

Printing Terror: An Empirical Overview of the Use of 3D-Printed Firearms by Right-Wing Extremists

By Yannick Veilleux-Lepage

The last decade has seen a rapid proliferation in the use of 3D-printed firearms by right-wing extremist actors, presenting significant new challenges for law enforcement in countering political violence. This article provides an empirical overview of right-wing extremists' adoption of 3D-printed firearms (3DPF) for political violence using a dataset of 35 incidents worldwide. It analyzes the geographical and temporal spread of 3DPF use by RWE and outlines four main motivations: symbolic and ideological reasons, supplementing conventional firearms, using 3DPF as alternatives when legal acquisition might alert law enforcement, and financing other activities or profiting from sales. The study emphasizes the need for continuous monitoring, enhanced forensic techniques, and international cooperation, in addition to adapting law enforcement strategies and developing policies to address the evolving threats posed by 3DPF. As such, it provides an empirical foundation for further research and policy development into extremist use of 3D-printed firearms.

On May 5, 2013, Defense Distributed, an open-source nonprofit organization dedicated to the development of firearms, released the digital files for the Liberator, the world's first almost entirely 3D-printed firearm (3DPF). This .380 ACP pistol, assembled from 15 printable parts and a common nail serving as the firing pin, was made available online for public download. The release resulted in over 100,000 downloads in just two days, causing alarm about the potential untraceability of 3D-printed firearms and their potential misuse. Less than a week after the file release, two journalists from the British tabloid *The Mail on Sunday* purchased a £1700 CubeX 3D printer, printed the Liberator's 15 parts, and 'smuggled' them onto a Eurostar train departing from St Pancras International Station. This stunt prompted experts to call for a review of security procedures at airports and public buildings to account for this new threat.¹ Among those to weigh in was Lord

Alan West, a former Labour security minister, who called the Liberator "extremely dangerous because they are very difficult to detect" and warned that "this is going to be a real problem."² Several media outlets and politicians reporting on *The Mail on Sunday's* 'experiment' also raised the specter that such weapons could be used to bypass metal detectors in airports and to hijack planes.³ Some went as far as suggesting that this technological development could leave critical infrastructure vulnerable to a repetition of the terrors of 9/11. In Israel in 2013, staff of a Channel 10 TV show attempted a similar act by smuggling an assembled Liberator into the Israeli parliament.⁴ In reporting on the incident, NBC News mistakenly referred to the Liberator as a "semiautomatic" pistol and urged their readers to consider scenarios in which "an actual assassin" smuggled such a firearm into the Israeli parliament or "in the same room as [then-serving] President Barack Obama."⁵

In the decade since the Liberator's introduction, while the feared scenario of individuals using 3D-printed firearms for high-profile political assassinations or hijacking trains and planes has not materialized, extremists and terrorist groups, particularly right-wing extremists (RWE), have shown a growing interest in this technology. Concurrently, 3D-printed firearms have improved significantly in design, reliability, and effectiveness.

Utilizing a proprietary dataset of actual or disrupted plots involving 3DPF by RWE actors, this article provides an empirical overview of the motivations and methods behind RWE's adoption of this emerging technology for political violence. Against the pervasive tendency to engage in hypothetical discussions about the misuse of emerging technologies such as additive manufacturing and 3D-printed firearms, this article seeks to assess the current threat posed by the use of 3DPF, drawing from empirical data. By surveying 35 incidents worldwide, this study provides an overview of the geographical and temporal spread of this technology's use by RWE, along with an in-depth description of the four overarching motivations behind the adoption of this technology. These motivations range from symbolic and ideological reasons, where the desire to acquire or manufacture a 3DPF exceeds its material benefits and instead is viewed through ideological lenses, to a means of complementing stocks of conventional firearms. Additionally, they encompass use as an alternative to conventional firearms when acquiring them legally might alert law enforcement, and lastly, as a means of financing other activities or simply profiting by selling firearms within an extremist milieu.

The objective of this exploratory study is to offer a data-driven foundation for further theoretical and comparative research on the topic, along with a starting point for legislative and law-enforcement responses to this growing threat. To do so, this article begins by surveying the history of privately manufactured firearms and additive manufacturing, the two technologies whose convergence has enabled the proliferation of 3DPF. In doing so, it is argued that while terrorist and criminal groups have a long

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history of manufacturing firearms, additive manufacturing has significantly lowered the cost and skill necessary for production, to the point that 3DPF can rival commercially manufactured firearms in terms of accuracy, durability, and reliability. The following section of the paper describes the processes by which a dataset of worldwide incidents of RWE actors seeking to leverage 3DPF was compiled. This dataset forms the basis for both temporal and geographical analysis of the phenomenon, showing that since 2017, incidents of RWE actors attempting to manufacture or acquire 3DPF have grown at a concerning rate and have been observed in 18 countries. Finally, this paper outlines the four main motivations to acquire or manufacture 3DPF as expressed in the incidents in the database: for symbolic and ideological purposes, to supplement existing conventional firearm supplies, to use them as alternatives to conventional firearms when unavailable or when legal acquisition could alert law enforcement, and as a means to finance other activities.

The Technological Dimensions

Privately Manufactured Firearms

The use of privately manufactured firearms (PMF) by violent non-state actors long predates the emergence of additive manufacturing technologies (a process described in the next section). As such, “3D-printing technologies do not necessarily represent a true paradigmatic shift in the ability of non-state actors to manufacture firearms.”⁶ At their core, firearms are straightforward technologies that do not present particularly difficult manufacturing challenges. All firearms work by expelling projectiles through a controlled explosion of a propellant charge. In its simplest configuration, a firearm is comprised of three main components: a barrel, an ignition mechanism for the propellant, and a projectile. This crude typology applies equally to the first kind of small arms, which emerged in the 17th century in the form of a smooth bore muzzleloader using matchlock ignition mechanism, to modern day semi-automatic and automatic firearms that utilize advanced mechanisms to achieve rapid firing. Consequently, individuals, including violent non-state groups, through straightforward research and with basic tools and materials have long been capable of successfully producing functional homemade firearms.

During the Second World War, different theaters made use of a wide range of PMF. Resistance groups fighting the German occupation found relative success in quickly and cheaply reproducing the British Sten submachine guns. Notably, the Polish resistance widely produced the Blyskawica submachine gun in an underground workshop in Warsaw.⁷ In the Pacific theater, several groups fighting the Japanese occupation created a series of highly effective and easily manufactured shotguns known as the Paltik or Sumpak, which consisted of no more than two pieces of pipe and an end cap with a nail affixed in the middle.⁸ This basic design (often referred to as a ‘slam-fire shotgun’ or ‘slam gun’) remains one of the most common PMF designs in the world.

During the Troubles in Northern Ireland, the (P)IRA produced crude, yet fully functional weapons such as .22LR revolvers, pen guns, and improvised shotguns to supplement their cache of conventional firearms imported from the United States, Canada, and the Middle East.⁹ Loyalist paramilitary groups, for their part, lacking sophisticated weapon smuggling networks, sought to create their own improvised firearms, including the ‘Avenger’ submachine gun based on the German MP28.¹⁰ In South America, various

insurgent groups, including the Maoist People’s Revolutionary Army in Argentina, manufactured approximately 5,000 replicas of the Swedish Carl Gustaf M/45,¹¹ and the Colombia FARC produced its own version of the Sten Gun and Mac-10s. During the Chechen Wars, “Boaz” submachine guns, named after the Chechen word for “Wolf,” were widely produced. These weapons, costing about \$100 each to produce in secret workshops, were basic yet functional enough to ambush police and military forces, with the aim of acquiring high-quality, factory-produced firearms from downed foes.¹² More recently, Israeli Defense Forces have seized a substantial amount of “Carlos” improvised submachine guns also modeled after the Swedish Carl Gustaf M/45 and its variants.¹³ These firearms have been used during several deadly attacks against Israeli law enforcement.¹⁴ Additionally, faced with international sanctions and arms embargoes, Hamas and other Palestinian terrorist organizations have produced various privately manufactured weapons, including a “high-quality copy of the Soviet RPG-2 shoulder-fired recoilless weapon.”¹⁵ The Syrian and Libyan civil wars have also seen a variety of groups crafting a broad spectrum of makeshift weapons,¹⁶ from simple to highly sophisticated, including anti-material rifles.¹⁶

Likewise, criminals, including criminal organizations, have a long history of manufacturing or acquiring improvised firearms for reasons ranging from limited funds or access to conventional firearms, to the desire for a weapon that is difficult to trace or easier to conceal. According to a 2018 report on privately manufactured firearms, such firearms accounted for roughly 80 percent of firearms used during the commission of a crime in the United Kingdom between 2011 and 2012.¹⁷ The same report highlighted that in 2014, PMF, often of low quality, constituted at least 10 percent of firearms confiscated during serious crime investigations in New South Wales, Australia.¹⁸ In the United States, Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) data suggests a notable increase in privately manufactured firearms recovered by law enforcement agencies—increasing by 157 percent, from 7,517 in 2019 to 19,344 in 2021.¹⁹

PMF are not solely the domain of criminals or terrorists. They also attract firearm enthusiasts and hobbyists, who explore this activity both within and beyond legal boundaries. Since the 1960s, for instance, some newsletter publishers have reworked unclassified U.S. Army manuals into detailed guides for making such weapons. They have produced instructions on constructing items such as inexpensive submachine guns from hardware store supplies or crafting makeshift shotguns similar to the “paltik” or “sumpak.”²⁰ More recently, Philip A. Luty, a British designer of homemade firearms and advocate for universal firearm ownership, sought to widely disseminate a how-to book.²¹ This publication remains

a The “Carlos” submachine gun has been reportedly used in several attacks in Israel. Notably, it was used on February 3, 2016, against an Israeli Border Police officer. On June 8, 2016, during the Tel Aviv shooting, two Palestinian gunmen killed four Israelis using Carlos firearms. The weapon appeared again on March 14, 2016, in Hebron, targeting Israeli troops, and on July 14, 2017, three Arab-Israeli terrorists used Carlos submachine guns on Temple Mount, resulting in the deaths of two Israeli policemen. Judah Ari Gross, “Police Chief Confirms Two Officers Killed in Temple Mount Shooting,” *Times of Israel*, July 14, 2017; Peter Beaumont, “Homemade Guns Used in Palestinian Attacks on Israelis,” *Guardian*, March 14, 2016; Jack Moore, “‘Carlo’ Gun Weapon of Choice for Palestinian Attackers,” *Newsweek*, June 11, 2016; Judah Ari Gross, “Say Hello to ‘Carlo,’ the Cheap, Lethal Go-to Gun for Terrorists,” *Times of Israel*, March 16, 2016.

widely available on the internet and has inspired numerous copycat designs. Many other books, magazine articles, and printed publications containing instructions for the manufacture of improvised firearms have been digitized and are also readily available online. Moreover, several hobbyists in the United States, where creating such firearms is usually lawful, maintain detailed social media profiles. They frequently post about their processes and techniques, which range from Computer Numerical Control (CNC) milling to casting to 3D-printing, sharing their expertise in manufacturing improvised firearms.

Additive Technologies

3D-printing is a form of additive technology. It refers to the construction of three-dimensional objects by adding minute amounts of material in layers. Originally, 3D-printing machines were used for rapid prototyping to create plastic mock-ups in the 1980s, but in the 20 years following their introduction, 3D printers have gained increasingly sophisticated capabilities and are now frequently used for final production purposes. Importantly, several patents central to this technology have expired in the last decade, leading to a proliferation of high-quality consumer 3D printers at affordable prices.²² The most common 3D-printer technology uses thermoplastic filament and is called Fused Deposition Modeling (FDM). FDM incorporates four essential components: (1) the 3D-model file; (2) the slicing software; (3) the 3D printer itself; (4) and the printing material, a thermoplastic.

3D-model files are digital representations of three-dimensional objects. These files serve as blueprints that can be manipulated and visualized in 3D-modeling software, and are crucial in the process of 3D-printing, where they act as the source from which physical objects are created layer by layer. 3D models can be created using a computer-aided design (CAD) package, expensive 3D scanners, or even with a digital camera or smartphone combined with photogrammetry software.²³ However, most hobbyists will use 3D-model files from online repositories that offer a wide array of models, ranging from simple household items to complex mechanical parts. These online repositories foster vibrant communities of creators and makers, where users can share experiences, provide feedback, and find inspiration.

Slicing software acts as the intermediary between the 3D-model file and the actual 3D printer. This software takes the digital 3D-model and ‘slices’ it into a series of thin, horizontal layers, essentially translating the 3D-model file into a format that the 3D printer can understand and execute. Slicing software provides various key functionalities, such as determining the thickness of each layer, that influences the printer’s resolution, accuracy, and speed. Slicer software is typically included with the purchase of a commercial 3D printer; however, there are numerous third-party options available for free or purchase, offering users enhanced customization capabilities.

The 3D printer is the central device in the 3D-printing process, where digital designs become tangible objects. It reads the G-code file generated by the slicing software and precisely builds the object layer by layer. Each type of 3D printer has its own set of capabilities and limitations, influencing the resolution, strength, and appearance of the printed object. Good-quality, entry-level models are available for a few hundred dollars, while professional-grade printers can cost several thousand dollars.

The filament used in 3D-printing serves as the raw material

for creating physical objects layer by layer through the additive manufacturing process. Different filaments exhibit unique properties, such as strength, flexibility, durability, and aesthetic appearance, depending on their composition, enabling users to choose the most suitable filament for their specific application.

3D-Printed Firearms

In the decade since the release of the digital files for the Liberator, several communities aimed at pursuing the development of 3D-printed firearm blueprints, in whole or in parts, have emerged. This provides a digital ecosystem where designers, publishers, manufacturers, and end users of 3D-printed firearms can collaborate, test, and release new and improved 3DPF files and blueprints, navigating and communicating across multiple platforms on the internet. According to a recent study, there are more than 2,100 different 3DPF plans readily available online.²⁴

3D-printed firearms are typically classified—according to a typology developed by Armament Research Services (ARES)—into one of three categories: fully 3D-printed (F3DP), hybrids, and Parts Kit Completions/Conversions (PKC).²⁵ However, it is worth noting that experts can disagree on whether a firearm belongs in the F3DP or hybrid category as both these categories may overlap slightly.²⁶

Fully 3D-printed firearms are primarily composed of 3D-printed components, although they always incorporate some non-printed elements, such as nails for firing pins or elastic bands for powering certain parts. These firearms, including the Liberator, PM422 Songbird, PM522 Washbear, Marvel Revolver, and Grizzly, are generally considered less reliable and less durable than conventional firearms.²⁷

Hybrid 3D-printed firearms incorporate 3D-printed components with readily available and unregulated components such as steel tubing, metal bar stocks, and springs that are designed to withstand the pressure of a discharge more efficiently and thus generally make for a more reliable and durable firearm. These firearms are designed to perform comparably to conventional weapons and can incorporate standard unregulated firearm components such as magazines or optical devices. Hybrid 3D-printed firearms are particularly popular in regions with stricter gun control, as they can be made without conventional firearm parts and are capable of firing modern ammunition types.

Arguably the most popular model of hybrid 3D-printed firearms is the FGC-9 (“F**k Gun Control 9mm”^b) and its variants. The FGC-9 is a semi-automatic pistol-caliber carbine designed by Jacob Duygu, under the pseudonym JStark1809.²⁸ Its design is based on an earlier 3D-printed gun—the Shutty AP-9, designed by “Derwood”—and heralded as a major improvement. Whereas the Shutty AP-9 relies on several factory-made or extensively machined parts (such as the barrel) that pose a challenge to would-be builders in jurisdictions that regulate and restrict such components or those without access to a machining workshop, none of the FGC-9 components are regulated in Europe. The approximately 20 percent of the design that is made of metal (comprising the pressure-bearing parts such as the bolt and barrel) can be fashioned from readily available material sourced from a hardware store.²⁹ Unlike most other instructional guides for 3DPF, the FGC-9 was explicitly designed with non-American audiences in mind; the meticulous

b The name of the gun has been censored by this publication.

step-by-step instructional guide uses the metric standard.

Parts Kit Completions/Conversions (PKC) are firearms that consist of a 3D-printed receiver or frame^c that is then assembled with components from conventional firearms. PKC are the most reliable type of firearms that use 3D-printed parts. However, unlike hybrid 3D-printed firearms, PKC are often more expensive and involve parts that might be restricted by law in many jurisdictions. However, PKC firearms are popular in the United States due to the unique regulatory framework surrounding firearm manufacture and ownership. In the United States, the receiver of a firearm is typically the only part that is serialized and legally defined as the firearm itself. Therefore, individuals can, without the need of purchasing a serialized part, assemble a firearm by manufacturing their own receivers using a 3D printer or by purchasing unfinished receivers, also known as “80 percent” receivers, and finishing them themselves. They can then legally acquire, with little to no scrutiny, “all parts” kits, which include all necessary components except the receiver. These kits often consist of parts from firearms slated for destruction by law enforcement but stripped before the receiver is destroyed.³⁰

3D-printing technology has also been used to manufacture firearm accessories, the legality of which may vary by jurisdiction. Popular among these are Drop-In Auto Sears and Glock auto-sears or “switch,” which enable a semi-automatic firearm to fire in fully automatic mode. Additionally, designs for suppressors, sometimes disguised as everyday items such as vases or YETI cups, can be found on digital repositories.³¹ Other readily available plans include magazines and magazine extensions, muzzle devices, and grips.

Approach and Dataset

Methodology

To understand how RWE actors have sought to leverage 3DPF, this article utilizes an inductive crime script analysis.³² Crime script analysis identifies specific stages and actions within the commission of a crime, from preparation to aftermath. By detailing these steps, a better understanding of criminal or terrorist behaviors, including the decision-making process and the vulnerabilities in the environment that facilitate the crime, can be gleaned.³³ This detailed breakdown also helps in identifying potential intervention points where actions can be taken to prevent the crime from occurring, disrupt the crime process, or reduce its impact. Crime script analysis has been most readily applied to cyber,³⁴ corruption and fraud,³⁵ and crimes of a sexual nature.³⁶ However, an emerging body of research has sought to apply this approach to terrorist tactics, including airplane hijacking³⁷ and vehicle ramming attacks,³⁸ as well as the general *modus operandi* of extremists.³⁹

This integrated approach is designed to uncover the operational steps, patterns, motivations, and tactical decision-making processes behind the adoption and use of 3DPF in extremist activities. This methodology hinges on an integrated analysis where the procedural mapping of crime script analysis is enriched by the inductive, emergent nature of grounded theory. By blending these approaches, this article systematically dissects the sequences of actions from acquiring 3D-printing technology to executing violent acts, while

simultaneously allowing for the emergence of new insights directly from the data. This methodological synergy facilitates a deeper understanding of the complex dynamics at play in the utilization of 3DPF by right-wing extremists.

Data

This article is based on the collection and systematic review of incidents of actualized or disrupted plots involving 3DPF by RWE actors worldwide.^d To qualify for inclusion in the dataset, an incident must satisfy two criteria: (1) a clear intent to utilize advanced 3D-printing technology for the creation of firearms or firearm accessories, ranging from possession of CAD designs (which may be illegal in some jurisdictions) to the actual manufacturing and intended use of these firearms, including cases where a well-developed plot is either thwarted or realized, and (2) the manufacturing of these firearms must be motivated by right-wing ideology.^e To construct this dataset, a formalized codebook was created and each incident of RWE use of 3DPF was coded based on the following elements:

- Date and Location of the Incident:
 - » Date: The exact date when the incident occurred.
 - » Location: Detailed geographical information including city, state/province, and country.
- Summary of the Incident, Including Motivations and Intended Use:
 - » Brief Description: A concise overview of what happened during the incident.
 - » Context and Background: Any relevant background information leading up to the incident. Information about the possession of conventional firearms or explosive devices is included in this field.
 - » Motivations: The ideological or personal motivations behind the incident, as understood from statements, manifestos, or investigations. In addition, information about other extremist activities undertaken by the

d It is worth noting that extremist groups linked to other ideologies have sought to leverage 3DPF. For example, on two occasions, dissident republican paramilitary groups in Northern Ireland have been observed with 3DPF. In April 2022, a member of Óglaigh na hÉireann (ÓNH) attending an Easter Sunday commemoration read a statement while two other members brandished FGC-22s (a .22 caliber version of the FGC-9). More recently, in February 2024, masked men in West Belfast were filmed firing a volley of shots using 3DPF as a tribute to a recently deceased former IRA prisoner, Sean McKinley. John Mooney, “Security Services Investigate 3D-Printed Gun at Republican Event,” *Times*, April 27, 2022; Allison Morris, “Masked Men Fire 3D-Printed Weapons in Tribute to Former IRA Prisoner Who Featured in Troubles Doc,” *Belfast Telegraph*, February 6, 2024.

e The author’s understanding of “right-wing beliefs” is informed by the Right-Wing Terrorism and Violence (RTV) dataset, indicating beliefs rooted in anti-egalitarianism. This ideology sees social inequality as natural or desirable, often grounded in the superiority of certain races, ethnicities, or genders. It is encompassed within a wider far-right ideology that includes exclusionary nationalism and authoritarianism, targeting various social and political groups as enemies. This framework underpins violence against minorities and liberal-democratic institutions, fueled by racism and conspiratorial thinking. The Right-Wing Terrorism and Violence (RTV) dataset is compiled every year by research assistants working at the Center for Research on Extremism (C-REX) at the University of Oslo. It systematically documents severe right-wing attacks and attack plots in 18 Western European countries, since 1990. Jacob Aasland Ravndal, Charlotte Tandberg, Simone Sessolo, Anders Ravik Jupskås, and Tore Bjørgo, “RTV Trend Report 2023,” University of Oslo, 2023.

c The frame or receiver is the part of the firearm that integrates other components by providing housing for internal action components and has threaded interfaces for externally attaching components.

perpetrators or the presence of right-wing extremist material is included in this field.

- » Intended Use: The specific purpose for which the 3DPF was used or intended to be used during, based on law enforcement accounts, court filings, or statements made by the perpetrators.
- Name(s) of the Perpetrator(s):
 - » Identification: Full names of the individuals involved. In cases where names are protected or not released, relevant descriptors were used (e.g., “unidentified male/female, age XX”).
 - » Affiliations: Associations with specific RWE groups or movements, if known.
 - » Background: A background of the perpetrator(s) that might be relevant to understanding the incident, including prior criminal records, if applicable.
- Technical Information:
 - » Model/Type of Firearm(s): The specific type or model of the 3D-printed firearm. Including information about the number of 3D-printed firearms involved.
 - » Printer Model: If known, the make and model of the 3D printer utilized for creating the firearm or found in the possession of the perpetrator.
- Information on Prosecution:
 - » Detailed account of the legal proceedings following the incident, including charges filed, court dates, and outcomes.

The dataset covers incidents from January 2017 to June 1, 2024, and was compiled through daily reviews of newspaper articles in French, English, German, Italian, Spanish, and Dutch. It was enriched with court records, law enforcement documents, governmental reports, as well as literature from NGOs, arms watch organizations, and scholars. Wherever possible, primary sources such as manifestos, interview transcripts, and online activities of the perpetrators were examined to gain deeper insights into their motives.

Limitations

Quantitative data on any type of firearm seizures is notoriously difficult to collect or obtain for a myriad of factors: varied reporting standards, underreporting, lack of centralized datasets, and variation in police activity frameworks. Data on 3D-printed firearms is exponentially more difficult to obtain due to issues of misidentification and lack of reporting. 3D-printed firearms are not always recognized as such by those who encounter them. Unlike traditional firearms, which have specific recognizable components and markings (such as serial numbers), 3D-printed firearms often lack these identifiers. This can lead to them being mistaken for toys, replicas, or not identified as firearms at all. Additionally, even when these items are uncovered or seized, the unique and novel nature of 3D-printed firearms means they might not be systematically categorized by law enforcement or reported by the media in a manner that highlights their method of manufacture.

These limitations are particularly well highlighted in the case of Steven Carrillo. In late May and early June 2020, U.S. Air Force Sergeant Steven Carrillo, associated with the Boogaloo movement, a loosely organized American right-wing anti-government

extremist group,^f conducted two ambush-style attacks against security personnel and law enforcement officers in California.⁴⁰ The attacks resulted in the death of two and injured three others. In November 2020, Timothy Watson, a resident of West Virginia, was arrested and later convicted of selling more than 600 3D-printed drop-in auto-sears online. The criminal complaint against Watson revealed Carrillo was among his customers.⁴¹ However, neither court documents for Carrillo or Watson nor media reports specify whether Carrillo used a firearm modified with one of Watson's 3D-printed auto-sears for his deadly attack. Therefore, while Watson is included in the dataset, Carrillo is not.

Additionally, three potential incidents involving the possession of 3DPF with the intent to commit a politically motivated attack were excluded due to the unclear nature of the ideology, and doubts remained as to whether they were motivated by right-wing extremist ideas or linked to another ideology. These are:

- 2024, United States: Two brothers, Andrew Hatziagelis and Angelo Hatziagelis, were indicted on 130 counts of criminal possession of a weapon and related charges following the discovery of an arsenal that included improvised explosive devices and privately manufactured firearms. Inside an Astoria apartment, authorities found two loaded 9mm semiautomatic 3D-printed pistols. A “hit list” targeting “cops, judges, politicians, celebrities, and banker scum” was also uncovered during a search of the residence.⁴²
- 2024, England: Jacob Graham, a 20-year-old man from Liverpool, was found guilty of preparing acts of terrorism, including the possession of documents useful for terrorism and files to create 3D-printed firearms. In a document titled “My Plan,” Graham articulated his desire to kill at least 50 people by attacking government buildings and the homes of politicians. He purchased several chemicals online and conducted experiments in his backyard before burying some of the ingredients. Police also seized a small pipe bomb and an Ender 3D printer. Graham described himself as “left-wing” but clarified that he was “more like an anarchist,” expressing his disdain for centralized control and monarchy. He supported the Green Party and advocated for environmentalism.⁴³ This led several media outlets to label him a “left-wing” terrorist, although some scholars have suggested his ideology might be more accurately described as anti-statism or possibly eco-fascism.⁴⁴
- 2024, United States: Wayne Brunner, a 27-year-old resident of Herkimer, New York, was arrested following a welfare check when police discovered weapons including three handguns with 3D-printed receivers and “materials expressing extremist views.”⁴⁵ However, police have not yet specified the exact nature of this material.

^f According to the Center for Strategic & International Studies, “The Boogaloo movement is a decentralized ideological network that believes in a coming second U.S. civil war—referred to as the ‘boogaloo’—and espouses anti-government and anti-law enforcement rhetoric. While some Boogaloo adherents promote white supremacist beliefs, others have provided security for and demonstrated alongside racial justice protesters, making the movement difficult to classify along traditional political lines.” Jared Thompson, “Examining Extremism: The Boogaloo Movement,” Center for Strategic & International Studies, June 30, 2021. For more on the Boogaloo movement, see Matthew Kriner and Jon Lewis, “The Evolution of the Boogaloo Movement,” *CTC Sentinel* 14:2 (2021).



*A man wields a 3D-printed FGC-9 near Auburn, Alabama, on February 10, 2022.
(Collin Mayfield/Sipa USA via AP Images)*

At times, there is also a significant time lag between announcements of arrests related to 3DPF and confirmation that the underlying motivation was right-wing extremist ideas or linked to another ideology. This is perhaps best exemplified in the case of Artem Vasilyev, a man from Adelaide, Australia, arrested in September 2021.⁴⁶ Following a raid on his mother's house, police discovered conventional firearms and an FGC-9 manufactured by Vasilyev. At the time of his arrest, police alleged that Vasilyev intended to attack an Adelaide Hills electrical substation.⁴⁷ However, the ideological nature of the plot was not made public until his trial in May 2024, when prosecutors asserted that his intention was to advance the ideological cause of white nationalism.⁴⁸ The trial also revealed more information that led to the inclusion of Vasilyev in the dataset, namely that Vasilyev had several Telegram accounts, including one named Panzer, which he used to send 108 PDF files containing extremism material to an account named Vlad. These included handbooks on chemicals, explosives, warfare, and white ethnic societies. In addition, his phone contained a montage of images from the 2019 Christchurch mosque massacre and a copy of the body camera video footage the perpetrator, Brenton Tarrant, uploaded to the internet.⁴⁹

Findings

The dataset encompassing incidents from January 2017 to June 2024 includes a total of 35 documented cases involving 3DPF linked to right-wing extremists. The majority of these incidents, totaling 22 cases, involve attempts to manufacture or acquire 3D-printed firearms, highlighting a significant engagement in the actual creation of such weapons. Additionally, there are 12 incidents categorized under the possession of 3DPF files only, indicating

cases where individuals held digital blueprints or other necessary files for producing firearms but did not proceed to manufacture before arrest.

Temporal Trends

The dataset details a concerning growth in 3DPF RWE cases. Beginning with just one incident in 2017, the count remained at one case until 2019. By 2020, the number of incidents rose to four, signaling a noticeable uptick in the adoption of 3DPF for violent purposes. The trend continued to escalate in 2021 with eight cases recorded, reflecting ongoing interest among right-wing extremists in 3DPF. In 2022, eight cases were documented showcasing the persistent appeal of this technology. The peak of this trend was observed in 2023 with 11 documented cases. Two cases have been recorded so far in 2024, as of June 1. Figure 1 provides both the annual and cumulative RWE-related incidents involving 3D-printed firearms from 2017 to 2023.

This growth appears to correspond roughly to the increase in overall cases of 3DPF seizures observed in several jurisdictions worldwide. While comprehensive data on 3DPF is extremely difficult to obtain, some publicly available data paints a concerning picture. For example, in Ontario, Canada, the number of privately made firearms submitted to the Firearms Analysis and Tracing Enforcement Program, which is part of the Criminal Intelligence Service of Ontario, increased from five in 2020, to 51 in 2021, 63 in 2022, and 213 in 2023.⁵⁰ In other jurisdictions, similar trends have been observed.⁵¹ A Canadian criminal lawyer—in a private conversation with the author of this article discussing the exponential growth reflected in the police data regarding seizures of 3DPF among criminals—speculatively likened it to Moore's Law.

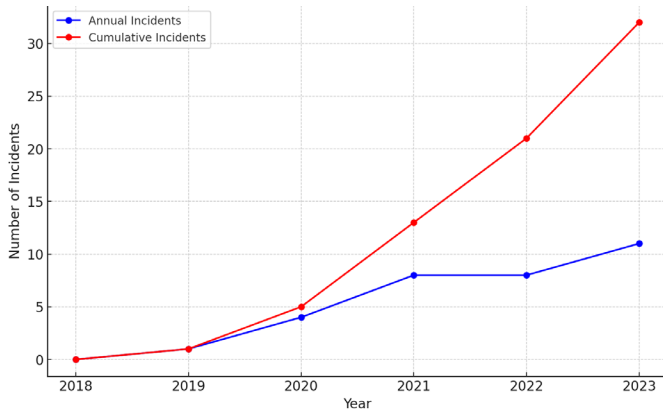


Figure 1: Annual and cumulative RWE-related incidents involving 3DPF

Moore's Law states that the number of transistors on a microchip doubles approximately every two years, while the cost of computers is halved, thus suggesting that the prevalence of 3D-printed firearms is increasing at a similarly rapid pace, potentially doubling in prevalence over short periods of time.

Geographical Distribution

While the 3D-printed firearm community is largely located in the United States, its reach is global. In recent years, 3D-printed firearms have been confiscated by law enforcement in every part of the world.⁵² Similarly, the use of 3D-printed firearms by right-wing extremists has occurred in a multitude of countries, and sometimes involving transnational networks. Table 1 provides a breakdown of cases by country.

Table 1: Geographical breakdown of RWE-related incidents involving 3DPF

Country	Number of Incidents
United Kingdom	9
Australia	3
Germany	3
United States	3
Belgium	2
Italy	2
Netherlands	2
Brazil	1
Canada	1
Croatia	1
Finland	1
Iceland	1
Ireland	1
Lithuania	1
Romania	1
Slovakia	1
Spain	1
Sweden	1
Total	35

The United Kingdom has recorded the highest number of cases involving 3D-printed firearms used by right-wing extremists, with nine out of 35 cases (approximately 26 percent) from January 2017 to June 2024. This trend in the United Kingdom might be attributed to the 'weapon substitution hypothesis,' a concept from homicide and suicide studies suggesting that when access to one method is restricted, individuals may switch to alternative methods.⁵³ This pattern is particularly noted in environments with strict firearm regulations and low household firearm ownership, where an increase in non-firearm suicides has been observed.⁵⁴ Within the literature on PMF, it is widely recognized that a similar phenomenon applies, where individuals unable to acquire conventional firearms might seek privately manufactured firearms.

Using the same logic, a potentially satisfactory explanation for the high concentration of 3D-printed firearm incidents with an extremist RWE in the United Kingdom could be linked to the strict firearm control legislation in the United Kingdom. Indeed, following the 1987 Hungerford massacre and the 1996 Dunblane school massacre, the United Kingdom, despite its longstanding traditions of hunting and competitive target shooting, has implemented some of the strictest gun control legislation in the world, including a near-total ban on handguns.⁵⁵

However, a qualitative dive into the details of the nine U.K.-based cases paints a slightly more nuanced picture. Six out of the nine cases in the United Kingdom involved physical attempts to manufacture a 3D-printed firearm; the remaining cases focused solely on the possession or distribution of files related to the manufacturing of 3D-printed firearms. In the United Kingdom, the possession of such files can fall afoul of legislation on the 'possession of material for terrorist purposes' under section 57 of the Terrorism Act 2000,⁵⁶ which specifies that:

(1) *A person commits an offence if he possesses an article in circumstances which give rise to a reasonable suspicion that his possession is for a purpose connected with the commission, preparation or instigation of an act of terrorism.*

In fact, it appears that crown prosecutors in the United Kingdom are very willing to use (and successful in doing so) this piece of the Terrorism Act to prosecute the possession of 3D-printed firearm files in cases where there is an ideological angle present, which could partly account for the disproportionate number of U.K. cases. In a notable case among six physical attempts to produce a 3D-printed firearm, Daniel John Harris, a British man whose online videos were praised by Buffalo shooter Payton S. Gendron, was found guilty of five counts of encouraging terrorism and one count of possessing materials for terrorist purposes. His conviction came despite his failure to successfully manufacture anything resembling a firearm.⁵⁷

As will be discussed in the subsequent section, the weapon substitution hypothesis itself is not a sufficient explanation for why individuals may seek to produce 3DPF; in numerous cases, 3DPF appear to be used or planned to be used in conjunction with traditional firearms, as opposed to being an alternative to traditional firearms.

In addition to the overrepresentation of U.K. cases, the second noteworthy aspect of the worldwide distribution of cases is the existence of transnational networks uncovered during the course of disrupting RWE plots involving 3DPF. Out of the 35 cases, 11 involved clear transnational elements. This is perhaps best illustrated by a series of arrests that took place in November

2023 in relation to a transnational right-wing extremists network operating in Belgium, Croatia, Germany, Lithuania, Romania, and Italy, which saw five individuals arrested and seven others interrogated for participating in terrorist-related activities online, including the dissemination of violent extremist propaganda, the active recruitment of new members, and the sharing of manuals for 3D-printed weapons.⁵⁸ According to Europol, the suspects had written their own manifestos in preparation for attacks and had access to weapons. No information is currently available as to whether these weapons were 3D-printed firearms.⁵⁹

Other transnational links in the cases surveyed ranged from planning to commit an attack using 3DPF in a foreign jurisdiction,⁶⁰ importing parts for the fabrication of 3DPF,⁶¹ fleeing to a foreign jurisdiction following an arrest related to the illegal production of 3DPF,⁶² and involvement in the production or distribution of RWE material online.⁶³ Additionally, in some cases, the arrest came as a result of information shared by a foreign police service.⁶⁴

The existence of a high number of transnational elements within the cases surveyed can be explained by two factors: first, the inherently transnational nature of right-wing extremism, which can be attributed primarily to the globalization of its ideological components and the digital era's facilitation of cross-border connections.⁶⁵ This form of extremism does not exist in isolation within any single country but is part of a broader, but still diverse, international movement that shares core beliefs. Second, the 3DPF community itself is inherently transnational. The discrepancies between legal frameworks governing 3DPF production and possession—combined with the ease of sharing knowledge online—creates particular challenges for the governance and regulation of such activities. In particular, the majority of online 3DPF communities operate lawfully in the United States, under the context of the highly permissive Second Amendment protections afforded by the U.S. Constitution. This digital community, which has assembled on Discord servers, dedicated subreddits, and different social media platforms, is largely characterized by its engagement with the broader maker culture, which values innovation, open-source sharing, and the DIY (do-it-yourself) ethos. The community is primarily composed of hobbyists, technology enthusiasts (both in firearm technologies and 3D-printing technologies), and advocates for gun rights, many of whom are concerned about exercising their Second Amendment rights. Nonetheless, hobbyist communities have a long history of being tapped for technological information by nefarious actors beyond national borders.⁶⁶ For example, in 2002, a Lashkar-e-Taiba operative sought a technological solution to increase the range of a drone the group was attempting to procure by asking a series of questions on an internet forum for remote control toy enthusiasts called RCuniverse.com.⁶⁷ With regard to the 3DPF, these mostly lawful digital communities provide crucial, geographically unbounded guidance and knowledge for the manufacturing of 3DPF in jurisdictions where the manufacturing of 3DPF is unlawful.

In fact, a widely shared tenet of the 3DPF community ethos relates to the advocacy for unlimited freedom of speech (which includes the freedom to distribute files for the manufacturing of 3DPF) and the right to self-defense. From its nascent stages, Defense Distributed, founded by Cody Wilson, the designer of the Liberator, aimed to create global online communities for manufacturing firearms using additive technologies. These efforts involved crowdfunding initiatives and the creation of a digital file

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repository called DEFCAD. Working under the motto “come and take it,” Defense Distributed, along with other designer collectives, have significantly enhanced the effectiveness of and access to 3DPF.⁶⁸ The community's commitment to the transnational spread of these files is exemplified by the popular slogan “Can't stop the signal,” which highlights the futility of attempting to regulate or criminalize the distribution or possession of files for 3DPF. This is further evidenced by the general enthusiasm displayed over the adoption of 3DPF by rebels in Myanmar.⁶⁹ That said, the use of 3DPF by right-wing extremists has been largely denounced by many of the most prominent figures within the 3DPF community.⁷⁰ Nonetheless, given the inherent digital and transnational nature of the phenomenon of 3DPF, it is unsurprising to see that right-wing extremism cases involving 3DPF often feature a transnational element.

Motives

An analysis of court filings and media reports on the 35 cases enabled the author to identify four primary motives (sometimes overlapping) for the manufacturing and/or acquisition of 3DPF by right-wing extremists: symbolic/ideological reasons; complementing stocks of conventional firearms; circumventing regulations or due to lack of available alternatives; and financial motives.

Symbolic/Ideological Motives

As rational actors, extremists and terrorist groups select specific targets and modes of attack to maximize the feasibility of a successful operation and its effectiveness in achieving their objectives.⁷¹ Nevertheless, individuals and groups may still have normative preferences.⁷² For example, in the late 1960s and 1970s, the Popular Front for the Liberation of Palestine, its splinter factions, and sympathizers developed a preference for targeting El Al flights and offices outside Israel.⁷³ Similarly, al-Qa`ida developed a penchant for executing simultaneous attacks.⁷⁴ Likewise, the choice of using a particular type of firearm or weapon can also be influenced by normative preferences rather than practical ones. This is perhaps best illustrated by the preference for the Kalashnikov AKS-74U in propaganda videos by Usama bin Ladin, Ayman al-Zawahiri, and Abu Bakr al-Baghdadi. The AKS-74U, a variant of the AK-74 with a much shorter barrel, is less effective, reliable, and has lower muzzle energy than its counterpart. However, its popularity among jihadi leaders is tied to its unique symbolic appeal. Issued to Soviet special military units, officers, and helicopter pilots, possessing an AKS-74U legitimizes the bearer's credentials. It signifies that they

have combated the Soviets as veteran mujahideen, and it allows for the speculation that they might have achieved the significant feat of downing a Soviet helicopter and seizing this prized rifle from their defeated enemy.⁷⁵ As such, firearms can be seen as highly sophisticated and advanced cultural artifacts that are the results of a process of cultural production,⁷⁶ with an intrinsic symbolic value.⁷⁷ Within this context, Ferdinand Halberl argues that “terrorist armament culture can be seen as its own ideology, frameworks of ideas, practices and symbolism, allowing individuals to identify themselves with a certain identity.”⁷⁸

Within the context of right-wing extremism, Anders Breivik, who killed 69 people at a Workers’ Youth League summer camp on the island of Utøya in Norway, sought to mythologize his firearms by engraving his Glock pistol with the word “Mjolnir,” the name of the hammer of Thor, and his Ruger rifle with the word “Gungnir,” a reference to Odin’s spear.⁷⁹ Similarly, Brenton Tarrant, who perpetrated the 2019 Christchurch, New Zealand, mosque shootings that resulted in the death of 51 worshippers, had inscribed the names of historical figures, personalities, or events associated with the white supremacist milieu on two of his rifles.⁸⁰ Illustrating the cultural significance of his firearms, he chose to publish photos of his arsenal on Twitter prior to the attack.⁸¹ In both cases, Breivik and Tarrant transformed their weapons itself into illocutionary devices that transcended their lethal utility.

The deliberate choice to employ a PMF instead of conventional ones for symbolic reasons is perhaps best illustrated by the case of Stephan Balliet. On October 9, 2019, Balliet attempted to forcibly enter the Jewish community center and synagogue in the eastern German town of Halle (Saale) to execute a mass shooting that was to be livestreamed online.⁸² After failing to enter the building, he shot a passerby and moved to a Turkish restaurant as a secondary target, where he shot and killed a second victim.⁸³

Before the attack, he uploaded a manifesto to Meguca,⁸⁴ a now-inactive imaging board, detailing his weaponry, which included a longsword (unused during the attack), various pipe bombs and homemade explosives, and six firearms, five of which were privately manufactured, two of which were Luty 9mm submachine guns. Many of these firearms, crafted from steel, aluminum, and wood, incorporated 3D-printed parts. Specifically, one of the Luty SMG, nicknamed ‘the Plastic Luty,’ was equipped with a 3D-printed grip, feed ramp, trigger clip, torch barrel, and magazines, purportedly compatible with another Luty made of steel. Additionally, one of his slam-fire shotguns was shown with a 3D-printed shell holder. Balliet’s description of his arsenal in his manifesto included a picture of each firearm, accompanied by a brief overview of its capabilities and limitations, as well as a breakdown of some production costs.

The second part of the manifesto featured a subsection titled “Objective” that outlined his three main goals: prove the viability of improvised weapons; increase the morale of other suppressed whites by spreading the combat footage; kill as many anti-whites as possible, Jews preferred.

Balliet’s manifesto underscores his key goal to prove the effectiveness of makeshift weapons with his attack, essentially positioning it as a proof-of-concept. He stated, “the whole deal is to show the viability of improvised guns. After all, some of you fellows don’t have the luxury of industrially-made equipment.” This motivation to use improvised weapons is further exemplified in the final part of his manifesto, which includes a section titled “Achievements” styled after those in first-person shooter video

games. Several achievements relate to killing individuals with specific improvised firearms he crafted: “This is my BOOM-STICK!” refers to killing someone with a Slam-Bang, “You only live once” to killing someone with the single-shot, and “The Eternal Anglo” to killing someone with a Luty. This last achievement particularly highlights the symbolic significance of his improvised firearms. “The Eternal Anglo” directly alludes to Philip A. Luty, the designer behind the Luty SMG.⁸⁵ Luty faced legal action twice for his activities, including a conviction under the Terrorism Act 2000, before his death in 2011. Since then, Luty has emerged as somewhat of a martyr figure within the PMF communities.⁸⁶ Thus, the reference to Luty as “The Eternal Anglo” further highlights the symbolic importance he attributed to these improvised weapons and the broader improvised weapon community.

The achievement section along with the description of these firearms also underscore the fact that Balliet was fully aware of the potential limitations of his improvised weapons. For example, one of the achievements was called “I liked that hand . . .,” which would be awarded for “Accidentally frag[ging] yourself with the improvised explosives.” As such, Balliet made the conscious choice to employ improvised firearms and documented it extensively, despite having access to a conventional firearm and being worried that they might malfunction.

The nature of 3D-printing technologies means that a 3DPF can be further embedded with symbolic meaning through relatively easy cosmetic alteration. Whereas Breivik and Tarrant’s cosmetic alterations were rather simplistic—involving hand engraving and the use of a marker—3DPF files can be modified to include intricate designs, symbols, or text that are precisely and seamlessly integrated into the weapon’s structure, allowing for a higher level of customization and personalization that reflects specific ideologies, commemorates events, or honors individuals within the context of their intended use or community significance.

In July 2023, police in Finland revealed that a four-man RWE cell based in Lahti District had planned to carry out racially motivated terror attacks in the country using 3DPF. The men’s social media activities on the video-sharing platform Odysee clearly illustrate the convergence of 3DPF and right-wing extremism aesthetics. In addition to several pictures of them posing with 3DPF in front of a swastika flag, the men also distributed a picture of an FGC-9 surrounded by 9mm bullets in ammunition boxes arranged to display a swastika and spell out “Lue Siege,”⁸⁷ which translates to “Read Siege,” a reference to the anthology of essays written by James Mason.⁸⁸ The phrase “Read Siege” (and the associated hashtag #ReadSiege) has become popular among internet neo-Nazis and alt-right social media,⁸⁹ thus again demonstrating how the act of manufacturing and possessing 3DPF can be deeply intertwined with wider cultural meaning. Moreover, in one of the videos of the men testing out their firearms, a “ROCK against Communism” patch—a reference to white power rock concerts held in the United Kingdom in the late 1970s and 1980s, which has since become a catch-all term for white nationalist music⁹⁰—can clearly be seen on the frame of an FGC-9.⁹¹

Another noteworthy example of this symbolic use of 3D-printing is the case of Ryan Scott Bradford, an American man arrested on charges of conspiring to distribute methamphetamine and being a felon in possession of ammunition. According to the criminal complaint, “between 2021 and January 2023, Bradford posted online messages and photographs documenting his use of a 3-D

printer to manufacture firearms, as well as calling for the mass murder of Jews.⁹² Upon a raid of his house, police recovered several firearms parts, “including two 3D printed auto sears and five ‘switches,’ both of which are used to convert semi-automatic firearms into fully-automatic firearms; two 3D printers, one of which had swastikas painted on it; various Nazi propaganda; and an apparent improvised explosive device (IED).”⁹³ In this instance, the printer itself, rather than just its output, was emblematic of the individual’s commitment to extremist ideologies, demonstrating an additional layer of significance where the tools of production are also vessels of ideological expression.

Finally, the notion that individuals choose the 3DPF due to its symbolic meaning is further supported by the fact that in at least six of the 23 cases in which there was either a clear attempt to manufacture or procure 3DPF, the individuals in question were in possession of conventional firearms in addition to 3DPF. This indicates that their choice to produce or acquire 3DPF was motivated by factors beyond mere necessity. This phenomenon will be explored in the following subsection.

Complementing Stocks of Conventional Firearms

As already discussed, privately manufactured firearms have a long history of being utilized by insurgents to supplement their limited stocks of conventional weapons, rather than as a means of replacing them. Within the context of RWE plots, it appears that 3DPF can serve a similar purpose, bolstering the arsenal of conventional firearms. In six out of the 23 cases in which there was either a clear attempt to manufacture or procure 3DPF, the individuals in question were also found in possession of conventional firearms, suggesting that 3DPF serve not only as a replacement but as an augmentation to traditional firearms.

This trend is particularly underscored by the case of Noah Edwin Anthony, a 23-year-old soldier stationed at Fort Liberty (formerly Fort Bragg) in North Carolina who was arrested in March 2022 following a random vehicle inspection at an entrance gate, which led to the discovery of a handgun in the center console of his vehicle. Further searches of his barracks room and his vehicle led to the discovery of two unserialized conventional firearms; a 3DPF; white supremacist literature, T-shirts, and patches; an American flag with a swastika replacing the blue field and stars; and a document titled ‘operations’ in which Anthony detailed his goal to “physically remove as many of [black and brown people] from Hoke, Cumberland, Robeson and Scotland Counties by whatever means need be.”⁹⁴ At the time of his arrest, Anthony did not have any prohibitions stopping him from legally purchasing a firearm. Anthony served 18 months in the custody of the Bureau of Prisons before being released from custody on March 22, 2024, and began serving a 36-month term of supervised release.⁹⁵

The same phenomenon can also be observed in countries with stricter firearm regulations. As previously mentioned, in Germany, Stephan Balliet’s arsenal, while mostly composed of PMF, also included a conventionally manufactured Smith Carbine. Similarly, in September 2022, Icelandic police arrested two individuals, Sindri Snær Birgisson and Ísidór Nathansson, alleging that they were planning to murder several high-profile individuals, including the Minister of Environment and Natural Resources, the chairman of the workers’ union Efling, and the Chairman of the Icelandic Socialist Party, as well as members of the police force.⁹⁶ The plot, the first of its kind in Iceland’s history, shocked the nation.

During searches in nine different locations, police seized dozens of firearms, including 3DPF, but indicated that the majority of the firearms confiscated were legally registered but in the process of being converted from semi-automatic to fully automatic.⁹⁷ The presence of 3DPF in Iceland, a country with a relatively high rate of firearm ownership due to its hunting culture,⁹⁸ further highlights the trend of individuals supplementing legally acquired firearms with 3D-printed ones.

Circumventing Regulations or Lack of Available Alternatives

In 17 cases, the individual involved demonstrated a desire to obtain or manufacture 3DPF as alternatives to conventional firearms. Two broad, interlinked factors might explain why, in these cases, 3D-printed firearms would be acquired instead of conventional firearms. The first relates to a desire to circumvent firearm regulations, and the second to the lack of access to conventional firearms.

First, an individual may opt for 3DPF because of their relative untraceability. Research on PMF in general has shown that in some cases, a preference for weapons that are harder to trace may lead some criminal users to choose a less capable PMF over a professionally manufactured alternative.⁹⁹ Modern firearm investigative techniques and tracing procedures rely on characteristics such as the presence of serial numbers or other markings, or by examining unique striations impressed into a bullet from the barrel rifling (and other tool markings), and propellant signatures, which can be harder to identify in the case of PMF.¹⁰⁰ With regard to 3DPF, new forensic techniques are being developed, including the use of organic compound specific reactivity (CSR) testing as a method to determine the thermoplastic polymer composition of a firearm using Direct Analysis in Real Time (DART) mass spectrometry.¹⁰¹ New techniques also encompass new approaches to analyzing firing pin impressions¹⁰² and, promisingly, other markings unique to 3DPF, such as deformations in the printer’s extruding nozzle or fine marks on the printer bed.¹⁰³ Despite these forensic advances, 3DPF remain attractive due to their lack of serialization, which can make them more challenging for investigators to trace.

Even in places where conventional firearms are available, individuals might choose to manufacture 3DPF to avoid attracting the attention of law enforcement. While both Breivik and Tarrant employed conventional firearms in their attacks, both expressed fears that their attempts to procure these firearms might tip off authorities.¹⁰⁴ They went to great lengths to circumvent these risks. As such, it is possible to envisage cases in which someone, despite having access to conventional firearms, chooses to acquire or manufacture a 3DPF due to the level of anonymity it affords.

Second, literature on the criminal use of privately manufactured firearms has shown that such firearms are most commonly acquired and used when commercial alternatives are not available.¹⁰⁵ For example, the prevalence of “zip guns” in the United States made from sections of automobile radio antennas used as barrels, mounted on frames from cap guns, with modified hammers acting as firing pins among juvenile delinquents in inner cities during the 1960s has largely been attributed to the challenges, often related to cost, of acquiring traditional firearms.¹⁰⁶ Similarly, the draw toward PMF in the face of a paucity of conventional weapons can be seen among many terrorist groups. For example, the 3DPF (particularly FGC-9) has become an essential part of the anti-junta resistance in the Myanmar civil war due to its affordability and ease of manufacture

and as a battle standard to conduct ambush-style attacks against the military junta.¹⁰⁷

As discussed earlier, while the weapon substitution hypothesis does not fully explain why 3DPF are sought by right-wing extremists, it nonetheless provides explanatory power in several cases. Perhaps one of the clearest examples of an individual choosing 3DPF over conventional firearms, due to a lack of alternatives, can be seen in the case of Ryan Scott Bradford, the individual with the swastika-adorned 3D printer. It appears that Bradford sought to manufacture 3DPF as a result of a past 2012 conviction for burglary, “which prevented him from legally owning firearms or possessing ammunition.”¹⁰⁸

The case of Matthew Cronjager, a 17-year-old white nationalist who plotted to kill his Asian friend over claims he had had intercourse with white women, underscored an indifference he had between 3DPF and conventional firearms, provided he could obtain a firearm.¹⁰⁹ Cronjager, in communications with an undercover officer, sought to purchase either an FGC-9 or a Cheetah-9 Hybrid SMG, or alternatively, a sawn-off shotgun.¹¹⁰ This situation highlights that while there may be a normative preference for conventional firearms, individuals motivated by specific intentions are willing to opt for a 3DPF if conventional firearms are not accessible. The determination to acquire any form of firearm, irrespective of its manufacturing method, reflects a pragmatic approach among individuals constrained by legal limitations or the availability of weapons.

In 19 of the 35 cases surveyed, police or media reports have indicated that efforts to acquire or manufacture 3D-printed firearms were part of a violent plot.^g These ranged from committing acts of property damage using firearms for racial intimidation, to plotting the killing of individuals based on their sexuality or religion, to planning large-scale attacks on places of worship or government institutions and figures. Out of these 19 incidents, 3D-printed firearms appeared as the sole type of firearm envisaged by the perpetrator in 13 cases. Interestingly, instead of appearing in conjunction with conventional firearms, they most often occurred in conjunction with explosive devices, which were either part of the plot or confiscated by the police in 11 of these 19 cases.

The prevalence of cases involving the FGC-9, or its variants, in the dataset also lends credence to the argument that 3D-printed firearms are often favored by right-wing extremists as a means to circumvent firearm regulations or due to a lack of available alternatives. In at least 15 out of 23 cases where there was a clear attempt to manufacture or procure a 3DPF, the firearm in question was an FGC-9. The FGC-9’s popularity among RWE—and also among lawful 3DPF enthusiasts—can be attributed to its simplicity, relative effectiveness, and ease of production. According to a prominent American 3DPF designer known as Ivan the Troll, who extensively collaborated with Jacob Duygu to upgrade the design of the FGC-9 into the FGC-9 Mark II,^h the FGC-9 is the “easiest, cheapest, most accessible, and reliable semi-automatic DIY

firearm.”¹¹¹ As such, those intending to use 3DPF to commit acts of political violence have seized upon this model, despite the myriad of other 3DPF designs available, because it essentially is held to offer a near perfect blend of these attributes. This explains why more complicated designs, sometimes involving high rates of fire or chambered in large calibers (such as the Amigo Grande CETME 308 or the Plastikov), have not been featured in any of the cases surveyed.

However, recent developments within the 3DPF community are concerning, as they seem to focus on further lowering the barriers to entry for producing 3DPF. Noteworthy developments include the ‘Nutty 9,’ an improved bolt design for the FGC-9 consisting of nothing more than four nuts and two bolts screwed into a printed connector piece, and the development of the Urutau—a soon-to-be-released hybrid pistol-caliber carbine—that is said to be significantly easier to build than the FGC-9.

Financial Motives

Finally, in five cases surveyed, financial gain appeared to have been an important motivation for the fabrication of 3DPF or 3DPF accessories. Most of the literature on criminal firearm marketplaces and the sale of firearms (conventional or otherwise) related to terrorism has largely focused on terrorists acquiring firearms from criminals, rather than extremists selling firearms. In fact, in their survey of illicit firearm trade in Europe, Nils Duquet and Kevin Grois noted that while “traditional separatist groups have developed their own distinct (and context-specific) firearms acquisition patterns, religiously inspired terrorist networks across the EU generally rely on criminal connections to obtain firearms from local illicit markets.”¹¹² Nonetheless, in some instances, terrorists have used their own connections to acquire firearms from like-minded individuals. For example, the El Bakraoui brothers—two of the perpetrators of the Brussels attacks on March 22, 2016, that killed 32 people—are believed to have played a key role in supplying firearms to the perpetrators of several terrorist incidents, including the November 2015 Paris terrorist attacks.¹¹³ In Belgium, police investigations into the right-wing group Bloed, Bodem, Eer en Trouw, a Belgian splinter group of the international right-wing extremist group Blood & Honor, suggested that some members, including the leader of the group, were supplying firearms to members of the Dutch right-wing extremist group as a means of funding their terror activities.¹¹⁴ Investigators also believed that one of the two vz.58 assault rifles used by Amédée Coulibaly during his lethal attack on the Hypercacher supermarket in Paris, which occurred just hours after the attack on the Charlie Hebdo office in January 2015, was imported from Slovakia and reactivatedⁱ by a known militant right-wing extremist with French nationality living in Comines, Belgium, prior to being used in the attack.¹¹⁵

The making of 3DPF or 3DPF accessories can serve as a lucrative endeavor to both criminal and terrorist actors. The price of a 3DPF on the black market can vary based on a myriad of factors, including the type of firearm, its quality of production, the scarcity of conventional alternatives, and the geographical location. For example, the price of an FGC-9 in several locations appears to range between \$1,500 USD and \$3,000 USD, with a production

^g In most cases, the individuals were found guilty of lesser offenses because prosecuting someone for terrorism before an attack occurs is challenging. Authorities often rely on related offenses such as conspiracy or possession of illegal materials to intervene preemptively.

^h These enhancements include improvements to the electro-chemical machining process to rifle the barrel (ECMv2.0 process) and the Common Sense Fire Control Group AR-15 printable trigger.

ⁱ Reactivating a firearm refers to the process of restoring a firearm to working condition after it has been rendered inoperable or deactivated.

cost anywhere between \$150 to \$500 USD. Similarly, Drop-In Auto Sears and Glock Switches (which enable users to modify a firearm to enable automatic fire) can cost less than \$2 USD in filament and be printed in less than 10 minutes using a low-grade consumer printer. These items are often sold online in the United States for approximately \$20 USD.¹¹⁶

Drop-In Auto Sears were at the center of the first case involving an individual with apparent right-wing extremist inclinations manufacturing and selling 3D-printed firearm accessories for profit. According to an October 2020 criminal complaint, Timothy Watson, a resident of Ranson, West Virginia, sold over 600 3D-printed Drop-In Auto Sears disguised as wall hooks for keys or coats on his website.¹¹⁷ The devices featured a superfluous base meant to be discarded, while the remaining part could be inserted into an AR-15 to prevent the trigger from locking in preparation for the next round, instead allowing the hammer to cycle back and fire automatically, effectively converting a semi-automatic weapon into a fully automatic one.¹¹⁸ Notably, Watson advertised his wares on his website through Facebook groups associated with the Boogaloo movement.¹¹⁹ Prosecutors also discovered cryptic comments made by apparent sympathizers of the movement on Watson's social media accounts. One message exchanged between Watson's wall hanger Instagram account and a user mentioned "dead 'redcoats,' an anti-government reference."¹²⁰ As part of a plea deal, Watson received a five-year prison sentence in 2021.¹²¹

In September 2020, in Spain, a 55-year-old, known only by his initials 'J.M.', was arrested for operating a 3D-printing gun workshop. Police uncovered 19 3D-printed pistol frames, multiple melee weapons, explosive precursors, and over 30 manuals on subjects such as homemade explosives and firearm manufacturing through 3D-printing.¹²² The operation was initiated when investigators discovered an individual attempting to sell 3D-printed firearms and explosives over the internet, leading to the seizure of two 3D printers, numerous handgun frames, magazines, various weapon parts, a carbine with a scope, knives, a machete, and a katana.¹²³

The same year in Germany, Joachim Thome, a founder of the criminal group "Paladin," which produced weapon parts and organized training sessions aimed at taking armed action against pandemic measures in Germany, was apprehended for using 3D printers to manufacture firearms and firearm parts after he attempted to sell an FGC-9 firearm to an undercover police officer.¹²⁴ Following his arrest, Thome relocated to Portugal in the summer of 2023. A European arrest warrant was later issued against him. He received a sentence of one year and 10 months in January 2022 for violations of the weapons law but was released from custody after serving six months.¹²⁵ Thome subsequently fled to Portugal, where he was again arrested at the end of November 2023 and extradited to Germany.¹²⁶ As of June 2024, he remains in custody, awaiting trial.

Sometimes, financial motives intersect with ideological considerations. In the United States, Ryan Scott Bradford, the man with the swastika-decorated 3D printer, is believed to have also attempted to sell 3D-printed firearms and firearm parts to other like-minded individuals on Telegram.¹²⁷

More recently, in January 2024, a 26-year-old Frenchman, leading a network known for manufacturing and selling 3D-printed firearms, was apprehended in Belgium. The police reported that the individual possessed a libertarian ideology, aligning with the

American pro-gun movement.¹²⁸ His group's aim was to distribute firearms widely to arm the populace against what it considered a totalitarian and oppressive state.¹²⁹ Upon his arrest, authorities confiscated eight 3D printers, seven fully 3D-printed weapons, and more than 500 3D-printed weapon parts, 11 conventional handguns of various calibers, 13 long guns, over 1,000 rounds of ammunition of various caliber, and 3,046 euros in cash.¹³⁰ This case also led to the arrest of six other individuals in France and Belgium, with some placed under judicial supervision and one in temporary detention.¹³¹

These cases suggest that the production and sale of 3D-printed firearms and their components can be a profitable enterprise for extremists seeking to finance their activities. The cost-effectiveness of producing these items, combined with their high potential resale value on the black market, presents a lucrative opportunity for those with nefarious intentions.

Conclusion

Over the last decade, the evolution of 3D-printed firearms has been profound and rapid, marking significant strides in both technology and accessibility. This period has witnessed not only improvements in the reliability and effectiveness of these firearms but also a substantial decrease in the cost and complexity of producing them. While most designers, publishers, manufacturers, and end users of 3D-printed firearms do so either within the confines of the law or without violent intent, the democratization of 3D-printed firearms nonetheless raises real and empirically grounded critical concerns about the intersection of additive manufacturing technology and political violence.

The geographical and temporal analysis within the study underscores a troubling increase in the incidents involving 3DPF across multiple regions, indicating a spread beyond isolated communities into more mainstream adoption among right-wing extremist factions. This spread is facilitated by the transnational nature of digital platforms where blueprints and manufacturing techniques are exchanged, creating a decentralized network of firearm production that transcends national borders.

Moreover, this study clearly illustrates that the utilization of 3DPF by right-wing extremists is not merely an issue of weapon possession but deeply intertwined with the symbolic and ideological underpinnings of these groups. These weapons provide a means to circumvent traditional legal and logistical barriers to firearm access, aligning with broader anti-government and libertarian sentiments prevalent within right-wing extremist ideologies. The adaptability of 3DPF technology allows these groups to enhance their operational secrecy and reduce their dependency on conventional arms markets, which are more susceptible to law enforcement scrutiny.

Given these developments, the study highlights the critical need for continuous monitoring and documentation of 3DPF-related incidents. Enhanced forensic techniques, more robust data collection methods, and international cooperation are paramount in developing effective strategies to address the challenges posed by 3DPF. Law enforcement agencies must adapt to these technological advancements to preemptively counter the threats posed by these increasingly accessible weapons. As 3D-printed firearms continue to evolve and become more embedded in criminal and extremist activities, it is imperative that stakeholders from law enforcement, legislative bodies, and the international community collaborate

to mitigate the risks associated with this technology. The insights provided by this study serve as a foundation for ongoing research and policy development, aiming to keep pace with the rapid

advancements in 3DPF and their implications for global security.
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