A violent debate: Could guns be made at home by 3-D printers?

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Do we really have anything to worry about? Credit: Pete Prodoehl/Flickr

Gun laws have been back in the media recently due, largely, to the horrific events at Sandy Hook Elementary School on December 14, 2012 which claimed the lives of 20 children and six adults. In response President Obama has just unveiled gun control proposals.

In light of this growing focus on gun legislation, some have expressed

concern about the possibility of guns being manufactured in the home using 3D-printing technology (also known as "additive manufacturing" or AM).

If this were the case, the ability of almost anyone to 'print' a gun at home brings about the question of monitoring and oversight. This is particularly significant in places where guns are difficult to get locally, including Australia.

So is it possible to manufacture a ready-to-fire gun using a 3D printer? And would this be possible at home? Before we can answer these questions, it's important to understand how and why we even got here.

Supply and demand

Over the past couple years the growth of 3D printing has represented an unprecedented shift in how objects are made. It's just one very visible part of a transition from mass manufacturing dependent on factories and global freight systems, to innovative manufacturing done locally and on-demand.

With 3D printing, bits of information digitised in a computer design appear out of thin air in the atoms of a finished object. This happens in front of the eyes and at the press of a button.

As we've reported previously on The Conversation, there are many uses for 3D printing in the home, office and beyond that are driving the development of this technology.

A key problem in commentaries about the 3D printing of guns is that there has been a gross over-simplification of what constitutes 3D printing, particularly what can be done with a home desktop printer.

To accurately look at printing a firearm it is critical to understand the capabilities in the range of equipment.

Apples and oranges

3D printing isn't just one technology but a whole ecosystem of machinery with a common theme: taking designs created using 3D computer-aided design (CAD) data and fabricating structures in a layer-by-layer fashion.

These machines can be used to print a wide variety of materials, from plastics and metals to even food and living tissue, all in arrangements that are impossible with traditional methods.

The equipment also varies greatly in terms of size, ease-of-use, and cost. At the entry level (which gets the most attention), 3D printers are compact units, some only a few hundred dollars, targeted to the home/school/community hobbyist.

These typically work by extruding coils of pre-formed thermo-plastics onto a platform, guided by a computer. Some 3D printers can be assembled open source, such as the Rep Rap, others can be bought pre-assembled, such as the Makerbot.

At the high end of 3D printing are laser-sintering units (see video below), electron-beam melting systems and specialised polyjet printers. These printers can stand as tall as a person and require custom software and specialist technicians.

High-end systems are completely different from domestic-use 3D printers, relying on high-power sources to repeatedly fuse layers of plastic, ceramic or metal powders, or the activation of thermal and UV cured resins in a layer-by-layer fashion.

These techniques are capable of printing a wider range of stronger materials such as steel alloys or titanium and require special handling and lots of energy to process.

The reality

So, with this in mind, is it possible to "print" a gun at home?

The simple answer is that with current personal 3D printer technology, you cannot simply download a file and build an assembled ready-to-fire gun like those available on the market today.

With inexpensive desktop 3D printers, a host of difficulties are apparent in replicating a complete commercial firearm. A chief problem is the fact that the plastics are generally too weak to withstand the stresses of repeated firing without destroying the printed structure.

It is possible to print individual components on more advanced machines, but these parts still require "finishing", using traditional fabrication equipment, and often require assembly with additional components produced elsewhere.

Even the highest-end polymer and metal printers would have difficulty printing a market-replicate firearm without further equipment development. The printers could again provide individual parts for a gun but prints would still require post-processing with specialist equipment.

Metal printing in particular demands special handling procedures as certain materials, such as titanium powders, can be very reactive with air and can ignite and explode. As such, all handling is done in inert or vacuum environments.

And even more finishing and complexity would be required to 3D print

ammunition, which combines a number of different materials, including some sensitive to heat processes such as gunpowder or cordite.

The powder and the finger

So even at the high-end of 3D printing it is not currently possible to download a design and print an operational firearm with the press of a button. In some ways it would be far easier to make a weapon using traditional methods and it is possible to find aspirational gunsmiths making firearms at home.

3D printing could certainly play a role in prototyping for the multi-billion-dollar global arms industry, particularly in the aerospace sector, although it is debatable whether 3D printing can offer any real economic advantages in firearm development on top of current techniques.

Better used elsewhere

Although 3D printing guns illegally for malicious uses is a contentious issue, those not familiar with 3D printing should understand that additive manufacturing offers many obvious benefits across a range of areas including robotics, infrastructure and medicine. This is taking place in innovations at home, in industry and at research centres around the world.

In the Intelligent Polymer Research Institute (IPRI) at the University of Wollongong some of the most sophisticated 3D printers are being used for projects ranging from bioprinting to advanced energy applications.

Additive manufacturing in biofabrication is already revolutionising medicine by creating patient specific implants. Part of IPRI's work focuses on developing new materials, methods and AM equipment in the

hopes of producing regenerative tissues. In the future such technology could help enable science-fiction-like concepts such as replacement organs or printable skin.

No doubt people will keep trying to print firearms and other weapons. But discussions on the topic would benefit from a clear understanding of the range and capabilities of personal versus non-domestic 3D printing.

While the future legality and availability of 3D printed weapons is uncertain, guns will be far from the most innovative object to emerge from the build tray of 3D printers in the foreseeable future.

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