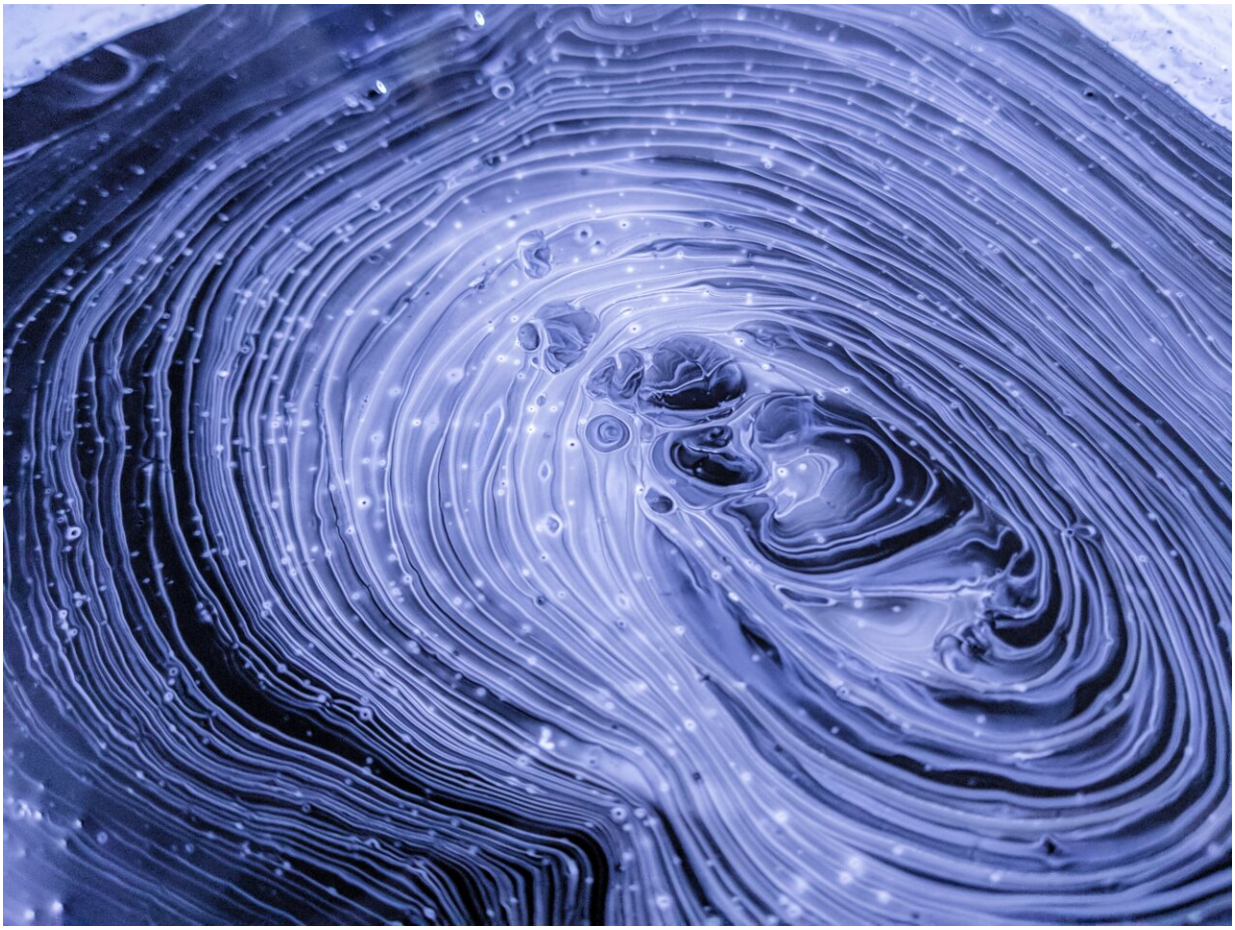
Fingerprinting to solve crimes is not as robust as you think

October 24 2017, by Jamie Walvisch



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Police have used fingerprint evidence to catch and convict criminals for

more than 100 years. It's a commonly used technique in Australia: more than 10,000 fingerprint matches were made in Victoria alone last year.

But in a recent report, the American Association for the Advancement of Science has questioned the scientific validity of fingerprint analysis.

The report is a reminder that although fingerprinting is an essential tool for investigating crime, it's not infallible. We need to minimise the inappropriate application of the "science" of fingerprinting, and reduce repeats of miscarriages of justice linked to fingerprint analysis that have already occurred.

Most notoriously, Brandon Mayfield, an American lawyer, was wrongly linked by four fingerprint experts to the 2004 Madrid train bombing. He was arrested and detained for two weeks, before investigators realised that an Algerian man, Ouhnane Daoud, was the real source of the print.

How does fingerprint examination work?

Everybody's fingers, palms and soles have "friction ridges" on them. These ridges occur in patterns (such as arches and loops) that contain specific features (for example, ridge endings and dots).

Fingerprint examiners use these patterns and features to compare an unknown (or "latent") print with a known print, to determine if they may have come from the same person.

In Australia, police use the National Automated Fingerprint Identification System – a database with more than 2.6 million sets of fingerprints - to narrow down the field of fingerprints to compare. But the final decision about whether there is a "match" is made by a person.

A 2010 report, published by the US National Institute of Justice,

concluded that automated systems were significantly less accurate than well-trained examiners at making comparisons between latent and known prints.

Problems with the underlying science

Until the mid-2000s, little scientific research had been done on most forensic disciplines, including fingerprinting. This lack of research became widely publicised in 2009, when the US National Research Council published a landmark report on the forensic sciences.

It found that the only forensic method that had been rigorously validated was nuclear DNA analysis. All other forensic sciences – including fingerprinting – lacked a proper scientific foundation.

When examining this issue again in 2016, the President's Council of Advisors on Science and Technology (PCAST) in the US found that only two properly designed studies of latent fingerprint analysis had been conducted. These both found the rate of false matches (known as "false positives") to be very high: 1 in 18 and 1 in 30.

One of the main reasons for these high error rates is that fingerprint analysis involves human judgement, and relies on a methodology (known as "ACE-V") that is not sufficient to ensure the accuracy and reliability of an examiner's conclusions. This means there is no guarantee that two different examiners who follow its steps will reach the same result.

Recent improvements

Since the National Research Council report was released, scientists have worked hard to prove that fingerprint examination is scientific.

Research has now convincingly established that the ridge patterns on fingers vary greatly among individuals, and that there is little variation in a person's fingerprints over time. This provides a scientific basis for using fingerprints to distinguish individuals, even identical twins.

But there is still no scientific basis for concluding that a print must have been left by a specific person, or even for estimating the number of people who might be the source of a print.

The most that can be said is that two prints have many corresponding features, with no differences that would indicate they were made by different fingers. It may also be possible for an examiner to say that the set of features found in the prints is unusual.

Cognitive bias

Because fingerprint analysis depends heavily on human judgement, an examiner's conclusions may be improperly influenced by non-scientific factors, such as irrelevant contextual information.

This phenomenon, which is known as "cognitive bias", has been demonstrated in various studies.

In one study, five fingerprint experts were told they were comparing Brandon Mayfield's fingerprint with the fingerprint found in Madrid. They were asked whether they would also have (wrongly) found a match.

In reality, the experts were given fingerprints from a different case they had personally found to match years earlier, in the normal course of their casework. Four of the five experts changed their opinion. This was seen to be due to their expectation that the fingerprints did not match.

Another study found that fingerprint examiners can be improperly

influenced by the use of automated fingerprint identification systems, which provide ordered lists of the most likely matches.

The study found that examiners are more likely to wrongly identify one of the prints near the top of the list as a match, and to fail to make correct identifications if the print is down low on the list.

Implications

While these reports and studies indicate a need for caution when relying on fingerprint examinations, they do not mean that police should stop using fingerprints.

Fingerprinting is an essential tool for investigating crime, and should continue to be used for this purpose. But steps need to be taken to limit the likelihood of future miscarriages of justice.

Everyone in the system has a role to play. Scientists need to conduct further research under realistic conditions.

Police forces must take steps to minimise the risks of cognitive bias. For example, they should use context management procedures to avoid exposing examiners to unnecessary contextual information.

Lawyers and judges must make sure that only scientifically valid opinions are given in court, and that the value of fingerprint evidence is not overstated. Fingerprint examiners should make it clear that they are expressing an opinion and not a fact.

And everyone should acknowledge that errors do occur in fingerprinting analysis, and have happened in the past.

This article was originally published on The Conversation. Read the

original article.

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