Challenging the validity of fingerprint evidence

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The reliability of fingerprint evidence as a means of identification for purpose of court continues to be generally accepted by academia and the criminal justice system. However, despite a long tradition of forensic identification to individualize prints there have been some recent challenges as to the scientific basis for fingerprint evidence. These challenges stem from valid concerns about the potential for human errors in fingerprint matching. A major factor in trying to establish the validity of fingerprint evidence is the theoretical framework as to the physical aspects of forensic science. The psychological aspect of forensic science (the preparation of physical evidence for purpose of court) is also a potential Achilles heel as to the validity of fingerprint evidence – in particular in countries with an adversarial legal system where the function of counsel is largely to undermine the credibility of the evidence presented.

Key words: prints, marks, reliability, validity, probability, error, bias

Introduction

A [finger]print is a record taken by police of a (usually) known individual under controlled conditions. A mark is an impression found at a crime scene. The role of fingerprint examiners (dactyloscopists) is to analyse marks (individualize marks) to determine whether it/they match the print/s of a known individual. Fingerprints are routinely used by police in order to identify suspects and victims of crime (e. g. homicide) and fingerprint evidence remain one of the most trusted forms of forensic evidence used in a court of law. Despite this, the various techniques used by fingerprint examiners have neither been scientifically tested nor published in scientific peer reviewed journals.

The reliability of dactyloscopy techniques as a means of identification (individualization) is based on a theoretical framework as to the physical aspects of forensic science, including: persistence, uniqueness and transferability of prints and marks for purpose of identification. Until recently there had been no scientific studies conducted to validate fingerprints as physical evidence of identification. Despite this significant gap in the science of fingerprint evidence, the evidential value of fingerprint identification remains unquestioned.

The reliability of dactyloscopy techniques as a means of identification continues to be generally accepted by academia and the criminal justice system. However, the use of fingerprint identification as evidence at court inevitably leads to interactions between science and the law where basic assumptions are frequently challenged. There are two different kinds of issues which may arise when presenting fingerprints as evidence at court: (i) the lack of scientific rigour in the techniques used, and; (ii) the influence of cognitive biases on expert evidence.

The evidential value of fingerprint identification

Fingerprint identification as it’s used in the criminal justice system is typically done by comparing and attempting to match a mark (latent fingerprint) found at a crime scene with a print taken from a known suspect. The various techniques used by fingerprint examiners in matching two prints are different from e. g. biometric fingerprint checks introduced by the UK Border Agency (UKBA) in 2009 as a means of identification to improve on airport security.

The lack of scientific rigour in the techniques used

Whilst the evidential value of fingerprint identification remains unquestioned, even by its critics, it is often assumed that it’s the theoretical framework as to the physical aspects of fingerprint evidence, such as the uniqueness and transferability of fingerprints, which make fingerprint identification well suited as forensic evidence for purpose of court. However, these theoretical underpinnings are often not backed up by scientific evidence and the validity of the theoretical framework of forensic science is therefore a potential Achilles heel in fingerprint evidence.

The influence of cognitive biases on expert evidence

Whilst the different techniques and methods used by fingerprint examiners vary from those used in automated biometric fingerprint checks, the theoretical underpinnings of fingerprint identification are the same as for biometric fingerprint checks (such as uniqueness and transferability). The results from automated biometric fingerprint checks would not however be suitable as forensic evidence at court. The main reason is that apart from the physical aspects of fingerprints, the evidential value of fingerprints is primarily based upon the expert opinions of fingerprint examiners and governed by the rules on circumstantial evidence.

Highlighting the lack of objectivity in the analysis and matching of fingerprints, Stoney (1991: 198) notes: “ In fingerprint work we become subjectively convinced of identity; we do not prove it. And this works just fine. For fingerprints.”

The evidential value and admissibility of fingerprint expert evidence

The Law Commission’s report on admissibility of evidence 2008 and 2011:

The opinion evidence of an expert witness is admissible only if the court is satisfied that it is sufficiently reliable to be admitted.

The opinion evidence of an expert witness is sufficiently reliable to be admitted if:

the evidence is predicated on sound principles, techniques and assumptions;

those principles, techniques and assumptions have been properly applied to the facts of the case; and

the evidence is supported by those principles, techniques and assumptions as applied to the facts of the case.

It is for the party wishing to rely on the opinion evidence of an expert witness to show that it is sufficiently reliable to be admitted.

This means that guilt cannot be determined by expert evidence alone and that trust in the validity of fingerprint evidence requires a “ leap of faith”. (Broeder, 2006, p. 154)

Challenging the Validity of Fingerprint Evidence

The validity of fingerprint evidence is dependent upon: the credibility of expert witnesses; validity of the theoretical framework of forensic science, and; the accuracy of procedures and techniques used. Despite its lack of scientific evidence, the theoretical underpinnings of fingerprints and

reliability of methods used are rarely challenged at court. When the theoretical underpinnings of fingerprints are challenged at court, it also tends to undermine the reliability of methods used in a range of forensic evidence.

In Daubert v. Merrell Dow Pharmaceuticals, Inc., the US Supreme Court ruled that forensic evidence has to be both relevant and reliable in order to be valid. However, there are no reliability studies for fingerprint evidence and fingerprint evidence should therefore be ruled inadmissible in a US court of law. Pierce (2011) notes that the core issue in Daubert v. Merrell Dow Pharmaceuticals, Inc. was the “ validity of deductive reasoning to reach a conclusion.” (Pierce, 2011) The validity of fingerprint evidence in effect comes down to an issue of trust and credibility – both of which can be undermined.

The Daubert case raised the need for a model by which statistically quantifiable measures can be generated to objectively assess the reliability of fingerprint evidence. One method considered reliable by US courts is the ACE-V (analysis-comparison-evaluation-verification) method. (Haber & Haber, 2008) Despite the promise of such models, Broeder (2007) argues that: “ No expert or expert system can provide incontrovertible categorical evidence – i. e. absolute proof that a certain trace originates from a particular source. There is no objective or subjective, scientific or alternative method that will enable us to do this.” Stoney (1991: 198) argues that trying to prove uniqueness by use of statistical models “ is a ridiculous notion”. (Stoney, 1991)

Basis for Challenging Fingerprint Evidence

Despite significant issues in terms of the validity of both theoretical underpinnings of forensic science and various techniques used, the main reason why fingerprint evidence will continue to be challenged as valid forensic science evidence is that fingerprint matching (recognition, analysis, comparison, and interpretation / evaluation) is ultimately a subjective decision-making process where results and expert evidence can be influenced by contextual and confirmation biases (human error) resulting in false identification.

Whilst Stoney (1991) appears to argue that it's the subjective nature of fingerprint evidence which give the individualization process credibility, Dror et. al. (2005: 800) also note that " fingerprint identification involves a decision making process" (Dror, et al., 2005) which may ultimately result in human error and in false identification. It is therefore unfortunate that much of the debate is currently focused on attempts to improve on the reliability of fingerprint evidence through advancements in technological innovation.

Attempts at improving the physical aspects of scientific evidence indicate that some problems with forensic evidence might one day be overcome by future advances in technological innovation. Whilst technical and scientific evidence are becoming increasingly important for the criminal justice system, Broeder (2006: 148) suggests that it's difficult for judges and juries to assess the validity of expert forensic evidence. (Broeder, 2006, p. 148) Mnookin (2008: 343) argues that the courts have been seduced by superficial arguments as to the reliability of scientific methods. (Mnookin, 2008, p. 343)

Considering that fingerprint evidence is ultimately a decision-making process it’s difficult to see how fingerprint matching could be replaced by advances in technology such as future generations of automatic fingerprint recognition systems (e. g. the ACE-V process/methodology). More effort should perhaps be focused on the social science aspect of expert forensic evidence (in particular psychology) to reduce potential cognitive biases and human error in fingerprint evidence – the main basis for challenging fingerprint evidence.

Cognitive Biases in Fingerprint Evidence

Fingerprint evidence is supported by a general theoretical framework as to the physical principles of forensic evidence. However, fingerprint evidence is ultimately based on a series of decisions formulated by fingerprint examiners through cognitive processes. Whilst Stoney (1991) might argue that becoming subjectively convinced of identity works just fine for purpose of fingerprint matching, as it turns out, fingerprint examiners are highly susceptible to various forms of cognitive biases.

Giannelli (2010) describes four different kinds of cognitive biases which may influence decision-making in forensic examination of evidence. Giannelli describes contextual bias as occurring “ when extraneous information influences a decision, typically in cases of ambiguity.” Techniques used to avoid the influence of contextual bias when testing a new drug, include randomized (“ double blind”) clinical trials. A similar process as part of the fingerprint verification process has been proposed by Haber and Haber (2003). (Haber & Haber, 2003)

Giannelli describes confirmation bias in terms of “ the tendency to test a hypothesis by looking for instances that confirm it rather than by searching for potentially falsifying instances.” Kassin, Dror & Kukucka (2013) describe the various contextual influences which may generate bias in forensic evidence, in terms of: “ Knowing the nature and details of the crime, being pressured by detectives; working within – and as part of – the police; the use of computer-generated lists that feature some suspects ahead of others; appearing in court within an adversarial criminal justice system.”

Experiments in cognitive biases

The importance of cognitive psychology of expert evidence has been highlighted in a series of experiments conducted by Dr. Itiel Dror (2005) in which he had took the fingerprints from real criminal cases and presented them to the same fingerprint examiners who had previously given evidence at court. By changing the context for the analysis, such as strongly suggesting that a mark had previously been incorrectly matched to a print (or that a mark belonged to a particular suspect when in fact it did not), the examiners came to different conclusions, contradicting their own evidence given at court.

Dr. Dror’s experiments showed the influence that contextual and confirmation biases can have on the outcome of fingerprint analysis. The research found that fingerprint examiners were more likely to make a match judgment on ambiguous fingerprints when exposed to “ emotional background stories of crimes and explicitly disturbing photographs from crime scenes, as well as subliminal messages.” The researchers concluded

that examiners were more likely to confirm a match in ambiguous fingerprints when exposed to contextual biases highlighting the importance of cognitive psychology in fingerprint evidence.

To further highlight the importance of cognitive psychology in fingerprint evidence, an international panel of fingerprint experts convened to examine errors committed by the FBI which led to the identification of Brandon Mayfield note that “ the pressure of working on a high-profile terrorism case created an atmosphere which contributed to the misidentification.” (US Department of Justice, 2006, p. 177)

Error Rates and Probability

Error Rates

Experiments similar to those conducted by Dr. Dror (2005) have also been conducted by e. g. Ulery et. al. (2012) and Evett and Williams (1995). (Evett & Williams, 1995) All such studies find varying degrees of inconsistency. Ulery et. al. found that “ when the same fingerprint evidence is given to the same examiners, they reach different conclusions approximately 10% of the time.” (Kassin, et al., 2013) Ulery et. al. (2012: 9) attributed such errors to a “ lack of quantitative criteria and limited qualitative criteria for decision.” (Ulery, et al., 2012, p. 9)

Such error rates are only known as a result of research conducted where examiners were themselves the subject of research experiments. Mnookin (2008b) (Mnookin, 2008) as well as (Haber & Haber, 2003) and other researchers point to the lack of transparency of crime laboratories in disclosing the results “ double-blind” tests where e. g. one examiner discover

an error made by another examiner and that no data exist on the error rate correction resulting from the verification process.

Jasanoff (2006) notes the right of US citizens to “ receive information, including scientific and technical information, in order to effectuate the goal of informed participation.” (Jasanoff, 2006) However, considering the increasingly commercial nature of forensic laboratories, such error rate data is unlikely to be volunteered any time soon.

Probability

Aitken & Taroni (2004: 126) note that evaluation of fingerprint evidence is based on a statistical model of probabilistic inference. (Aitken & Taroni, 2004) Probability may be defined as “[a] statistical means of describing uncertainty.” (Brenner, 1997, p. 126) Galton (1892: 100) raised the problem of estimating the probability of two prints (“ alike in their minutiae”) as having been made by two different persons and attempted to give “ an approximate numerical idea of the value of finger prints as a means of Personal Identification.” Galton (1892: 110) calculated the probability of two different individuals having the same fingerprints (Type I error) to be “ less than 1 to 224 x 24 x 28” or about 1 in 64 billion.

Neumann (2012: 21) explains the difficulty of probability as faced by fingerprint examiners giving evidence at court: “ If it is his belief that the mark ‘ probably does’ or ‘ almost certainly does’ or ‘ is rather unlikely to’ match, he is forbidden to say so in court; in those cases, fingerprint evidence, for or against the accused, simply does not appear in the case.” (Neumann, 2012)

So, how common is it that examiners giving evidence at court aren't necessarily 100% certain of the evidence they give at court? According to research by Neuman et. al. it happens in 30% of the all comparisons performed. (Neumann, et al., 2011)

Galton notes the effect on probability when matching two or more marks to the prints of a known individual: " When two fingers of each of the two persons are compared, and found to have the same minutiae, the improbability of 1 to 236 becomes squared, and reaches a figure altogether beyond the range of the imagination; when three fingers, it is cubed, and so on. "[W]hen two, three, or more fingers in the two persons agree to that extent, the strength of the evidence rises by squares, cubes, etc., far above the level of that amount of probability which begins to rank as certainty." Galton (1892: 111-112)

Case Studies

Broeder (2006) notes that there have recently been several highly publicised appeals against criminal convictions around the world where forensic evidence has played a significant role in the identification of suspects. Broeder further notes that these have at least partly been " associated with inadequate standards of forensic expertise." The following case studies involve examples of Type I errors (false positives in fingerprint matching) made by examiners.

Case Study 1: Shirley McKie

In January 1997, DC Shirley McKie attended a crime scene in Kilmarnock, Scotland as part of an investigation into the murder of Marion Ross. A single

mark found at the scene was attributed to DC McKie who denied under oath that it could be hers. DC McKie was subsequently charged with perjury. At her trial, two fingerprint experts disputed the mark belonged to DC McKie. A jury later found DC McKie not guilty of perjury. In 2008, the Scottish Government appointed Sir Anthony Campbell to “ hold a public inquiry into the identification and verification of fingerprints associated with the case of HM Advocate v McKie in 1999”. Sir Campbell noted that “[t]he community of fingerprint experts is deeply divided over the case of Shirley McKie” and that some experts “ are perceived by others to be so closely associated with colleagues or organisations that have expressed an opinion that they are not universally regarded as being independent”. (The Fingerprint Inquiry, 2011)

Case Study 2: Brandon Mayfield

In 2004, the Federal Bureau of Investigation identified Brandon Mayfield’s fingerprints as a match to a single mark found on a bag containing explosives used in the Madrid train bombings on 11 March 2004. Mayfield’s fingerprints had been initially retrieved as a potential match using the FBI’s Integrated Automated Fingerprint Identification System (IAFIS). Upon closer examination, three fingerprint experts reviewing the initial result each confirmed that the mark belonged to Mayfield. (Stacey, 2004) The FBI launched a covert operation and Mayfield was subsequently arrested on 6 May 2004. An independent fingerprint expert appointed by the court to review the evidence (who also knew that a positive match had already been made) also concluded that the mark found did belong to Mayfield. Spanish Police informed the FBI that they had identified the mark as belonging to an Algerian national. After examining the prints of the Algerian national, the FBI

released Mayfield from custody. The Office of the Inspector General (OIG) concluded that the reason for the misidentification was due to the “ unusual similarity between the [latent print] and Mayfield’s known fingerprint” which had “ confused three experienced FBI examiners and a court-appointed expert”. (US Department of Justice, 2006)

Discussion

Fingerprint evidence was first used in the UK in 1858 and is the most common form of forensic evidence used at court today. Fingerprint evidence has also been raised as one of the most important categories of forensic evidence admitted at court. However, a study conducted by Baldwin and McConville (1980) found that forensic evidence played a significant role in only five per cent of cases presented at court.

Inman and Rudin (2002: 1) describe forensic science as “ an applied science based on the laws of physics and chemistry.” (Inman & Rudin, 2002) Whilst this might provide an appropriate definition of forensic science, it ignores the importance of psychology in forensic evidence.

The reliability of fingerprints as a means of identification (individualization) for purpose of evidence at court continues to be generally accepted by academia and the criminal justice system. Mnookin (2001: 16) argues that “ scrutiny of expert evidence does not take place in a cultural vacuum” and infers that fingerprint evidence was accepted too quickly in US courts. In 2013, a US District Court Judge ruled that the process fingerprint identification failed to meet three of the four criteria set for scientific evidence.

The technique hadn’t been scientifically tested

Wasn’t subject to scientific peer review

Didn’t possess a known rate of error

The ruling means that whilst the court accepts that the process of fingerprint analysis does not meet the standards set for scientific evidence, the testimony of expert fingerprint analysts may still be admissible as evidence at court.

Because the validity of fingerprint evidence is primarily based upon the credibility expert witnesses, challenges as to the validity of fingerprint evidence need to address the psychological aspects of forensic science, in other words – the potential cognitive (contextual and confirmation) biases of forensic experts resulting in false identification.

Part of this effort might involve simple solutions such as shielding fingerprint examiners from the details of crimes being investigated or having all fingerprint experts directly appointed by the courts. Other requirements might involve a minimum of two marks or more having to match the prints of a suspect before it can be used as evidence at court.