

COMPUTER-AIDED DESTRUCTION: REGULATING 3D-PRINTED FIREARMS WITHOUT INFRINGING ON INDIVIDUAL LIBERTIES

Jessica Berkowitz[†]

ABSTRACT

Additive manufacturing, also known as 3D printing, is a rapidly developing technology that is changing the way people manufacture goods. Individual consumers can purchase a 3D printer for their own personal use, providing them with the ability to create fully customizable products in the privacy of their own homes. However, there is one 3D-printed product that is causing much controversy and debate: firearms. Armed with a 3D printer and the desired design and filament, an individual can print a fully functioning weapon, bypassing federal and state licensing, registration, and manufacturing requirements. There are statutes currently in effect that may offer some control over 3D-printed guns; however, these statutes may need to be altered to provide adequate regulatory control over illegal possession and misuse of 3D-printed firearms. Additionally, any future regulations will almost certainly be scrutinized under both the First and Second Amendments, balancing public safety concerns with individual liberties. Moreover, many possible regulations of the technology itself would be impractical and run afoul of the public policy goal of protecting technological innovation. It is currently—and will likely always be—impossible to 3D-print gunpowder, a necessary component of a functioning firearm. Therefore, to best regulate 3D-printed firearms, while also protecting constitutional liberties and technological innovation, this Note proposes an expansion of the Brady Bill to require background checks for ammunition purchases. This is the most readily available remedy to the specific regulatory challenges posed by 3D-printed firearms, as amending the Brady Bill is relatively simple and less invasive for firearms dealers who already have access to the National Instant Criminal Background Check System used for firearms purchases.

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I. INTRODUCTION

Additive manufacturing, more commonly known as three-dimensional (“3D”) printing, is a rapidly developing technology that presents novel legal challenges. One of the most difficult challenges is how to adequately regulate 3D-printed firearms.¹ Anyone with a 3D printer can now turn a digital blueprint into a functioning lethal weapon, bypassing numerous federal gun control laws.² Although 3D-printing technology has existed since the 1980s, technological advances and decreasing costs have made these printers more accessible to individual consumers.³ Because the market for 3D printers is relatively new, it is not yet directly regulated, nor has the Supreme Court had an opportunity to address the legal implications of 3D-printed products.⁴ As 3D printers become more available to the public, there is concern many people may use the technology to circumvent the law.⁵

Armed with a 3D printer and Internet access, individuals may manufacture firearms in their own homes, thereby avoiding licensing, registration, manufacturing, and background check requirements.⁶ Currently, very few laws exist that can regulate the possession or manufacture of 3D-printed firearms,

1. For the purposes of this Note, “3D-printed firearms” include any firearm that is made with any 3D-printed part that contributes to the firearm’s functionality, regardless of the material from which it is made. See Caitlyn R. McCutcheon, Note, *Deeper Than a Paper Cut: Is It Possible to Regulate Three-Dimensionally Printed Weapons or Will Federal Gun Laws Be Obsolete Before the Ink Has Dried?*, 2014 U. ILL. J.L. TECH. & POL’Y 219, 222.

2. See *id.* at 221.

3. See *id.* at 220, 223.

4. See *id.* at 222; Jennifer Huddleston Skees, *What a Supreme Court Decision on Cheerleading Uniforms Means for the Future of 3D Printing*, PLAIN TEXT (Aug. 2, 2017), <https://readplaintext.com/what-a-supreme-court-decision-on-cheerleading-uniforms-means-for-the-future-of-3d-printing-ad086e6b0469> [<https://perma.cc/9PRE-R7HH>].

5. See, e.g., McCutcheon, *supra* note 1, at 221; Christopher J. Ferguson, *3-D Printed Guns Are a Boon for Criminals*, CNN (May 7, 2013, 7:28 AM), <http://www.cnn.com/2013/05/07/opinion/ferguson-printable-gun/> [<https://perma.cc/TVR6-G5XR>] (expressing concern that 3D-printed guns could be used to “circumvent existing” prohibitions on gun possession); Andy Greenberg, *Bill to Ban Undetectable 3D Printed Guns Is Coming Back*, WIRED (Apr. 6, 2015, 7:00 AM), <https://www.wired.com/2015/04/bill-ban-undetectable-3-d-printed-guns-coming-back/> [<https://perma.cc/A883-EDEW>] (describing congressional legislation proposing a ban on 3D-printed guns); Jordan Pearson, *A 3D Printing Company Is Trying to Deny Legal Protection to Hobbyists*, VICE: MOTHERBOARD (May 1, 2015, 2:14 PM), https://motherboard.vice.com/en_us/article/ypw4by/the-legal-fight-to-put-whatever-you-want-in-a-3d-printer [<https://perma.cc/Y422-GD6F>] (discussing the controversy over a law that “make[s] tampering with products that have digital protections in place against the law, whatever the eventual goal” in the context of 3D printing).

6. See McCutcheon, *supra* note 1, at 221.

as long as an individual does not sell, trade, share, or cross state lines with such weapons.⁷ Thus far, 3D-printed firearms have mostly raised intellectual property issues, including concerns over patent, trademark, and copyright infringement.⁸ However, as the technology becomes more prevalent, it will undoubtedly frustrate current gun control efforts.⁹

Although some existing gun control statutes may encompass 3D-printed firearms, these laws do not sufficiently control for the novel challenges arising from the use of 3D-printing technology.¹⁰ For example, 3D-printed guns made from plastic may circumvent the Undetectable Firearms Act's ban on firearms that cannot be detected by metal detectors.¹¹ Similarly, individuals who print, instead of purchase, firearms may bypass background checks mandated under the Brady Handgun Violence Prevention Act, opening firearm access to prohibited classes.¹² Potential regulations regarding 3D-printed guns may also implicate First and Second Amendment challenges. The digital blueprints necessary to create 3D-printed products likely constitute electronic speech, so any gun-specific regulation of these files would be subject to strict scrutiny in court.¹³ Furthermore, the Second Amendment protects an individual's right to self-manufacture firearms, which likely extends to homemade 3D-printed guns.¹⁴ The Supreme Court seemingly agrees that the right to print one's own gun is protected under both the First and Second Amendments, making a future ban on 3D-printed firearms unlikely.¹⁵

With tens of thousands of gun-related homicides per year,¹⁶ 3D-printing firearms must be scrutinized in light of its capability to add to that number. Currently, the likelihood of countless individuals printing their own guns is low, but 3D printers will generally contribute to placing more illegal guns into the market and provide criminals with a new avenue to obtain firearms.¹⁷

7. See Elizabeth A. Harlan, *The Inadequacy of the Second Amendment for 3D Printed Guns*, 48 MD. B.J. 25, 30 (2015).

8. See McCutcheon, *supra* note 1, at 220.

9. See *id.*

10. See *infra* Section III.A.

11. See 18 U.S.C. § 922(p) (2012); Harlan, *supra* note 7, at 30 (“[I]t is inevitable that other plastic 3D guns manufactured at home will not include any metal parts.”).

12. See 18 U.S.C. § 922(g) (2012) (listing prohibited classes).

13. See Josh Blackman, *The 1st Amendment, 2nd Amendment, and 3D Printed Guns*, 81 TENN. L. REV. 479, 499–501 (2014).

14. See McCutcheon, *supra* note 1, at 237–38; *infra* Section III.B.2.

15. See *District of Columbia v. Heller*, 554 U.S. 570, 625–29 (2008); Blackman, *supra* note 13, at 492.

16. See 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, 1506 (2014).

17. See McCutcheon, *supra* note 1, at 237.

Furthermore, inexperienced users may harm themselves in attempting to print and shoot a poorly designed firearm. It is vital, however, that lawmakers are careful not to allow the novelty of 3D printing to distract from the actual issue at hand: effective gun control.¹⁸

This Note analyzes how 3D-printed firearms fit into current gun control regulations and modern First and Second Amendment jurisprudence. It further proposes a solution as to how the legal system can regulate 3D-printed guns, with minimal infringement on individuals' constitutional rights. Part II provides background on why 3D printing is important to innovation, how the technology works, and how individuals may use it to self-manufacture firearms. Part III discusses why the current regulatory scheme may not effectively control 3D-printed guns and analyzes the constitutional hurdles to possible regulation. Part IV proposes extending current federal firearms requirements to ammunition purchases, which would help curtail the number of illegally possessed guns made with 3D printers while also protecting innovation of the technology. Finally, Part V concludes, reiterating that regulating ammunition is the most readily available approach to controlling 3D-printed firearms while preserving individual liberties.

II. READY, PRINT, FIRE!: THE BASICS OF 3D PRINTING AND 3D-PRINTED FIREARMS

In 2013, President Barack Obama described 3D printing as having “the potential to revolutionize the way we make almost everything.”¹⁹ Additive manufacturing is already transforming numerous industries: for instance, NASA utilized the technology to create parts for its spacecrafts.²⁰ Moreover, in the medical field, 3D printers are used every day to create devices such as hearing aids, prosthetics, orthopedic implants, and dental fillings.²¹ With this technology, surgeons can even print replicas of a patient's body to practice surgery before it is performed.²²

The technology allows for a nearly effortless manufacturing process that is more efficient and less wasteful than traditional methods.²³ In 2012, the federal

18. See Little, *supra* note 16, at 1510 (asserting that regulations should focus on the misuse of technology and not inhibit innovation).

19. Blackman, *supra* note 13, at 483.

20. See McCutcheon, *supra* note 1, at 221.

21. See Peter Jensen-Haxel, Comment, *3D Printers, Obsolete Firearm Supply Controls, and the Right to Build Self-Defense Weapons Under Heller*, 42 GOLDEN GATE U.L. REV. 447, 451–52 (2012) (describing dental filling production).

22. See *id.*

23. See McCutcheon, *supra* note 1, at 222.

government dedicated thirty million dollars to the National Additive Manufacturing Innovation Institute to increase American manufacturing jobs related to 3D printing.²⁴ However, many commenters are concerned that as the use of 3D-printing technology becomes widespread, some individuals will use it to further illegal enterprises.²⁵ The ability to regulate 3D-printed guns effectively is at the forefront of this concern.²⁶

A. ADDITIVE MANUFACTURING

Additive manufacturing consists of a layering process, adding layer by layer of raw material until the desired object is complete.²⁷ An operating printer resembles a sort of robotic hot glue gun, but instead of glue, the printer emits whatever filament with which it is loaded.²⁸ Although plastic is the most common filament,²⁹ different types of printers can print objects using a wide variety of materials, including metals like titanium and gold, and even edible materials such as sugar.³⁰ These printers can print more complex shapes and structures than are possible through traditional manufacturing.³¹ Unlike other manufacturing methods such as cutting or injection molding, 3D printing requires only one machine, which does not need to be reconfigured before a different object is created.³² It is also significantly more efficient than other forms of manufacturing because it can preassemble the product.³³

24. See Anne Lewis, *The Legality of 3D Printing: How Technology Is Moving Faster than the Law*, 17 TUL. J. TECH. & INTELL. PROP. 303, 304 (2014).

25. See, e.g., Brian Krebs, *Gang Used 3D Printers for ATM Skimmers*, KREBS ON SECURITY (Sept. 20, 2011), <https://krebsonsecurity.com/2011/09/gang-used-3d-printers-for-atm-skimmers/> [<https://perma.cc/E797-9PN2>] (providing an example of how criminals have used 3D-printing technology to commit crimes); see also *supra* note 6 and accompanying text.

26. See McCutcheon, *supra* note 1, at 235–37.

27. See *id.* at 222–23.

28. See A. J. Jacobs, *Dinner Is Printed*, N.Y. TIMES (Sept. 21, 2013), www.nytimes.com/2013/09/22/opinion/sunday/dinner-is-printed.html [<https://perma.cc/UJ4E-NB9C>].

29. See Jeff Yoders, *What Materials Are Used in 3D Printing? It's More Fantastic Than Plastic*, REDSHIFT (Nov. 4, 2014), <https://www.autodesk.com/redshift/what-materials-are-used-in-3d-printing/> [<https://perma.cc/H243-D5DB>] (“Plastic still reigns supreme in the 3D-printing materials world.”); Elizabeth Palermo, *Fused Deposition Modeling: Most Common 3D Printing Method*, LIVE SCI. (Sept. 19, 2013, 6:28 PM), <https://www.livescience.com/39810-fused-deposition-modeling.html> [<https://perma.cc/V7NU-A3XQ>] (noting that Fused Deposition Modeling is the most common form of 3D printing, which uses a plastic filament).

30. See Jensen-Haxel, *supra* note 21, at 448. Other materials include rubber, hard plastics, temperature resistant materials, opaque, transparent materials, and stainless steel. McCutcheon, *supra* note 1, at 225.

31. See McCutcheon, *supra* note 1, at 222.

32. See Jensen-Haxel, *supra* note 21, at 450.

33. See *id.* at 450–51. For example, a 3D-printed clock will print with all the gears already inside. *Id.*

To begin, one must have a computer-aided design (“CAD”) file, which acts as a digital blueprint for the desired object.³⁴ CAD software requires some level of expertise, particularly for complex designs.³⁵ However, for beginners, there are numerous resources online to bypass creating one’s own CAD files, including software tutorials and thousands of existing downloadable files.³⁶ For example, websites such as Thingiverse.com and GrabCAD.com host online communities of millions of skilled designers who upload and share their own CAD creations for free.³⁷

Although 3D printers are more prevalent in commercial settings, they are growing in popularity among private consumers, who can purchase the technology at stores like Home Depot and Best Buy.³⁸ As of this writing, Amazon offers a “mini” 3D printer for only \$199.99.³⁹ This model, advertised as “[a]ffordable 3D printing for everyone,” is a nine-pound desktop printer that works with “any type of filament,” including metal.⁴⁰ Other companies lease printers or, for a small fee, will print any design and ship it to the consumer.⁴¹ Some economists predict that the 3D-printing market will become a \$6.5 billion industry by 2019, and increase by 300 percent in 2020.⁴² As mainstream awareness continues to grow, 3D-printing costs are expected to further decrease, providing users an inexpensive and convenient way to produce physical objects from their home computers.⁴³

Moreover, the manufacturing industry can be completely transformed by the numerous benefits of 3D printing.⁴⁴ The technology is likely cheaper than

34. See McCutcheon, *supra* note 1, at 223.

35. See *id.*

36. *Def. Distributed v. U.S. Dep’t of State*, 838 F.3d 451, 454–55 (2016).

37. See GRABCAD, <https://grabcad.com/> [<https://perma.cc/WS3W-EMVX>] (last visited Mar. 12, 2018); THINGIVERSE, <https://www.thingiverse.com/> [<https://perma.cc/Q6JZ-G6U4>] (last visited Feb. 12, 2017).

38. See *Def. Distributed*, 838 F.3d at 454.

39. *Monoprice 115365 Select Mini 3D Printer with Heated Build Plate, Includes Micro SD Card and Sample PLA Filament*, AMAZON, <https://www.amazon.com/Monoprice-Select-Printer-Heated-Filament/dp/B01FL49VZE/> [<https://perma.cc/2HEK-3C9G>] (last visited Mar. 12, 2018).

40. *Id.*

41. Becoming 3D and Stratasys are examples of companies that lease 3D printers. *3D Printer Leasing*, BECOMING 3D, <https://www.becoming3d.com/3d-printer-leasing/> [<https://perma.cc/PWF7-RVMB>] (last visited Mar. 12, 2018); STRATASYS, <http://www.stratasys.com/> [<https://perma.cc/ZCB9-9QZS>] (last visited Mar. 12, 2018).

42. See McCutcheon, *supra* note 1, at 224.

43. See *id.* at 220, 223.

44. See THOMAS CAMPBELL ET AL., ATLANTIC COUNCIL, COULD 3D PRINTING CHANGE THE WORLD? TECHNOLOGIES, POTENTIAL, AND IMPLICATIONS OF ADDITIVE MANUFACTURING 1–2 (2011), http://www.atlanticcouncil.org/images/files/publication_pdfs/403/101711_ACUS_3DPrinting.PDF [<https://perma.cc/BF8D-XJ4Q>].

traditional manufacturing methods and can allow for quick production, reducing product to market time.⁴⁵ Due to its ability to print complex shapes and structures, there is potential for practically unlimited concept and design development, leading to better quality products and more customization.⁴⁶ It produces less waste than traditional manufacturing, is more sustainable, and is expected to reduce both export reliance and surplus by localizing production.⁴⁷

The technology provides numerous benefits, but also boundless opportunities for abuse. One technology expert has predicted that within the next decade, the majority of American households will own a 3D printer.⁴⁸ Troublingly, 3D printers have already been used to further illegal endeavors.⁴⁹ For example, a gang used a 3D-printed skimmer to steal \$400,000 from an ATM.⁵⁰ Because this is quickly developing technology, it may be better to prepare for potential issues now before 3D printing becomes a widespread legal nightmare.⁵¹ In particular, 3D-printed weapons are able to evade current gun control regulations because they may be undetectable, untraceable, and easily disposed of.⁵² Because the technology allows anyone to print an almost fully functioning, deadly weapon in the person's own home, it is especially prudent to address regulatory issues now.⁵³

B. 3D PRINTING A FUNCTIONING FIREARM

Gunsmiths and hobbyists have taken advantage of 3D printing's unique manufacturing benefits and have begun to perfect the ability to print a fully functioning firearm.⁵⁴ A mere two years after the first attempt, the concept of printing an operable gun became a reality.⁵⁵ In 2013, a 3D-printed firearm, made up of almost completely printed parts, shot 600 rounds of ammunition.⁵⁶

45. *See id.* at 10.

46. *See id.* at 5–6.

47. *See id.* at 2, 6.

48. *See* Lewis, *supra* note 24, at 307.

49. *See* McCutcheon, *supra* note 1, at 235; Krebs, *supra* note 25.

50. *See* Krebs, *supra* note 25.

51. *See* Lewis, *supra* note 24, at 307 (discussing how “technology moves faster than the law” (quoting New York Times reporter Nick Bilton)).

52. *See* McCutcheon, *supra* note 1, at 221, 235–37, 240–41.

53. *See id.* at 225–26, 238. *See also generally* *About Defense Distributed*, DEF. DISTRIBUTED, <https://defdist.org/about/> [<https://perma.cc/5H48-V8JC>] (last visited Mar. 12, 2018).

54. *See* McCutcheon, *supra* note 1, at 226 (discussing Defense Distributed's mission to create a fully-printable gun).

55. *See id.* at 227.

56. *See* Cyrus Farivar, “Download this Gun”: 3D-Printed Semi-Automatic Fires Over 600 Rounds, *ARS TECHNICA* (Mar. 1, 2013, 6:00 AM), <https://arstechnica.com/tech-policy/2013/03/download-this-gun-3d-printed-semi-automatic-fires-over-600-rounds/> [<https://perma.cc/V5JG-2GN6>]; McCutcheon, *supra* note 1, at 227.

Homemaking 3D-printed guns is appealing because it allows for complete customization, and production is inexpensive and convenient.⁵⁷ Besides the 3D printer itself, the total cost to print a functioning firearm can be as low as three to ten dollars.⁵⁸ Furthermore, if made from plastic, they are easily disposable and may be melted down after use, exacerbating the current lack of serial numbers and other systems in place to track firearms.⁵⁹ For these reasons, 3D printing is especially attractive to hobbyists who may see self-creating a gun as a “technical challenge.”⁶⁰

The process has come a long way since its inception. The first 3D printers could not print all of the working parts of a gun, requiring gunsmiths to print individual parts and add those pieces to an already-existing firearm.⁶¹ Now, printing the gun itself is possible by simply filling a 3D printer with the chosen material and connecting it to a computer loaded with the desired design file.⁶² On GrabCAD.com alone, there are nearly 2,000 blueprints for guns and related parts.⁶³ Once the computer software processes the CAD file, the user initiates the printing process, and layer-by-layer, a functioning firearm is created.⁶⁴

However, firearms created with completely printed parts must overcome a significant challenge: achieving compatibility with traditional ammunition.⁶⁵ Originally, 3D-printed guns were typically made from plastic, and the heat and pressure generated by traditional ammunition caused parts of the gun to explode or crack.⁶⁶ Although one developer claimed to have shot fourteen rounds using traditional ammunition, most 3D-printed guns broke when taking their first shots.⁶⁷ However, a Pennsylvania man recently created a printable bullet that causes less wear on 3D-printed firearms.⁶⁸ Compared to traditional ammunition, the bullet has a thicker and longer shell, and the cartridge itself contains all the pressure generated by gunpowder upon pulling

57. See McCutcheon, *supra* note 1, at 226; CAMPBELL ET AL., *supra* note 44, at 5–7.

58. See Harlan, *supra* note 7, at 29.

59. See McCutcheon, *supra* note 1, at 236, 240.

60. See *id.* at 226.

61. See *id.*

62. See *id.* at 222–23.

63. See GRABCAD, https://grabcad.com/library?page=18&per_page=100&time=all_time&sort=recent&query=gun [<https://perma.cc/ZGA2-ANPB>] (last visited Mar. 29, 2017).

64. See McCutcheon, *supra* note 1, at 223.

65. See Lance Ulanoff, *Now There Are Bullets That Won't Break Your 3D-Printed Gun*, MASHABLE (Nov. 6, 2014), <http://mashable.com/2014/11/06/bullets-3d-printed-gun/> [<https://perma.cc/37QU-8URV>].

66. See *id.*

67. See *id.*

68. See *id.*; Harlan, *supra* note 7, at 28.

the trigger.⁶⁹ Federal law prevents him from selling the bullets without a license, but he plans to release the blueprints on his website so anyone can download and print the bullets.⁷⁰

Although bullets can be printed, gunpowder cannot.⁷¹ The chemical makeup of gunpowder, which creates the necessary explosive reaction, is beyond the capabilities of a 3D printer and is “scientifically very difficult” to replicate using such a device.⁷² However, gunpowder is easily obtained in sporting goods stores or online, and does not require that the buyer have any special license or registration to purchase it.⁷³

C. DEFENSE DISTRIBUTED AND THE FIRST 3D-PRINTED HANDGUN

In 2012, Cody Wilson and Ben Denio founded Defense Distributed, an “anti-monopolist digital publishing” corporation, with the mission of “defend[ing] the human and civil right to keep and bear arms . . . [and] to collaboratively produce, publish, and distribute to the public information and knowledge related to the digital manufacture of arms.”⁷⁴ The organization is an online platform that provides weapons blueprints to further its goal of reducing government and corporate interference with weapons manufacturing.⁷⁵ Wilson, in particular, is clear in his mission to provide widespread access to munitions.⁷⁶ In 2013, Defense Distributed announced

69. See Ulanoff, *supra* note 65.

70. See Harlan, *supra* note 7, at 28.

71. See Little, *supra* note 16, at 1508.

72. See *id.*

73. See Brendan J. Healey, *Plugging the Bullet Holes in U.S. Gun Law: An Ammunition-Based Proposal for Tightening Gun Control*, 32 J. MARSHALL L. REV. 1, 5–9 (1998). This article proposed regulating all ammunition, and ammunitions dealers themselves, under the Brady Handgun Violence Prevention Act as an all-encompassing solution for handgun violence in the United States. However, the article was written over a decade before 3D-printed guns were a reality. This Note builds on Healey’s proposal—an expanded Brady Bill—in a world where consumers now have the capability to manufacture weapons in their own homes through the use of a 3D printer. As discussed *infra*, 3D-printed guns lead to numerous gun control issues, such as having the capability to increase the number of illegally possessed guns. Because gunpowder cannot be printed, it is likely that the most readily available solution for remedying the issues posed by 3D-printed firearms is to regulate ammunition. See *infra* Part IV.

74. DEF. DISTRIBUTED, *supra* note 53; *DD History*, DEF. DISTRIBUTED, <https://defdist.org/dd-history/> [<https://perma.cc/GCW3-HKKH>] (last visited Mar. 12, 2018).

75. See Lewis, *supra* note 24, at 305 (noting that Defense Distributed identifies its mission as causing “disintermediation of state governments and large, collusive corporations”).

76. See Andy Greenberg, *Meet the ‘Liberator’: Test-Firing the World’s First Fully 3D-Printed Gun*, FORBES (May 5, 2013, 5:30 PM), <http://www.forbes.com/sites/andygreenberg/2013/05/05/meet-the-liberator-test-firing-the-worlds-first-fully-3d-printed-gun/> [<https://perma.cc/C59E-Q8ZR>] (discussing Wilson’s goal of “enabling individuals to create

that it had created the first functioning 3D-printed handgun, the “Liberator.”⁷⁷ In only four hours, Wilson printed fifteen of the sixteen parts necessary to create the gun.⁷⁸ He added a final piece, a metal firing pin, which can be purchased from a hardware store.⁷⁹

To create the Liberator, Wilson leased a printer from Stratasys,⁸⁰ a 3D-printing solutions company. When Stratasys discovered how Wilson planned to use the equipment, it seized the printer in fear of violating federal weapons laws.⁸¹ Unstoppable in his mission, Wilson acquired a secondhand Stratasys printer and, using ABS plastic, a heat-resistant material, printed the Liberator.⁸² The Liberator shoots standard .380 bullets and can fire several rounds.⁸³ Wilson immediately posted the Liberator’s blueprints online, making it the first “open-source weapon.”⁸⁴ Within two days of Wilson’s posting, the Liberator’s schematics were downloaded over 100,000 times.⁸⁵

The Liberator was the first major step toward proving that “anyone can print a gun in their bedroom.”⁸⁶ More recently, Defense Distributed released the “Ghost Gunner,” a CNC mill,⁸⁷ which provides hobbyists an alternative method for creating unregulated firearms.⁸⁸ On their website, Defense

their own sovereign space” and “demonstrat[ing] how technology can circumvent laws until governments simply become irrelevant”).

77. *See id.* This announcement immediately followed the Boston Marathon bombing, which involved homemade weapons.

78. *See* McCutcheon, *supra* note 1, at 227–28; Greenberg, *supra* note 76.

79. *See* Lewis, *supra* note 24, at 308; Greenberg, *supra* note 76.

80. *See* Lewis, *supra* note 24, at 305; STRATASYS, *supra* note 41.

81. STRATASYS, *supra* note 41.

82. *See* McCutcheon, *supra* note 1, at 227–28.

83. *Id.* at 228.

84. *See id.* The term “open source” was coined by the Open Source Initiative and applies to source code that is freely distributable. To qualify as “open source,” the Open Source Initiative requires that the code or software is freely distributable, includes source code, allows for modifications and derived works, has a readily available source, does not discriminate against any group or person, does not discriminate against fields of endeavor, includes redistributable licenses that are not product specific or restrictive of other software, and is technology neutral. For further explanation of “open source,” see *The Open Source Definition (Annotated)*, OPEN SOURCE INITIATIVE, <https://opensource.org/osd-annotated> [<https://perma.cc/5FFZ-257L>] (last visited Mar. 1, 2017).

85. *See* McCutcheon, *supra* note 1, at 245.

86. *See* Lewis, *supra* note 24, at 306.

87. Unlike a 3D printer, which uses an additive process, a CNC (computer-numerically-controlled) mill carves digital designs into the desired material using a drill. *See* Andy Greenberg, *The \$1,200 Machine That Lets Anyone Make a Metal Gun at Home*, WIRED (Oct. 1, 2014, 6:30 AM), www.wired.com/2014/10/cody-wilson-ghost-gunner/ [<https://perma.cc/2PQL-GWMG>].

88. *See* *Ghost Gunner 2*, DEF. DISTRIBUTED, <https://ghostgunner.net/> [<https://perma.cc/MW6D-KHZU>] (last visited Mar. 12, 2018) (“Due to Federal regulatory

Distributed advertises the Ghost Gunner saying, “With simple tools and point and click software [and] [n]o prior CNC knowledge or experience [you can] [l]egally manufacture unserialized AR rifles in the comfort and privacy of your home.”⁸⁹

Across the country, many legislators sprang into action following the unveiling of the Liberator and the Ghost Gunner.⁹⁰ Philadelphia became the first city to regulate the use of 3D printers, enacting an ordinance that requires one to have a federal manufacturing license to produce 3D-printed guns or their components.⁹¹ Although the ordinance was admittedly preemptive, Philadelphia’s policymakers found it more important to stay ahead of the quickly developing technology.⁹² The State Department acted similarly and sent Wilson a formal letter demanding he remove the Liberator’s blueprints from Defense Distributed’s website, claiming Wilson violated the International Traffic in Arms Regulations (“ITAR”),⁹³ which makes it unlawful to export technical data without authorization from the Directorate of Defense Trade Controls.⁹⁴

This was the first time in the State Department’s nearly forty years of regulating munitions “export[s]” that it sought enforcement against an Internet posting.⁹⁵ In response, Defense Distributed removed the blueprints and filed for authorization as required by the State Department.⁹⁶ However, the files continued to be shared across other websites.⁹⁷ Defense Distributed has since sought prior authorization before posting any new digital blueprints, but the State Department has yet to approve a single one.⁹⁸

overreach, Ghost Gunner is now the only affordable CNC solution for privately finishing your 80% lower receivers.”).

89. *Id.*

90. *See* Lewis, *supra* note 24, at 308.

91. *See id.* The ordinance stated, “No person shall use a three-dimensional printer to create any firearm, or any piece or part thereof, unless such person possesses a license to manufacture firearms under Federal law, 18 U.S.C. § 923(a).” PHILA., PA., CODE § 10-2002 (2018).

92. *See* Lewis, *supra* note 24, at 308 (discussing divergent views of proactively legislating 3D-printed weapons before printers are truly prevalent among individual consumers).

93. *See* Julia Cosans, *Between Firearm Regulation and Information Censorship: Analyzing First Amendment Concerns Facing the World’s First 3-D Printed Plastic Gun*, 22 AM. U. J. GENDER SOC. POLY & L. 915, 918 (2014).

94. *See* Def. Distributed v. U.S. Dep’t of State, 838 F.3d 451, 462 (2016) (Jones, J., dissenting).

95. *Id.*

96. *See id.* at 456.

97. *Id.*

98. *Id.*

D. *DEFENSE DISTRIBUTED V. U.S. DEPARTMENT OF STATE*

In the interim, Defense Distributed sued the State Department to enjoin it from enforcing ITAR.⁹⁹ Defense Distributed argued that the State Department's interpretation of the regulation constituted prior restraint on constitutionally protected speech.¹⁰⁰ Defense Distributed asserted a "hybrid claim," arguing the State Department violated both its First and Second Amendment rights.¹⁰¹ Additionally, Defense Distributed sought relief through a preliminary injunction to allow its files to remain online temporarily until the litigation's resolution.¹⁰² The district court denied the injunction, maintaining that Defense Distributed did not meet its burden of showing that its interest in protecting its constitutional rights outweighed national security concerns.¹⁰³ Defense Distributed appealed to the Fifth Circuit Court of Appeals.¹⁰⁴

The Fifth Circuit acknowledged that the act of privately printing firearms is lawful, but it narrowly focused its opinion on the legality of sharing firearms blueprints online that may be accessed by almost anyone worldwide.¹⁰⁵ The Fifth Circuit held that the district court did not abuse its discretion in denying the preliminary injunction, and remanded the case to the district court for further proceedings.¹⁰⁶ Judge Edith H. Jones dissented from the opinion, warning that the majority's affirmation will encourage the State Department to "threaten and harass" other individuals posting similar information online.¹⁰⁷

The procedural posture in the case limited the Fifth Circuit's ability to discuss the case's merits beyond the legitimacy of the preliminary injunction. However, the court recognized that on remand, the district court must address

99. *Id.*

100. *Id.*

101. *See id.*; Kyle Langvardt, *The Doctrinal Toll of "Information as Speech"*, 47 LOY. U. CHI. L.J. 761, 767 (2016).

102. *Def. Distributed*, 838 F.3d at 456.

103. *See id.* at 458. To be granted a preliminary injunction, the party must meet four requirements. The party must show:

(1) a substantial likelihood that he will prevail on the merits, (2) a substantial threat that he will suffer irreparable injury if the injunction is not granted, (3) that his threatened injury outweighs the threatened harm to the party whom he seeks to enjoin, and (4) that granting the preliminary injunction will not disserve the public interest. "We have cautioned repeatedly that a preliminary injunction is an extraordinary remedy which should not be granted unless the party seeking it has 'clearly carried the burden of persuasion' on all four requirements."

Id. at 456–57.

104. *Id.* at 453.

105. *See id.* at 455.

106. *Id.* at 460.

107. *See id.* at 462.

several issues, including (1) whether 3D-printing files are protected speech under the First Amendment, (2) the level of scrutiny applicable to the regulations, (3) whether posting files online to be freely downloaded constitutes “export,” and (4) whether ITAR’s regulatory scheme is unconstitutional prior restraint under the First Amendment.¹⁰⁸

III. STARING DOWN THE BARRELL: SCRUTINIZING 3D-PRINTED GUNS UNDER CURRENT LAW

The ability to self-manufacture weapons is protected under the law, and the current firearms regulatory scheme was written under this assumption.¹⁰⁹ Currently, very few individuals make their own firearms.¹¹⁰ Whereas self-manufacturing weapons has historically required specialized skills, 3D printing does not and therefore allows even novice gunsmiths to produce their own sophisticated weapons.¹¹¹ There are statutes currently in effect that may offer some control over 3D-printed guns, but they may need to be altered to provide adequate regulation.¹¹² By 3D printing guns, individuals have the capability to bypass federal regulations that dictate a firearm’s manufacturing, licensing, and registration requirements.¹¹³ Furthermore, any statute regulating 3D-printed firearms will likely be scrutinized under both the First and Second Amendments, requiring a balancing of public safety concerns with the constitutionally protected liberties of freedom of speech and the right to bear arms.¹¹⁴

A. THE CURRENT GUN CONTROL REGULATORY SCHEME AND ITS INABILITY TO REGULATE 3D-PRINTED FIREARMS

Federal, state, and local governments have taken numerous steps to control the prevalence of illegally possessed guns in the United States, with state and local governments enacting the majority of gun-related legislation because federal firearm legislation is limited.¹¹⁵ Although guns are heavily

108. *See id.* at 461.

109. *See* McCutcheon, *supra* note 1, at 239.

110. *United States — Gun Facts, Figures and the Law*, GUNPOLICY.ORG (Dec. 2, 2016), <http://www.gunpolicy.org/firearms/region/united-states> [http://perma.cc/96MV-KYCD].

111. *See* McCutcheon, *supra* note 1, at 239.

112. *See infra* Section 3.A.

113. *See id.*

114. *See infra* Section III.B.

115. McCutcheon, *supra* note 1, at 228. For a comprehensive list of state-enacted legislation, see Bindu Kalesan et al., *Firearm Legislation and Firearm Mortality in the USA: A Cross-Sectional, State-Level Study*, 387 LANCET 1847, 1849–50 (2016).

regulated, they are not truly “controlled.”¹¹⁶ There are hundreds of state and federal gun control statutes on the books,¹¹⁷ but because of gaps in federal legislation and conflicting state laws, the illegal gun market is flourishing.¹¹⁸ Furthermore, because individuals have not had an opportunity to self-produce guns as easily in the past, current firearm legislation is tailored towards acquiring and possessing commercially-made weapons.¹¹⁹ Thus, the ability to self-manufacture guns using a 3D printer complicates the already-complex issue of effective gun control regulation.

All states except Alaska and Vermont enforce some restrictions on concealed firearms.¹²⁰ However, state regulatory trends lean towards relaxed restrictions, opting for permit systems instead of total prohibitions on concealed carry.¹²¹ Similarly, the federal government currently enforces a licensing scheme, allowing most citizens to obtain firearms, with narrow exceptions for prohibited classes.¹²² Federal legislation includes: the Undetectable Firearms Act of 1988, the Arms Export Control Act of 1976, the Gun Control Act of 1968, the National Firearms Act of 1934, and the Brady Handgun Violence Prevention Act of 1993.¹²³ The Bureau of Alcohol, Tobacco, Firearms, and Explosives (the “ATF”) is charged with enforcing these statutes, issuing firearms regulations, providing federal firearm licenses,

116. See Little, *supra* note 16, at 1507.

117. See Susan Jones, *How Many Gun Laws Are There? Study Disputes 20,000 Number*, CNS NEWS (July 7, 2008, 8:20 PM), <http://www.cnsnews.com/news/article/how-many-gun-laws-are-there-study-disputes-20000-number> [<https://perma.cc/VCW7-64NL>]. Jones discusses a study by the Brookings Institution Center on Urban and Metropolitan Policy that found there are 300 “relevant” gun control statutes in the United States among federal and state governments, disputing a former report that there are 20,000 gun laws in the United States. *Id.* However, the study considered local laws “irrelevant.” *Id.*

118. See Daniel W. Webster, Jon S. Vernick, Emma E. McGinty & Ted Alcorn, *Preventing the Diversion of Guns to Criminals through Effective Firearm Sales Laws*, in REDUCING GUN VIOLENCE IN AMERICA: INFORMING POLICY WITH EVIDENCE AND ANALYSIS 109, 110–11 (Daniel W. Webster & Jon S. Vernick eds., 2013) (describing a study conducted by the ATF, which surveyed over 1,400 inmates with gun-related convictions, discovering that a mere 11.4% purchased their guns from a licensed dealer, with the majority of inmates stating that they stole their guns or purchased them through the black market).

119. See McCutcheon, *supra* note 1, at 240.

120. Philip J. Cook, Jens Ludwig & Adam M. Samaha, *Gun Control After Heller: Threats and Sideshows from a Social Welfare Perspective*, 56 UCLA L. REV. 1041, 1054 (2009).

121. *Id.*

122. See McCutcheon, *supra* note 1, at 228. Prohibited classes include felons, those with gun-related misdemeanors, drug and alcohol abusers, juvenile offenders, and the mentally ill. *Categories of Prohibited People*, LAW CTR. TO PREVENT GUN VIOLENCE, <http://smartgunlaws.org/gun-laws/policy-areas/background-checks/categories-of-prohibited-people/> [<https://perma.cc/RLJ4-DAX3>] (last visited Mar. 18, 2018).

123. 22 U.S.C. § 2778(a)(1) (2012); McCutcheon, *supra* note 1, at 229.

and conducting compliance inspections.¹²⁴ Currently, the ATF does not have much power over 3D-printed firearms and is only able to regulate them through gun control laws currently in place.¹²⁵

1. *The Undetectable Firearms Act of 1988*

The Undetectable Firearms Act of 1988 (“UFA”) makes it illegal to manufacture guns that cannot be detected by a metal detector.¹²⁶ The statute requires that all firearms contain at least 3.7 ounces of metal.¹²⁷ Additionally, the UFA requires that any firearm component, when viewed under an x-ray machine, maintain an accurate depiction of that component.¹²⁸ The UFA expired in 1998, but was extended for five additional years and then reauthorized for an additional ten years in both 2003 and 2013.¹²⁹

Criminals strive to go undetected and 3D-printed firearms, especially those made of plastic, can effectuate this goal. Currently, most printed guns are manufactured with some metal component, but as the technology progresses, this may change.¹³⁰ Even so, the metal presently used in printed guns, like the Liberator, is not substantial enough to set off any alarms.¹³¹ Recently, a group of Israeli journalists set out to test 3D-printed guns’ detectability, downloading and printing their own Liberator.¹³² Even with a metal firing pin in the gun, the journalists managed to go unnoticed through metal detectors, carrying the replicated Liberator into a meeting of the Israeli Parliament during the Prime Minister’s address.¹³³

Fully plastic firearms clearly violate the UFA. However, enforcement will be difficult because 3D-printed guns are becoming an inexpensive alternative to traditional firearms and can be produced in the privacy of one’s own home, where governmental oversight is functionally impossible.¹³⁴ Even if a printed firearm contains metal in compliance with the UFA, it may still go undetected,

124. See *Firearms*, ATF, <https://www.atf.gov/firearms> [<https://perma.cc/TYW3-UV6P>] (last visited Mar. 12, 2018).

125. See *What Say Does ATF Have in the Technology Used to Produce Firearms?*, ATF (Sept. 23, 2016), <https://www.atf.gov/firearms/qa/what-say-does-atf-have-technology-used-produce-firearms> [<https://perma.cc/5ARH-QW2T>].

126. See 18 U.S.C. § 922(p) (2012); Harlan, *supra* note 7, at 30.

127. § 922(p)(2)(C)(i).

128. See McCutcheon, *supra* note 1, at 226.

129. H.R. 3626, 113th Cong. (2013); McCutcheon, *supra* note 1, at 232.

130. See Harlan, *supra* note 7, at 30.

131. See Lewis, *supra* note 24, at 309.

132. See *id.*

133. See *id.*

134. See McCutcheon, *supra* note 1, at 226 (discussing the inexpensive aspects of the technology).

as in the case of the Israeli journalists.¹³⁵ Furthermore, some 3D-printed gun models have removable parts, so the owner could remove any metal while walking through a security detector and then put it back in place to fire the gun.¹³⁶

2. *Arms Export Control Act of 1976 and the International Traffic in Arms Regulation*

The Arms Export Control Act of 1976 (“AECA”) authorizes the President of the United States to control the import and export of “defense articles” and “defense services.”¹³⁷ It also grants the power to promulgate regulations for such imports and exports.¹³⁸ The President has the discretion to determine what constitutes defense articles and services, which are then added to the United States Munitions List.¹³⁹ The Munitions List does not list defense articles by name, but rather by specific attributes.¹⁴⁰ According to the regulations, “technical data recorded or stored in any physical form, models, mockups or other items that reveal technical data directly relating to items designated in [the Munitions List]” are considered defense articles.¹⁴¹ This includes information presented as blueprints, drawings, and instructions.¹⁴² The AECA imposes both civil and criminal penalties, with violations punishable by fines and imprisonment.¹⁴³

The AECA is enforced by the State Department.¹⁴⁴ The President has delegated the authority to make regulations under the AECA to the Secretary of State under ITAR.¹⁴⁵ ITAR requires authorization from the Directorate of Defense Trade Controls to “export” technical data related to any defense

135. See Lewis, *supra* note 24, at 309.

136. Rebecca Leber, *This Is the Only Gun Safety Bill That Passed Congress This Year*, THINKPROGRESS (Dec. 10, 2013, 1:45 PM), <https://thinkprogress.org/this-is-the-only-gun-safety-bill-that-passed-congress-this-year-f22ce0c0fd5b> [<https://perma.cc/T29D-J2VL>]. For these reasons, Congressman Steve Israel introduced the Undetectable Firearms Modernization Act of 2015 to better tailor the UFA to include 3D-printed weapons. H.R. 2699, 114th Cong. (2015); McCutcheon, *supra* note 1, at 232.

137. See 22 U.S.C. § 2778(a)(1) (2012).

138. See *id.*

139. See *id.*; *Def. Distributed v. U.S. Dep’t of State*, 838 F.3d 451, 455 (5th Cir. 2016).

140. See *Def. Distributed*, 838 F.3d at 455.

141. International Traffic in Arms Regulation, 22 C.F.R. § 120.6 (2018).

142. § 120.10(a)(1).

143. See § 2278(c) & (e). Violations are punishable by fines that may exceed one million dollars and prison terms of up to twenty years. *Def. Distributed*, 838 F.3d at 462 n.3 (Jones, J., dissenting) (citing 28 U.S.C. § 2778(c); *United States v. Covarrubias*, 94 F.3d 172 (5th Cir. 1996)).

144. See § 2778(i).

145. See *Def. Distributed*, 838 F.3d at 455.

article listed on the Munitions List.¹⁴⁶ Disclosing or transferring this data, including orally or visually, to a “foreign person” is considered an “export,” regardless of whether the transfer occurred in the United States or abroad.¹⁴⁷

In *Defense Distributed v. U.S. Department of State*, the State Department relied on ITAR, claiming that Defense Distributed’s published blueprints constituted technical data related to the Munitions List.¹⁴⁸ It claimed that posting these files online, which foreign nationals could access, equated to “export” and required prior approval from the State Department.¹⁴⁹ Courts have not yet determined whether posting gun-related digital blueprints online constitutes “export” under ITAR, a question intentionally left open by the Fifth Circuit in *Defense Distributed*.¹⁵⁰ If sharing digital weapons blueprints online is considered “export,” then the federal government may more strictly enforce the regulation to curtail the prevalence of 3D-printed firearms.¹⁵¹ However, this is unlikely, particularly as prepublication censorship is probably beyond the scope of ITAR.¹⁵²

Neither the AECA nor ITAR define the term “export.”¹⁵³ According to the dictionary cited by the Fifth Circuit, export is defined as “ship[ping] (commodities) to other countries or places for sale, exchange, etc.”¹⁵⁴ This definition implies the transmission of goods to foreign entities.¹⁵⁵ Based on this plain meaning, the term “export” does not include digital files that were uploaded domestically.¹⁵⁶ Furthermore, Congress presumably did not use vague statutory language, unintentionally deviating from the term’s plain

146. *See id.* at 463–64 (Jones, J., dissenting).

147. International Traffic in Arms Regulation, 22 C.F.R. § 120.17(a)(4) (2014); *see also Def. Distributed*, 838 F.3d at 462 (Jones, J., dissenting).

148. *Def. Distributed*, 838 F.3d at 456.

149. *Id.* at 455–56.

150. *See id.* at 461.

151. *See* International Traffic in Arms Regulation, 22 C.F.R. § 126 (2014).

152. *See Def. Distributed*, 838 F.3d at 466 (Jones, J., dissenting) (“Whether AECA itself, concerned with the ‘export’ of defense article related technical data, authorizes prepublication censorship of domestic publications on the Internet is at least doubtful.”).

153. *See id.*

154. *Id.* (quoting *United States v. Ehsan*, 163 F.3d 855, 858 (4th Cir. 1998)) (internal quotation marks omitted). The Fourth Circuit in *Ehsan* cited to “*The Random House Dictionary of the English Language* 682 (2d ed.1987).” *Ehsan*, 163 F.3d at 858.

155. *See Def. Distributed*, 838 F.3d at 467 (citing *Ehsan*, 163 F.3d at 858).

156. *See id.*

meaning.¹⁵⁷ Where a statute’s meaning is plain, a federal agency may not act beyond the scope of that meaning.¹⁵⁸

Additionally, it is doubtful that sharing digital weapons blueprints on a website, which may be accessed by anyone, will constitute “export” under ITAR.¹⁵⁹ Most online postings, particularly on websites such as the one at issue in *Defense Distributed*, are accessible to the public broadly.¹⁶⁰ These postings are distinguishable from past incidents of ITAR enforcement against defendants who, for example, tried to send WMD materials to North Korea, missile blueprints to China, or licensed chemical purchasing software to corporations owned by the Iranian government.¹⁶¹ Unlike these occurrences, where the shared information targeted a specific country or entity, posting CAD files to online platforms that are accessible to anyone does not have a direct, targeted contact. Overall, it is unlikely that posting digital firearms blueprints will constitute “export” under ITAR; and even if it were considered “export,” enforcement nonetheless may be blocked as unconstitutional under the First Amendment.¹⁶²

3. *The National Firearms Act of 1934, the Gun Control Act of 1968, and the Brady Handgun Prevention Act of 1993*

Congress enacted the National Firearms Act of 1934 (“NFA”) through its authority to tax, with an underlying goal of reducing the use of firearms in criminal endeavors, particularly by gangs.¹⁶³ It imposed a \$200 tax on the making and transfer of all enumerated firearms, including firearms and rifles with barrels less than eighteen inches long, machine guns, firearm mufflers, silencers, and “any other weapons.”¹⁶⁴ Although this tax was severe at the time of the statute’s enactment, the monetary amount remains the same today.¹⁶⁵

157. *See id.* (quoting *King v. Burwell*, 135 S. Ct. 2480, 2495 (2015)) (“Congress . . . does not alter the fundamental details of a regulatory scheme in vague terms or ancillary provisions.”).

158. *See id.* (citing *Chevron U.S.A. v. Nat. Res. Def. Council, Inc.*, 467 U.S. 837, 842–43 (1984)).

159. *See id.* at 466 (describing how the government may prosecute individuals who directly email classified data to foreign persons or give them technical advice related to militant operations).

160. *See id.* at 462.

161. *See id.* at 465–66.

162. *See infra* Section III.B.1.

163. *See* National Firearms Act of 1934, 26 U.S.C. §§ 5801–72 (2012); *National Firearms Act*, ATF (Dec. 1, 2016), <https://www.atf.gov/rules-and-regulations/national-firearms-act> [<https://perma.cc/D8GJ-58XD>].

164. ATF, *supra* note 163.

165. *See id.*

The NFA also requires that the listed weapons be registered with the Secretary of the Treasury.¹⁶⁶ In the past, when individuals with unregistered NFA firearms attempted to register them, the Treasury could contact state authorities to report the unregistered weapon.¹⁶⁷ Practically, this became a Fifth Amendment self-incrimination issue and made the NFA unenforceable.¹⁶⁸ However, the Gun Control Act of 1968 (“GCA”) amended the NFA and remedied this defect.¹⁶⁹ Now, there is no mechanism for unregistered firearms already in one’s possession to be registered, and prosecutors are unable to use NFA registration applications against criminal defendants.¹⁷⁰

The GCA also imposes stricter gun control policies.¹⁷¹ Congress enacted the GCA in response to the assassinations of President John F. Kennedy, Attorney General Robert Kennedy, and Dr. Martin Luther King, Jr. to “provide support to Federal, State, and local law enforcement officials in their fight against crime and violence.”¹⁷² Through the GCA, Congress imposed stricter licensing requirements, established new firearm offenses, required firearms to bear a serial number, and banned sales to felons and other prohibited classes.¹⁷³ In particular, undocumented immigrants, illicit drug users, the mentally ill, felons, and those convicted of an act of domestic violence may not possess firearms under the GCA.¹⁷⁴ The statute further prohibits licensed dealers from selling firearms to those under the age of twenty-one, except in the case of rifles and shotguns, in which case the buyer must be eighteen.¹⁷⁵ Defendants with gun-related charges are most often prosecuted under the GCA’s provision that makes it “unlawful for a prohibited person to ship, transport, possess, or receive” a firearm.¹⁷⁶

In 1993, Congress amended the GCA by enacting the Brady Handgun Violence Prevention Act (the “Brady Bill”) to further limit prohibited classes

166. *Id.*

167. *Id.*

168. *See id.*

169. *See* Gun Control Act of 1968, 18 U.S.C. § 921 (2012); ATF, *supra* note 163.

170. *See* ATF, *supra* note 163.

171. *See* *Gun Control Act*, ATF (Sept. 22, 2016), <https://www.atf.gov/rules-and-regulations/gun-control-act> [<https://perma.cc/X2HS-GDP7>].

172. Gun Control Act of 1968, Pub. L. No. 90-618, § 101, 82 Stat. 1213; ATF, *supra* note 171.

173. *See* 18 U.S.C. § 921 (2012); ATF, *supra* note 171.

174. *See* 18 U.S.C. §§ 922(d)(1), (3), (4), (5)(A), (9) (2012).

175. *See id.* § 922(b)(1).

176. *See* McCutcheon, *supra* note 1, at 230.

from acquiring firearms.¹⁷⁷ The Brady Bill established the National Instant Criminal Background Check System (NICS) to be used by licensed firearms dealers before firearm transfers.¹⁷⁸ This system determines whether the purchaser is part of a prohibited class at the time of purchase.¹⁷⁹ The Brady Bill's requirements only apply to Federal Firearms Licensees, which include over 130,000 firearm manufacturers, dealers, and importers.¹⁸⁰ Since its enactment, the Brady Bill has prevented over two million prohibited persons from purchasing a firearm.¹⁸¹ However, there is a loophole for private sellers, who do not engage in the business of firearms dealing, to transfer guns without performing background checks.¹⁸²

It is uncertain whether 3D-printed guns are within the purview of the NFA, the GCA, and the Brady Bill at all.¹⁸³ The NFA may capture 3D-printed firearms if such firearms constitute “any other weapons” under the statute.¹⁸⁴ As defined, “any other weapons” includes “any weapon or device capable of being concealed on the person from which a shot can be discharged through the energy of an explosive.”¹⁸⁵ Nearly all 3D-printed guns will meet this definition, attaching the GCA's registration requirements and a \$200 tax upon their making.¹⁸⁶ However, since 3D-printed guns can be made at home, individuals who 3D print guns can easily evade these impositions, making it nearly impossible to enforce the GCA's licensing requirement.¹⁸⁷ Additionally, there is no way to control how an individual designs the printed gun, rendering the serial number requirement futile.¹⁸⁸

177. See H.R. REP. NO. 103-344, at 7 (1993) (“The purpose of [the Brady Bill] is to prevent convicted felons and other persons who are barred by law from purchasing guns from licensed gun dealers, manufacturers or importers.”).

178. See McCutcheon, *supra* note 1, at 231.

179. See *id.*

180. See 18 U.S.C. § 922 (2012); McCutcheon, *supra* note 1, at 231; *Fact Sheet – Federal Firearms and Explosives Licenses by Type*, ATF (Mar. 2016), <https://www.atf.gov/resource-center/fact-sheet/fact-sheet-federal-firearms-and-explosives-licenses-types> [<https://perma.cc/AQ3W-6A8C>].

181. *Effectiveness of the Brady Act and Background Checks*, LAW CTR. TO PREVENT GUN VIOLENCE, <http://smartgunlaws.org/effectiveness-brady-actbackground-checks/> [<https://perma.cc/VJV9-HSSX>] (last visited Mar. 13, 2018).

182. See McCutcheon, *supra* note 1, at 231.

183. See *id.* at 232.

184. See 26 U.S.C. § 5845(e) (2012).

185. *Id.*

186. See ATF, *supra* note 163.

187. See 18 U.S.C. § 923 (2012).

188. See Cook et al., *supra* note 120, at 1055 (noting current regulatory schemes are extremely difficult to implement).

Furthermore, self-manufactured 3D-printed guns clearly bypass mandated background checks under the Brady Bill. They are not purchased from a licensed dealer, but rather are most likely made in the privacy of one's own home. Prohibited persons, including felons, the mentally ill, and children and teenagers, can manufacture their own firearms, completely undermining the GCA's restrictions on prohibited classes.¹⁸⁹

B. CONSTITUTIONAL BARRIERS TO REGULATION: THE FIRST AND SECOND AMENDMENT

Printed firearms are controversial not only because of their dangerous nature but also because they likely implicate the first two amendments to the United States Constitution.¹⁹⁰ In its case against the State Department, *Defense Distributed* claimed it had an “extra-special First Amendment-Second Amendment ‘hybrid claim’ deserv[ing] even closer consideration.”¹⁹¹ *Defense Distributed* asserted that these two amendments together protect “expressive content about the right to keep and bear arms.”¹⁹²

1. *The First Amendment*

The First Amendment, sometimes referred to as “the First Freedom,”¹⁹³ guarantees one of the most fundamental rights—freedom of speech.¹⁹⁴ Textually, the First Amendment applies only to pure speech, as in spoken or written word.¹⁹⁵ However, the Supreme Court has held that the First Amendment protects more than literal speech, safeguarding freedom of expression through words, activities, and conduct.¹⁹⁶ Some have proposed a complete prohibition on sharing gun-related CAD files in order to block 3D printing illegal weapons at their source.¹⁹⁷ However, a growing body of scholarly work suggests that these digital blueprints likely constitute electronic speech subject to First Amendment protections.¹⁹⁸

189. See LAW CTR. TO PREVENT GUN VIOLENCE, *supra* note 122 (listing the GCA's prohibited classes).

190. See Blackman, *supra* note 13, at 504 (analyzing the “hybrid First and Second Amendments” and how they apply to 3D-printed guns).

191. Langvardt, *supra* note 101, at 767.

192. *Id.* at 767 n.15.

193. *Def. Distributed v. U.S. Dep't of State*, 838 F.3d 451, 476 (5th Cir. 2016) (Jones, J., dissenting).

194. U.S. CONST. amend. I.

195. Cosans, *supra* note 93, at 921.

196. *Id.* at 921–22.

197. See Blackman, *supra* note 13, at 499.

198. See *id.* at 501.

The *Defense Distributed* case illustrates the potential First Amendment concerns associated with prior restraint of CAD file publication. When Cody Wilson designed the Liberator, he uploaded its blueprints, consisting of CAD files, online.¹⁹⁹ Roughly 100,000 people downloaded the files within only three days of their posting.²⁰⁰ Because the CAD software requires specialized skills to operate, many individuals rely on online sources to access blueprints for what they seek to print.²⁰¹ There are numerous websites dedicated to offering users 3D-printable blueprints.²⁰² Accordingly, given the demand for this information and the expressive marketplace in which it occurs, scholars argue that this file sharing constitutes electronic speech, invoking First Amendment protection.²⁰³

In regulating speech under the First Amendment, there is a presumption that prior restraint is unconstitutional.²⁰⁴ Additionally, the degree of First Amendment protection for CAD files depends on the type of speech they are classified as.²⁰⁵ This characterization will dictate the level of scrutiny courts must apply in evaluating any future regulations.²⁰⁶ If CAD files constitute pure speech, or even expressive activity, laws controlling their distribution must satisfy strict scrutiny; such laws may also regulate the time, place, or manner in which the files are shared so long as the restrictions are content-neutral and leave open alternative channels for communication.²⁰⁷

Pure speech is given the highest level of First Amendment protection, prohibiting lawmakers from regulating the content of such speech unless such regulation passes the high bar of strict scrutiny.²⁰⁸ Conversely, if CAD files are considered expressive conduct, encompassing both speech and non-speech attributes, and they include elements of communication—in this case, the file

199. *Id.* at 485–86.

200. *Id.*

201. *See* McCutcheon, *supra* note 1, at 223.

202. *See, e.g.*, GRABCAD, *supra* note 37; THINGIVERSE, *supra* note 37.

203. *See, e.g.*, Blackman, *supra* note 13, at 499–502 (arguing that CAD files are electronic communications protected under the First Amendment); Cosans, *supra* note 93, at 930–36 (arguing that CAD files contain “sufficient” elements of communication to implicate the First Amendment).

204. *See* N.Y. Times Co. v. United States, 403 U.S. 713, 714 (1971) (recognizing the government’s heavy burden to justify limiting speech); *see also* Cosans, *supra* note 93, at 927 (noting that the government “bears a heavy burden of showing justification for prohibiting speech or expression”).

205. *See* Cosans, *supra* note 93, at 923.

206. *See id.*

207. *See id.* at 922; *see also* Def. Distributed v. U.S. Dep’t of State, 838 F.3d 451, 469 (5th Cir. 2016) (Jones, J., dissenting) (referring to the State Department’s actions as “pure content-based regulation”).

208. *See* Cosans, *supra* note 93, at 921.

sharing aspect—then burdensome regulations will be scrutinized under intermediate scrutiny.²⁰⁹ To be upheld under that standard, a regulation needs only to further a substantial government interest.²¹⁰

The Supreme Court has not yet spoken on how CAD files are classified under the First Amendment.²¹¹ However, lower courts continuously apply the First Amendment to computer code.²¹² Similarly, courts recognize that instructions, including blueprints, are protected speech.²¹³ Furthermore, the Supreme Court previously recognized that distributing photographs of guns, which are akin to gun-related digital drawings (i.e. CAD files), is constitutionally protected.²¹⁴ Therefore, CAD files, including gun-related blueprints, almost certainly qualify as speech, if not pure speech, and warrant First Amendment protection. Any regulation specifically targeted toward gun-related CAD files will likely be subject to heightened scrutiny, as such regulations would target a specific content-based subject and would not extend to all CAD files.²¹⁵

Furthermore, in *Defense Distributed*, the Fifth Circuit hinted that regulations regarding firearm-specific CAD files may qualify for strict scrutiny.²¹⁶ Although the majority focused on the injunction and reserved the merits for remand, the dissent offered an analysis of how 3D-printed firearms are protected under the First Amendment.²¹⁷ The dissent emphasized that if the government were able to regulate this kind of speech, regulations would likely encompass mediums beyond Internet postings.²¹⁸ The dissent criticized the majority for deciding the case on the basis of national security interests alone without even considering the broad-reaching effects that regulating content-

209. *See id.* at 923.

210. *See id.*

211. *See Def. Distributed*, 838 F.3d at 461; Cosans, *supra* note 93, at 921.

212. *See* Langvardt, *supra* note 101, at 768.

213. *See* *Universal City Studios v. Corley*, 273 F.3d 429, 451 (2d. Cir. 2001) (holding that computer code, and software programs made from that code, qualify as speech and are protected as such under the First Amendment).

214. *See* *Brown v. Entm't Merchs. Ass'n*, 564 U.S. 786, 804–05 (2011) (holding that violent video games, including those depicting gun violence, is protected speech under the First Amendment); Blackman, *supra* note 13, at 500–01.

215. *See* *Sorrell v. IMS Health Inc.*, 564 U.S. 552, 565–66 (2011) (noting that where a regulation imposes a “specific, content-based burden on protected expression . . . heightened judicial scrutiny is warranted”).

216. *See* *Def. Distributed v. U.S. Dep't of State*, 838 F.3d 451, 470 (5th Cir. 2016) (Jones, J., dissenting) (“Because the regulation of *Defense Distributed*’s speech is content-based, it is necessary to apply strict scrutiny.”).

217. *See id.* at 461–73.

218. *See id.* at 462.

based online speech may have on future cases.²¹⁹ By the time its case made it to the Fifth Circuit, Defense Distributed's ability to publish digital blueprints had already been hindered for three years.²²⁰ This was not a temporary injury, according to the dissent, but rather a trampling on Defense Distributed's First Amendment rights.²²¹

2. *The Second Amendment*

In addition to the First Amendment, any future regulation aimed at 3D-printed guns will be scrutinized under the Second Amendment.²²² The Second Amendment safeguards the right to "keep and bear Arms."²²³ Logically, this includes an implied right to acquire, and even self-manufacture, firearms.²²⁴ In 2008, the Second Amendment received its first substantive Supreme Court interpretation since the amendment was ratified over 200 years ago.²²⁵ In *District of Columbia v. Heller*, the Court held that gun ownership is an individual right, though not an unlimited one.²²⁶ In *Heller*, the Court struck down a Washington, D.C. handgun ban, focusing on the fact that handguns are widely used among the American people and potentially necessary for self-defense inside the home.²²⁷

The Court's holding in *Heller* protected the right to possess weapons "typically possessed by law-abiding citizens" in the home.²²⁸ Thus, under the Court's "in common use" test, firearms that are prevalent among the American people are protected under the Second Amendment.²²⁹ The Court stated that this test is "supported by the historical tradition of prohibiting the carrying of 'dangerous and unusual weapons,'" implicitly granting the ability to regulate

219. *See id.* at 461–63.

220. *See id.* at 463.

221. *See id.*

222. *See* Blackman, *supra* note 13, at 489–90.

223. U.S. CONST. amend. II.

224. *See* Blackman, *supra* note 13, at 491, 496; Little, *supra* note 16, at 1510–11.

225. Cook et al., *supra* note 120, at 1058. The pro-gun rights provision barely prevailed, passing with a 5-4 vote by the Court. *Id.* at 1059.

226. *See* *District of Columbia v. Heller*, 554 U.S. 570, 625–26 (2008); *see also* Cook et al., *supra* note 120, at 1059 (stating that the Court's opinion in *Heller* began "the process of accommodating an individualistic gun rights vision to the modern tradition of gun regulation").

227. *See Heller*, 554 U.S. at 628–29.

228. *See id.* at 625; Cook et al., *supra* note 120, at 1062.

229. *See Heller*, 554 U.S. at 624–28.

weapons that are “dangerous and unusual.”²³⁰ Therefore, it is likely that firearm ownership will be evaluated in light of the weapon’s popularity in the market.²³¹

In a 2017 case, *Kolbe v. O’Malley*, the United States District Court for the District of Maryland applied the “in common use” test to determine whether assault-style long guns can be lawfully possessed by private individuals.²³² That opinion provides insight into how lower courts may apply the “in common use” test to untraditional firearms.²³³ In determining the legality of the long gun, the Maryland court considered ownership statistics, the percentage of the total gunstock the weapon makes up, and whether the weapon is used for self-defense or another lawful purpose such as recreation.²³⁴ The Maryland court found that the long guns in question were likely dangerous and unusual.²³⁵ On appeal, the Fourth Circuit confirmed that these assault weapons were not protected under the Second Amendment.²³⁶

Under the reasoning in *Kolbe*, 3D-printed guns may not yet be considered “in common use,” in which case they would not be protected by the Second Amendment.²³⁷ Printed guns have only been in existence for four years as of this writing,²³⁸ and a significant portion of the population does not yet even own the technology to make them.²³⁹ Because 3D-printed guns are not in common use yet, it may be possible to regulate them under *Heller*’s “dangerous and unusual” exception.²⁴⁰ However, it is not necessarily the weapons themselves that are “unusual.”

230. *See id.* at 627.

231. *See id.* at 629 (discussing that handguns are one of the most popular self-defense weapons in America); *see also* Cook et al., *supra* note 120, at 1062 (stating that under *Heller*, handguns are viewed in light of their popularity, as opposed to machine guns, M-16s, and sawed-off shotguns, which the majority in *Heller* suggested would not be protected regardless of popularity).

232. *See* *Kolbe v. O’Malley*, 42 F. Supp. 3d 768, 788–89 (D. Md. 2014), *aff’d*, 849 F.3d 114 (4th Cir. 2017); Harlan, *supra* note 7, at 28.

233. *See* Harlan, *supra* note 7, at 28.

234. *See* *Kolbe*, 42 F. Supp. 3d at 784–90; Harlan, *supra* note 7, at 28.

235. *See* *Kolbe*, 42 F. Supp. 3d at 788. This court did not reach a final decision as to whether the ban on long guns violated the Second Amendment. *Id.* at 789.

236. *See* *Kolbe v. Hogan*, 849 F.3d 114, 121 (4th Cir. 2017). The Fourth Circuit avoided the question of whether the long guns were considered “dangerous and unusual,” basing its holding on the fact that these assault weapons are most useful in military service. *See id.* at 136–37.

237. *See* Harlan, *supra* note 7, at 31.

238. The first printed gun was made in 2013. *Id.*

239. *See id.*

240. *See id.* at 26.

Although some 3D-printed guns are readily distinguishable from the average store-bought gun, many are exact replicas of traditional firearms,²⁴¹ sharing nearly the same properties, such as their shape, firing power, and muzzle energy.²⁴² Thus, the main unusual—and potentially dangerous—aspect of 3D-printed guns is how they are manufactured. Unlike traditional firearms, which require specialized knowledge to make, 3D-printed guns may be created by completely inexperienced individuals.²⁴³ These individuals may be unfamiliar with the necessary materials and components of the weapon, or even unfamiliar with the operation of the firearm itself. Additionally, many users will likely rely on online CAD files whose sources may not be known or reliable, and whose designs may be flawed. Unfamiliarity with the materials, in addition to potentially flawed blueprints, could lead to catastrophic production safety issues, including guns that misfire or explode.²⁴⁴ These unique consumer safety issues may be able to bring 3D-printed firearms under the purview of the “dangerous and unusual” exception. However, since *Heller*, courts have not addressed whether weapons may be banned solely based on how they are produced.²⁴⁵ Therefore, it is possible that 3D-printed weapons may escape the “dangerous and unusual” exception and receive protection under the Second Amendment. Moreover, if and when 3D-printed guns become widespread,²⁴⁶ they will likely be considered “in common use,”²⁴⁷ particularly since the “in common use” test is not limited to weapons that existed at the time the Second Amendment was ratified.²⁴⁸

241. See McCutcheon, *supra* note 1, at 225–26.

242. See Jensen-Haxel, *supra* note 21, at 488–89.

243. See McCutcheon, *supra* note 1, at 239 (noting that although manufacturing a traditional gun requires “specialized knowledge,” “[t]oday, modern gunsmithing requires only a basic proficiency with computers and Internet access”).

244. See Liz Klimas, *Engineer: Don't Regulate 3D Printed Guns, Regulate Explosive Gun Powder Instead*, THEBLAZE (Feb. 19, 2013, 2:05 PM), <https://www.theblaze.com/news/2013/02/19/engineer-dont-regulate-3d-printed-guns-regulate-explosive-gun-powder-instead> [<https://perma.cc/VG2U-Y7XU>] (discussing one scholar's concern of the dangers that 3D printing firearms poses to hobbyists).

245. See Harlan, *supra* note 7, at 31.

246. It might be nearly impossible to determine at which point printed firearms become widespread. Unlike the long guns in *Kolbe*, it will be difficult to determine how many people actually own 3D-printed firearms, as there are no sales records, licenses, or serial numbers on which to rely. See *Kolbe v. O'Malley*, 42 F. Supp. 3d 768, 785–87 (D. Md. 2014); Harlan, *supra* note 7, at 31. One potential mechanism of establishing widespread use might be to analyze the number of times gun-related digital blueprints are downloaded; however, this seems unreliable as not every download is turned into a fully functioning firearm.

247. See Harlan, *supra* note 7, at 31.

248. See *District of Columbia v. Heller*, 554 U.S. 570, 582 (2008) (“Just as the First Amendment protects modern forms of communications . . . and the Fourth Amendment applies to modern forms of search . . . the Second Amendment extends, *prima facie*, to all

IV. TAKING AIM: ACHIEVING EFFECTIVE LEGISLATION

Printed firearms have the capability to evade federal gun control regulations almost completely.²⁴⁹ Because they can be created in the privacy of one's home, it is nearly impossible to enforce manufacturing, registration, or licensing requirements for such firearms.²⁵⁰ The technology also opens avenues for prohibited classes to print their own weapons, bypassing federally mandated background checks performed for traditional firearms purchases.²⁵¹ Furthermore, the First Amendment likely protects an individual's ability to share CAD files that can be used as blueprints for 3D-printed weapons, prohibiting the government from regulating these files without being subject to the strictest scrutiny.²⁵² Finally, following the Supreme Court's logic in *Heller*, 3D-printed guns are likely protected under the Second Amendment, which protects self-manufactured weapons and firearms that are in common use and not considered dangerous or unusual.²⁵³ In light of all of this, policymakers must tread carefully in attempting to regulate 3D-printed firearms.

A. THE CASE AGAINST REGULATING 3D PRINTING TECHNOLOGY

One possible approach to controlling the illegal possession and use of 3D-printed firearms is to regulate the 3D-printing technology itself. However, it is impractical to regulate any given aspect of 3D printing, as the technology by nature poses concrete challenges that are not easily isolated for effective regulation. Moreover, regulating the technology itself may also prematurely stifle its development, potentially resulting in greater detriment to society than the benefits that such regulation would bring.

As a practical matter, tracking who has 3D printers and what those individuals are printing would be difficult. One example of how the government could track the technology is to develop a system like the one used to uncover counterfeit printing.²⁵⁴ Companies, such as Hewlett-Packard, worked with the government to build a printing system that uses Printer Dots, which are microscopic yellow spots printed onto every document created by

instruments that constitute bearable arms, even those that were not in existence at the time of the founding.”).

249. See *supra* Section III.A.

250. See McCutcheon, *supra* note 1, at 221.

251. See Brady Handgun Violence Prevention Act, Pub. L. No. 103-159, 107 Stat. 1536 (1993) (codified at 18 U.S.C. §§ 921–922) (establishing criminal background checks for traditional firearm transfers).

252. See *supra* Section III.B.1.

253. See *Heller*, 554 U.S. at 624, 627–28.

254. See McCutcheon, *supra* note 1, at 241.

printers that are outfitted with that system.²⁵⁵ These spots provide the printer's serial number and make, so that law enforcement is able to track the document back to its particular printer, and presumably, to the person who printed it.²⁵⁶ However, to implement an effective system like the Printer Dots for 3D printing, manufacturers would need to develop a "spot" for every type of material that could be used in a 3D printer, which is highly impracticable given the abundance of different kinds of materials available for 3D printing.²⁵⁷

Alternatively, regulation could target 3D printing by prohibiting certain types of CAD files, such as firearm-related files. However, as discussed above, CAD files are likely protected under the First Amendment; therefore, any regulation of them must be narrowly tailored, or it will be struck down.²⁵⁸ Furthermore, online file sharing is nearly impossible to control. Although there are mechanisms used to police online postings, such as Content ID systems,²⁵⁹ users may find ways to evade these devices or use piracy websites to share prohibited CAD files.²⁶⁰ Additionally, tech-savvy individuals can manipulate the files to pass legal muster. For example, if firearm-related CAD files are prohibited, a designer could easily change the encryption of the file so that it would not resemble a gun, thereby avoiding restrictions.²⁶¹ Additionally, those skilled in CAD software will be able to altogether avoid regulations on publicly shared CAD files by simply creating their own digital blueprints.

Even if the government could practically regulate 3D-printing technology, doing so would likely stifle the benefits and possible advancements of 3D printing. In the past, the United States has been slow to regulate high-potential technology during the technology's infancy, in significant part because of the economic and social value of giving breathing room to young technological advancements. For example, when the Internet first began to experience widespread usage, the United States took a "hands off" approach to avoid inhibiting its potential.²⁶² In 1997, President Clinton issued an initiative

255. *See id.*

256. *See id.*

257. *See id.* at 241–42.

258. *See supra* Section III.B.1.

259. *See* Blackman, *supra* note 13, at 515.

260. *See* Stephanie Crawford, *How the Pirate Bay Works*, HOWSTUFFWORKS, <https://computer.howstuffworks.com/pirate-bay.htm> [<https://perma.cc/3BPV-YHFM>] (last visited Mar. 12, 2018).

261. *See* Blackman, *supra* note 13, at 516.

262. *See* Adam Thierer, *15 Years On, President Clinton's 5 Principles for Internet Policy Remain the Perfect Paradigm*, FORBES (Feb. 12, 2012, 1:16 PM), www.forbes.com/sites/adamthierer/2012/02/12/15-years-on-president-clintons-5-principles-for-internet-policy-remain-the-perfect-paradigm/ [<https://perma.cc/5X33-CJTZ>] (discussing President Clinton's approaches to Internet policy in 1997).

consisting of “liberty-enhancing” principles to guide the Internet’s governance.²⁶³ His framework favored having the private sector lead the way through self-regulation, and was based on the idea that the Internet should develop in a market-driven arena with limited government involvement.²⁶⁴ He also noted that, due to the Internet’s novelty, regulatory schemes at that time might not have been well-suited for governance and might need to be revised or eliminated altogether.²⁶⁵

In regulating 3D printing, lawmakers must be careful not to inhibit beneficial technological growth,²⁶⁶ which arguably includes smarter weapons manufacturing. Given all the economic and social benefits 3D printing offers overall, it has the potential to overhaul how humans manufacture almost everything and could lead to the next great industrial revolution.²⁶⁷ In order to maximize the benefits of 3D printing, the technology should be broadly accessible so that it may be continually improved upon and advanced by innovators. Engineers, scientists, programmers, and even hobbyists need time to further develop 3D-printing technology in order to realize its full potential.²⁶⁸ Future regulations or bans concentrated on the technology itself may create additional costs, delays, or insurmountable roadblocks for inventors trying to improve the technology.²⁶⁹

Like its approach to the Internet, the United States should allow 3D-printing technology time to advance rather than risk stifling its innovation too greatly, too soon. Accordingly, the technology should be monitored for abuse, but legislative focus should remain on how to better control guns generally.²⁷⁰ The problems surrounding 3D-printed firearms, at least pertaining to their illegal possession and misuse, are best addressed through effective gun control broadly as opposed to regulating 3D-printing technology, CAD files, or 3D-printed firearms specifically.²⁷¹ Severely burdening the use of 3D-printing

263. *See id.*

264. *See id.*

265. *See id.*

266. *See* McCutcheon, *supra* note 1, at 246–47 (discussing the main objectives legislators should consider when regulating 3D-printing technology).

267. *See* Blackman, *supra* note 13, at 483.

268. *See* Jeremy Straub, *Does Regulating Artificial Intelligence Save Humanity or Just Stifle Innovation?*, QUALITY DIG. (Nov. 9, 2017, 1:03 PM), <https://www.qualitydigest.com/inside/innovation-column/does-regulating-artificial-intelligence-save-humanity-or-just-stifle> [<https://perma.cc/TH4J-4D5Z>] (discussing how regulation may stifle technological advancements in the context of artificial intelligence).

269. *See id.*

270. *See* Little, *supra* note 16, at 1509–10 (arguing it is better to find effective gun control measures than severely regulate technology).

271. *See id.*

technology is not only likely to infringe on constitutional rights but is also impractical and against the policy goal of protecting technological innovation, making it an inadequate method for curtailing illegal gun usage.²⁷²

B. REGULATING GUNPOWDER

Currently, the only regulated part of a firearm is its frame.²⁷³ The federal regulatory scheme relies on the ability to control the frame through serial numbers, licensing, and registration.²⁷⁴ Because 3D-printed weapons can be produced at home and therefore bypass all of those requirements, merely regulating a gun's frame will no longer be effective.²⁷⁵ To control the misuse of 3D-printed guns, lawmakers must look beyond the frame and concentrate on other available methods of gun control.

Now, and for the foreseeable future, 3D printers cannot create every single ingredient necessary to simply print, aim, and fire.²⁷⁶ Due to a necessary chemical reaction, printing gunpowder is not yet possible, and likely will be extremely difficult to accomplish.²⁷⁷ Modern ammunition has gunpowder built in, so individuals printing guns have two options for acquiring ammunition: either buy cartridges from local sporting goods stores or purchase gunpowder to insert into printed ammunition. Therefore, the most reasonable way to control 3D-printed firearms is to regulate ammunition. The simplest way to do this is to expand the Brady Bill to encompass ammunition purchases.²⁷⁸ Because most ammunition is pre-loaded with gunpowder, to regulate it effectively, it is necessary to extend the regulation to any purchase of ammunition containing gunpowder or a gunpowder alternative.²⁷⁹

An expanded Brady Bill would require all Federal Firearms Licensees to perform background checks on customers purchasing ammunition, which is defined in the Bill as “ammunition or cartridge cases, primers, bullets, or propellant powder designed for use in any firearm.”²⁸⁰ Alternatively,

272. *See id.* at 1510–11.

273. Jensen-Haxel, *supra* note 21, at 449.

274. *See id.* at 464.

275. *See id.* at 464–65.

276. *See* Little, *supra* note 16, at 1508 (noting that the “most significant limitation” on 3D printing a fully functioning firearm is creating the chemicals needed for an explosive reaction).

277. *See id.*

278. *See* Healey, *supra* note 73, at 3.

279. Bullets work through three main components: the primer, the propellant, and the bullet proper. The primer begins the chemical reaction. The propellant, which holds the gunpowder, is the chemical explosive. The bullet proper is the piece that actually hits the target. Chris Woodford, *Bullets and Missiles*, EXPLAINTHATSTUFF (Sept. 1, 2016), <http://www.explainthatstuff.com/bullets.html> [<https://perma.cc/BBE2-W9YY>].

280. 18 U.S.C. § 921 (2012).

purchasers may provide a qualifying Brady permit, which verifies that the purchaser is not a member of a prohibited class under the GCA and may legally buy ammunition.²⁸¹ Practically, amending the Brady Bill to include ammunition is relatively straightforward.²⁸² For example, the parts of the statute using the term “firearm” could be amended to say “firearm or ammunition.”²⁸³

According to a study performed at Boston University, expanding the Brady Bill to include background checks for the purchase of ammunition is the most effective form of gun control, in addition to background checks for firearm purchases.²⁸⁴ The study estimated that implementing background checks for ammunition purchases would decrease the firearm mortality risk by eighty-two percent.²⁸⁵ To strengthen this impact, the federal government should incentivize states to adopt similar legislation and expand background checks to all ammunition purchases.²⁸⁶

Heller implicitly approved the constitutionality of the current federal firearms regulatory scheme, which includes the Brady Bill. In particular, the Court stated:

[N]othing in our opinion should be taken to cast doubt on longstanding prohibitions on the possession of firearms by felons and the mentally ill, or laws forbidding the carrying of firearms in sensitive places such as schools and government buildings, or laws

281. Brady permits are an alternative to the Brady Bill’s background requirement and are valid for up to five years after issuance. The permit must be valid under the state’s law in which it is issued. For a comprehensive list of each state’s Brady alternative, see *Permanent Brady Permit Chart*, ATF (May 10, 2017), <https://www.atf.gov/rules-and-regulations/permanent-brady-permit-chart> [<https://perma.cc/X726-JLLM>].

282. See Healey, *supra* note 73, at 25–26.

283. See *id.* at 25.

284. See Kalesan et al., *supra* note 115, at 1847–54. The Boston University study analyzed the link between firearm legislation and firearm mortality by looking at state-specific firearm legislation. *Id.* It categorized each state by the type of legislation present in that state and then compared those categories to firearm mortality rates from each state, stratifying for intent (i.e., whether homicide or suicide). *Id.* It also accounted for unemployment, non-firearm homicides, firearm exports, and firearm ownership rates. *Id.* Overall, the study found nine laws that correlate to reduced firearms mortality, with the three strongest being universal background checks for firearms purchases, requiring firearm identification through microstamping or ballistics fingerprinting, and background checks for ammunition. *Id.*

285. *Id.* at 1853.

286. Three states—Illinois, Massachusetts, and New Jersey—currently require a Brady check for ammunition purchases. *Id.* at 1849. In 2015, Massachusetts had the lowest firearm mortality rate out of all fifty states. New Jersey was ranked sixth and Illinois ranked twelfth. *Firearm Mortality by State*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/nchs/pressroom/sosmap/firearm_mortality/firearm.htm [<https://perma.cc/4RJH-7HUG>] (last visited Sept. 26, 2017).

imposing conditions and qualifications on the commercial sale of arms.²⁸⁷

It is therefore extremely likely that if the current federal regulatory scheme were expanded to enforce the same regulations over ammunition, it would be constitutional. By requiring background checks for ammunition purchases, prohibited classes could be effectively blocked from purchasing the necessary ingredients for homemade 3D-printed firearms. However, at the same time, legislators must be careful not to overly restrict access to ammunition.²⁸⁸ The Court has held that restricting the means to exercise an individual right is a violation of that right.²⁸⁹ In *Heller*, the Court solidified an individual's right to bear arms.²⁹⁰ *Heller's* holding would be moot if individuals were completely unable to access the ammunition necessary for firearms to function.²⁹¹

Although the Brady Bill has some loopholes,²⁹² its expansion would be a strong first step in curtailing the illegal possession and misuse of 3D-printed firearms while still safeguarding constitutionally protected rights. Gunpowder is the “unifying material everybody would need,” and without it, a 3D-printed gun would be inoperative.²⁹³ Expanding the Brady Bill to include background checks for ammunition purchases is the most readily available remedy to address the potential problems specifically posed by 3D-printed firearms. Amending the Brady Bill is relatively simple and less invasive for firearms dealers who already have access to the NICS used for firearms purchases. Of course, a black market may still exist for ammunition, and may even grow under an expanded Brady Bill.²⁹⁴ However, stricter regulations in the primary

287. *District of Columbia v. Heller*, 554 U.S. 570, 626–27 (2008).

288. *See* Blackman, *supra* note 13, at 513 (addressing constitutional limitations on regulating ammunition).

289. *See, e.g., Minneapolis Star & Tribune Co. v. Minn. Comm’r of Revenue*, 460 U.S. 575, 591 (1983) (holding that taxing newspaper ink and paper violates the First Amendment’s freedom of the press); *see also* Blackman, *supra* note 13, at 513 (analogizing the tax in *Minneapolis Star & Tribune* to an all-out ban on gunpowder).

290. *Heller*, 554 U.S. at 591.

291. *See* Nicholas J. Johnson, *Administering the Second Amendment: Law, Politics, and Taxonomy*, 50 SANTA CLARA L. REV. 1263, 1265 (2010) (“Even though *Heller* did not explicitly address ammunition, it would eviscerate the right to say that guns are protected but ammunition is not.”).

292. *See* McCutcheon, *supra* note 1, at 231 (discussing the private seller loophole).

293. Robert Beckhusen, *3D Printing Pioneer Wants Government to Restrict Gunpowder, Not Printable Guns*, WIRED (Feb. 19, 2013, 6:30 AM), <https://www.wired.com/2013/02/gunpowder-regulation/> [<https://perma.cc/H2DC-VLZV>].

294. Healey, *supra* note 73, at 23. The state-level study included a cross-sectional analysis of gun control laws and their effect on firearm mortality in the United States. The most effective gun control laws in terms of lowering the firearm mortality rate were universal background checks for firearm purchases, background checks for ammunition, and requiring

market typically lead to higher prices in the secondary market.²⁹⁵ Price increases may act as an additional deterrent to those wanting to purchase ammunition illegally.²⁹⁶

V. CONCLUSION

Self-manufactured, 3D-printed guns present unprecedented legal challenges. The technology potentially enables anyone with a 3D printer to create fully functioning firearms in the privacy of the home, bypassing gun control laws.²⁹⁷ The current regulatory scheme cannot effectively control 3D-printed guns, which are likely protected under the First and Second Amendments.²⁹⁸ In enacting new regulations, it is vital that legislators strike the proper balance between public safety and civil liberties, while taking care not to block beneficial technological innovation. The best approach towards balancing those interests should focus on expanding the Brady Bill to impose safeguards on the purchase of ammunition. Regulating ammunition best comports with the long-standing provisions in federal firearm law broadly, the implicit holdings in *Heller*, and the technological challenges inherent in the advent of 3D-printing.

firearm identification through either microstamping or ballistic fingerprinting. When the results were adjusted to only include the law's effect on homicide rates, the law requiring background checks on ammunition was associated with the greatest reduction in firearm mortality rates. Kalesan, et al., *supra* note 115, at 1848, 1853.

295. See Healey, *supra* note 73, at 23–24.

296. See *id.*

297. See McCutcheon, *supra* note 1, at 221.

298. See *supra* Section III.B.