The silent witness: what DNA found on a firearm tells about how it was used

When a firearm is recovered from a crime scene, finding DNA on it is only the beginning. The harder question – and one that starts to matter more in a courtroom – is what the firearm was used for.

DNA is the genetic material found in almost every cell of the human body. Every time we touch an object, we leave invisible traces of it behind. Finding the DNA of a suspect on a weapon does not mean they fired it. They might have touched it briefly or their DNA could have transferred indirectly through for example shared gloves. Currently, forensic scientists have limited tools to distinguish between these explanations.

I addressed that gap by comparing the distribution of DNA on a pistol after two different types of contact: active use (loading and shooting) and passive contact, in which the weapon was wrapped in a personal item such as a towel or shirt and carried in a bag. I collected DNA from 13 specific locations on the weapon, measured their amounts and genetic profiles of volunteers were obtained where possible.

The obtained patterns were informative, though not always straightforward to interpret. Loading and shooting concentrated DNA mostly on the grip and magazine – areas repeatedly contacted during these actions. In contrast, passive contact produced a more even distribution across the weapon, with DNA absent from the magazine. That absence turned out to be one of the most reliable indicators of how the weapon had been handled.

To make sense of the complex patterns across all 13 locations, I first attempted manual interpretation, then tested simpler measures such as the grip-to-magazine ratio. Both performed worse, misclassifying a substantial number of active-use samples as passive contact. In a legal setting, that kind of error could mean failing to identify the person who actually fired the weapon. Machine learning – a tool that helps computers find patterns in complex data that are difficult for humans to interpret directly – proved far more effective, distinguishing the two scenarios with near 100% accuracy.

I also tested the developed ML model on two firearms handled by volunteers under conditions resembling real casework. The DNA patterns matched what the controlled experiments had shown and the algorithm correctly classified both weapons as active use and passive contact, respectively.

These findings suggest that the amount and position of DNA found on a firearm, not just whose DNA it is, can serve as powerful evidence. If developed further, this kind of analysis could give forensic scientists a more precise basis for their expert testimonies in court and a better way to distinguish the person who pulled the trigger from the one who simply found themselves, or at least their DNA, in the wrong place at the wrong time.