385,000

Dupuy was convinced that there was a “relatively small” number of major advances in weapons throughout history. He defined a “major advance” as a “new development that changes the nature of warfare.”⁷⁵ A major advance was “a revolutionary” change, which might be followed by “a series of evolutionary changes.”⁷⁶ One such

⁷² See DUPUY, *EVOLUTION*, *supra* note 10, at 92.

⁷³ Situating the modern AR-15 (a successor to the German StG 44, the first “assault rifle,” that was used in World War 2) anywhere near the Maxim machine gun makes it exponentially more lethal than the flintlock musket of the Founder’s era. The term “AR-15” is now most-commonly used to refer only to the civilian variants of the rifle which lack the fully automatic function. There are a variety of ways to convert an AR-15 to a fully automatic weapon, as explained by Mike Searson, *Turning Your AR-15 into an M-16*, RECOIL (June 5, 2019), <https://www.recoilweb.com/turning-your-ar-15-into-an-m-16-150631.html> [<https://perma.cc/XGT9-4WBZ>].

⁷⁴ This table is constructed from Dupuy’s data. DUPUY, *EVOLUTION*, *supra* note 10, at 92.

⁷⁵ *Id.* at 287.

⁷⁶ *Id.*

“revolutionary weapon” was the Maxim recoil-operated, belt-fed machine gun which later became the model for other machine guns.⁷⁷ He constructed the TLI using a standard formula. As he pointed out, “Obviously the weapons that kill more people in shorter periods of time have greater lethality.” The TLI showed that “there have been few major advances in weapons lethality through the ages, and most of them have occurred since about 1850.”⁷⁸

III. LETHALITY AS A COMMON METRIC FOR ARMS

Currently, the analysis to determine whether any given “arm” is constitutionally protected fails to display much analytical rigor. The very features of large-capacity magazines that one judge thinks are essential for self-defense⁷⁹ are the very same features other judges consider unreasonably dangerous.⁸⁰ Trying to avoid the impasse by searching for “lineal descendants” of muskets in the Sig Sauer catalog, or by comparing the sales of rifles to pickup trucks⁸¹ threaten to make Second Amendment analysis even more unmoored from anything rational or functional.

At the very least, the TLI offers proof of concept that one can construct a single metric for lethality that may provide a basis for systematic comparisons of arms within and between time periods.⁸² Moreover, to the extent any question about gun rights and regulation turns partially or wholly on historical analogs,⁸³ the TLI supplies vital historical context using a common denominator.

First, the TLI shows that weapons have increased sharply in lethality from the mid-nineteenth century to the present day. Speaking of the period between the 1850s and 1860s, Dupuy described weapon advancement over prior ages during this time as a “quantum jump in

⁷⁷ *Id.* at 287-90.

⁷⁸ *Id.* at 287.

⁷⁹ See *Kolbe v. Hogan*, 849 F.3d 114, 162 (4th Cir. 2017) (Traxler, J., dissenting) (indicating that untrained civilians need more rounds because they are likely to miss the target).

⁸⁰ See *id.* at 127 (“[W]hen inadequately trained civilians fire weapons equipped with large-capacity magazines, they tend to fire more rounds than necessary and thus endanger more bystanders.”).

⁸¹ See *id.* at 153.

⁸² *But see* Wallace, *supra* note 2, at 16-17 (arguing that lethality as a stable metric is difficult to determine).

⁸³ Currently history and historical analogs are part of the conventional two-step framework for Second Amendment adjudication. The question in *Bruen* is whether this historical test is the only step of the analysis.

lethality.”⁸⁴ Another period of steady acceleration in lethality followed in the early to mid-twentieth century. Using apples-to-apples comparisons, based on this index, one can see that in 1903 it would only take two people with five-round Springfield rifles to kill as many as an eighteenth-century cannon.⁸⁵ By World War II it would require a battery of *five* eighteenth century cannon to be as lethal as a single machine gun.⁸⁶

Contrary to the implausible proposition that “[n]othing in the Second Amendment makes lethality a factor” in Second Amendment analysis,⁸⁷ it is apparent that the people’s representatives have considered lethality a relevant factor in the costs versus benefits of weapon technology from the beginning.⁸⁸ To the extent judges follow Justice Scalia’s proposition that “traditional restrictions go to show the scope of the [Second Amendment] right,”⁸⁹ the TLI can help courts ask the right questions. It is fruitless to ask counter-factuals like: “How would the founding generation have regulated widespread private ownership of AR-15s?” That’s akin to basing a First Amendment decision about home console entertainment on “what James Madison thought about video games.”⁹⁰ It’s a more useful question to ask: “What is the lethality threshold of the word ‘arms’ in the Second Amendment?” Using a single metric — lethality — can also help translate regulatory justifications to new technological environments as well as recognize the fact and pace of

⁸⁴ DUPUY, *EVOLUTION*, *supra* note 10, at 292.

⁸⁵ *See id.* at 92.

⁸⁶ *See id.*

⁸⁷ *Duncan v. Becerra*, 366 F. Supp. 3d 1131, 1145-46 (S.D. Cal. 2019), *aff'd*, 970 F.3d 1133 (9th Cir. 2020), *reh’g en banc granted, opinion vacated*, 988 F.3d 1209 (9th Cir. 2021), *reh’g en banc sub nom. Duncan v. Bonta*, No. 19-55376, 2021 WL 5577267 at *119 (9th Cir. Nov. 30, 2021), *rev’d and remanded sub nom.*

⁸⁸ *See* Cincinnati, Ohio, Ordinance to Prevent Accidents from the Firing of Cannon or Other Guns on Boats, in Front of the City of Cincinnati (Mar. 9, 1825) (“[I]t shall not be lawful for any person or persons having charge or being on board of any boat upon the Ohio river, when passing by, stopping at, or leaving the city of Cincinnati, to cause any cannon, gun or other fire-arms to be so fired as to discharge its contents towards the city”); Phila., Pa., Gun-Cotton Act of Assembly (Mar. 16, 1847) (“Whereas, an article called gun cotton, with properties of ignition and explosion similar to those of gunpowder, and equally if not more dangerous in towns and cities, has been introduced. Therefore . . . no gun-cotton shall be introduced in Philadelphia, nor placed in storage therein, in greater bulk or quantity in any one place, than is permitted by existing laws, with regard to gunpowder”).

⁸⁹ *McDonald v. City of Chicago*, 561 U.S. 742, 802 (2010) (Scalia, J., concurring).

⁹⁰ The quote is a sardonic remark by Justice Samuel Alito during oral argument over First Amendment protection of violent video games. Transcript of Oral Argument at 17, *Brown v. Ent. Merchs. Ass’n*, 564 U.S. 786 (2011) (No. 08-1448).

change in lethality between different eras.⁹¹ The TLI or similar tools can also help give content to distinctions between weapons suitable for personal self-defense and those “weapons of war” not covered by the Second Amendment.⁹² By using lethality as a metric, rather than less functional traits like the shape of a weapon, its materials, or its popularity, researchers can make inferences across different times along a margin that is of practical relevance.

The Founders lived in a period when they could perhaps be forgiven for thinking that “a gun is a gun is a gun,” because the basic flintlock hadn’t really become significantly more lethal in the previous 150 or so years. If the Constitution had been written in the middle of the nineteenth century, instead of the 1780s, the Founders would have been much more aware of the pace of innovation.⁹³ But we don’t have to speculate about how lawmakers may have reacted to knowledge of technological change. As Saul Cornell has noted, the nineteenth century, especially during and after Reconstruction, witnessed a flurry of regulation and constitution-drafting just as technological change was making firearms more common, concealable, and deadly.

The massive battlefield casualties of the American Civil War vividly revealed the lethality of new firearms technologies — especially the Minie ball. Cornell has argued that “Reconstruction ushered in one of the most intense periods of gun regulation in American history.”⁹⁴ He has documented how — in a significant act of constitution drafting during Reconstruction — many states both guaranteed a right to arms in their state constitutions, but were “equally committed to enacting strong racially neutral gun regulations, aimed at reducing interpersonal violence and preserving the peace.”⁹⁵ For example, Georgia’s Reconstruction constitution of 1877 stated: “[T]he right of the people to keep and bear arms shall not be infringed, but the General Assembly shall have power to prescribe by law the manner in which arms may be

⁹¹ For more on this move of “translation,” see Lawrence Lessig, *Fidelity in Translation*, 71 TEX. L. REV. 1165, 1211 (1993) (“[T]he practice of translation moves in two stages: first, understanding the contexts between which the translator must move; and second, locating something called an equivalence between the two contexts.”).

⁹² *Kolbe v. Hogan*, 849 F.3d 114, 121 (4th Cir. 2017) (“[W]e have no power to extend Second Amendment protection to the weapons of war that the *Heller* decision explicitly excluded from . . . coverage.”).

⁹³ See Tucker, *supra* note 9.

⁹⁴ Saul Cornell, Symposium, *The Right to Regulate Arms in the Era of the Fourteenth Amendment: The Emergence of Good Cause Permit Schemes in Post-Civil War America*, 55 UC DAVIS L. REV. ONLINE 65, 67 (2021).

⁹⁵ *Id.*

borne.”⁹⁶ The 1869 Constitution of Texas stated “Every person shall have the right to keep and bear arms, in the lawful defense of himself or the State, under such regulations as the Legislature may prescribe.”⁹⁷ Indeed, a brief examination of many of these Reconstruction and Gilded Age constitutions show both a statement about the right to keep and bear arms and a right to reasonably regulate such a practice. The TLI shows that these lawmakers were not operating in a technological vacuum; they were securing an express ability to regulate weapons at precisely the time that firearms were becoming dramatically more lethal.⁹⁸

Finally, whether you adhere to a theory that the Second Amendment is for self-defense against common criminals or against rogue governments, the TLI provides a tool to assess the weapon technology along a single dimension. For example, if one believes that right metric for self-defense weaponry is that kind of defensive armament most effective at countering a typical criminal threat, the TLI offers a number. How many people per hour is it necessary to kill in order to supply an adequate deterrent to common criminal perpetrators? Alternatively, although we are highly skeptical that the anti-tyranny purpose the Second Amendment contains much legally enforceable content, if one truly believes that weapons must be in the hands of private parties to counter the capacity of the United States military,⁹⁹ this metric provides some common denominator for that argument as well.¹⁰⁰

⁹⁶ GA. CONST. of 1877, art. I, § 1, pt. XXII (emphasis added).

⁹⁷ TEX. CONST. of 1869, art. I, § 13 (emphasis added).

⁹⁸ For more on this point, see Darrell Miller, *New Research from the UC Davis Symposium: The Theoretical Lethality Index, Reconstruction Regulation and Enforcement*, DUKE CTR. FOR FIREARMS L.: SECOND THOUGHTS BLOG (Oct. 22, 2021), <https://firearmslaw.duke.edu/2021/10/new-research-from-the-uc-davis-symposium-the-theoretical-lethality-index-reconstruction-regulation-and-enforcement/> [https://perma.cc/G7BC-QUNR].

⁹⁹ James B. Astrachan, *The Bumpy Road to the Supreme Court: Does the Second Amendment Prevent States from Prohibiting Ownership of Assault-Style Rifles and High-Capacity Magazines?*, 47 U. BAL. L. REV. 337, 375 (2018) (“[I]t is not the role of the courts to take away from the citizens the means to most effectively oppose such a [tyrannical] government.”).

¹⁰⁰ See JOSEPH BLOCHER & DARRELL A. H. MILLER, *THE POSITIVE SECOND AMENDMENT* 169 (2018) (“The keeping and bearing of lethal arms to deter government officials may be connected to the Second Amendment, but it is likely that the value is primarily moral or political, rather than a judicially administrable constitutional entitlement.”). But to the extent such an argument requires something other than speculation, the TLI offers some metric from which to assess what kind of weaponry in private hands would be necessary to counter a military armed with machine guns, artillery, and nuclear weapons. See Darrell A. H. Miller, *Second Amendment Equilibria*, 116 NW. U. L. REV. 239, 256-57 (2021).

Granted, the TLI cannot provide answers to all interpretive challenges of the Second Amendment. The TLI itself does not provide metrics for a host of twenty-first century weapons. (Military experts must extrapolate from Dupuy's methods to say what the theoretical lethality index of a modern 9mm pistol would be, for example). Non-experts, or those without access to the proprietary methods of the Dupuy Institute, can only provide estimates about where modern technology fit (a modern AR-15 is almost certainly more lethal than an eighteenth century musket and less lethal than a World War II medium tank, for instance). However, even with these limitations the TLI does provide a reliable benchmark from which to generate judgments about comparative lethality. The TLI, and derivative indices, offer a useful metric for understanding the lethality of different weapons, across time, and can therefore make an important contribution to the debate over the right to keep and bear arms.

CONCLUSION

After a decade of slumber, it is clear the Supreme Court, with its new conservative super-majority, is now awakening to decide Second Amendment matters left undecided after *Heller*. In the next few years, the Court is almost certain to address what counts as a constitutionally protected "arm." In doing so, it is also likely to rely on history and tradition to a greater degree than most other rights. Lethality, and the Theoretical Lethality Index constructed by Dupuy and his team, offers one way for the justices to anchor their analysis to historically-driven metrics that are functional, intelligible, and relevant; rather than those that are rhetorical and trivial.