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Continuing Legal Education for Criminal Lawyers

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***FORENSIC SCIENCE EVIDENCE: RECENT RESEARCH IMPACTING RELIABILITY***

## Introduction

When confronted with forensic science evidence it is not uncommon for practitioners and jurors alike to accept it as Gospel. Even with our propensity to question everything, the ‘longstanding claims about the infallibility’ of this type of evidence, have resulted in a reluctance to challenge it.

But this infallibility is not warranted. The UK and US have been leaders in challenging Forensic Science, far beyond Australia. The result of their studies has shown that the reliability of some Forensic “sciences” is questionable. Their conclusions can assist practitioners and the legal profession at large in properly challenging expert evidence in court, to ensure evidence which is presented against an accused is, as far as possible, safe, or that its failures are clearly outlined.

This paper reviews the position of the US and Australia. It looks at the impact of the recent Obama administration Review of Forensic Science evidence, and how defence practitioners can adapt its findings to assist their defence of clients, especially when challenging expert evidence.

## Need for Change – Courts and Governments review Forensic Evidence

*“The Forensic science system, encompassing both research and practice, has serious problems that can only be addressed by a national commitment to overhaul the current structure that supports the forensic science community in this country. This can only be done with effective leadership at the highest levels of both federal and state governments, pursuant to national standards, and with a significant infusion of federal funds.”<sup>1</sup>*

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<sup>1</sup> National Research Council, ‘Strengthening forensic science in the United States: A path forward’ (2009) Preface xx

Forensic Science has in the past been called infallible and then shown not to be. Science is always evolving and so is the methods used. Reviews of the sciences has led to exonerations of persons wrongly accused. In the last 10 years, many studies have looked at wrongful convictions and accusations caused by a reliance on faulty expert evidence. Some examples include the 2005 US Department of Justice review of the case of Braydon Mayfield. This is a case where the FBI identified using fingerprint evidence Braydon Mayfield as match for evidence found at the site of the Madrid train bombing. The conclusion of the report was that there had been too much focus on finding similarities in the prints at the expense of the differences.

In 2009 a study was released in the United States entitled “Strengthening Forensic Science in the United States: A path forward” (herein referred to as the NAS report). The study was performed by the National Academy of Science (NAS) (an independent body of scholars) at the request of Congress. It provided the entire international legal community with a basis for change in the area of Forensic Science evidence.

The research was funded because of concerns on the validity of some of the scientific processes relied on as expert evidence at trial. It was deemed necessary due to the wide-reaching impacts of this evidence in the criminal justice system. The concerns outlined by the American Congress included that of the disparity in the practice of this science was leading to inconsistent practices.

*“There are great disparities among existing forensic science operations in Federal, State and Local Law enforcement jurisdictions and agencies. This is true with respect to funding, access to analytical instrumentation, the availability of skilled and well trained personnel, certification, accreditation and oversight”.<sup>2</sup>*

Amongst the NAS’s conclusions, it called for an overhaul of the scientific practices, requiring rigorous peer reviewing of techniques, further research into validity and for a Nationwide standard to address inconsistent practices. The result of the NAS recommendations was that from 2009 until today, several fields have launched empirical studies trying to support their ‘specialised knowledge’ to address the concerns which were raised.

Then in 2016, the US Congress released its report, which followed on from the NAS. This report is entitled “Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods”. It was drafted by the President’s Council of Advisors on Science and Technology (PCAST). Released in September 2016 the report looks at past and recent studies in the fields of forensic sciences most commonly used in criminal courts. Its conclusions include that several fields have no scientific foundation, and others, with foundational validity, require better disclosure of their limitations.

The concerns regarding expert evidence extended beyond the United States. In 2005 in New South Wales, the NSW Law Reform Commission and the NSW Attorney General’s Civil Procedure Working Party performed reviews on expert evidence and its use in civil proceedings. It concluded in revised Code of Conduct for Expert Witnesses.

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<sup>2</sup> National Research Council, ‘Strengthening Forensic Science in the United States: A Path Forward’ 2009 National Academies Press (NAS Report) page 5.

Justice Stuart Morris of Victoria stated in a paper he presented in 2005:

*“Judges harbour a strong anxiety about the use of expert evidence in court, which can be explained in several ways. Questions have been raised about levels of competence, lack of training and accreditation of so-called experts. ... an over reliance on expert evidence may shift the burden of responsibility from the Bench to the witness box”.*<sup>3</sup>

However, the US has been the leader in questioning the validity of certain sciences. The PCAST’s findings should assist Courts, Jurors and practitioners in Australia question the admissibility of expert evidence in Courts. The continuation of this paper looks at the findings in specific fields, especially in Fingerprint and DNA evidence and its impact on admissibility of evidence in Australian Courts.

## General concerns about expert opinions in forensic science evidence

Forensic sciences are widely used in courts as sources of evidence. Often they provide the only concrete evidence of identity of an accused person. However there are general concerns which apply to their use. These include reliability, validation, bias and limitations. In writing this paper I am drawing from the extensive work of Professor Gary Edmond in this area.

His conclusion in a very useful paper on cross-examining experts<sup>4</sup> include:

1. That without properly constructed validation studies showing that experts have more to provide in their opinions than the law person, practitioners should object to the relevance of an opinion. DNA and Fingerprint evidence have provided studies validating specialised knowledge, however many other fields have not. In fact in the field of bitemark analysis it is quite the contrary, with studies finding that odontologist have “very limited abilities when it comes to comparing bite marks in order to identify a biter”<sup>5</sup>
2. That an experts qualifications and experience are not substitutes for scientific validation
3. “Limitations and information about potential sources of error should be included in reports and testimonies”<sup>6</sup>
4. Bias and domain irrelevant information should be made clear in reports so that the Courts and Jurors can make a proper assessment of its impact – but further should be made clear to the otherwise so that any other expert can review the decision and the impact of the irrelevant information on the opinion

## Expert evidence and the law in NSW

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<sup>3</sup> Judge Stuart Morris, ‘Getting Real about Expert Evidence’ (Paper presented at the National Environment Law Association Limited, 2005 National Conference, Canberra, 13-15 July 2005)

<sup>4</sup> G Edmond, K Martire, R Kemp, and others, ‘How to cross-examine forensic scientists: A guide for lawyers’ (2014) 39 *Australian Bar Review* 180.

<sup>5</sup> Beecher-Monas, E. ‘Reality Bites: the illusion of science in bite-mark evidence’ 2008 30 *Cardozo L Rev* 1369

<sup>6</sup> *Ibid* 4 page 180

To be admissible, an opinion must first be relevant. In the Uniform Law states, it is then subject to section 79 of the Uniform Evidence Act which governs expert evidence. It reads:

- (1) If a person has specialised knowledge based on the person's training, study or experience, the opinion rule does not apply to evidence of an opinion of that person that is wholly or substantially based on that knowledge.
- (2) To avoid doubt, and without limiting subsection (1):
  - (a) a reference in that subsection to specialised knowledge includes a reference to specialised knowledge of child development and child behaviour (including specialised knowledge of the impact of sexual abuse on children and their development and behaviour during and following the abuse), and
  - (b) a reference in that subsection to an opinion of a person includes, if the person has specialised knowledge of the kind referred to in paragraph (a), a reference to an opinion relating to either or both of the following:
    - (i) the development and behaviour of children generally,
    - (ii) the development and behaviour of children who have been victims of sexual offences, or offences similar to sexual offences.

An expert must prove they have specialised knowledge. In *Makita (Australia) Pty Ltd v Sprowles* (2001) 52 NSWLR 705 Heydon JA stated that for an opinion to be admissible it must be "agreed or demonstrated that there is a field of 'specialised knowledge'; there must be an identified aspect of the field in which the witness demonstrates that by reason of special training, study or experience, the witness has become an expert".

The need to demonstrate a field of specialised knowledge is particularly important in light of the rigorous studies and the PCAST's conclusions that many fields of forensic science have no foundational validity. If a field has no foundational validity, it cannot be said to be a field of specialised knowledge, and it follows that any opinion should be excluded.

*Dasreef* (2011) 277 ALR 611 highlighted the need by the tendering party to first establish the relevance of the opinion. In the context of Forensic Science evidence, it is often the case that the fact in issue is identity.

District Court Judge Andrew Haesler in his paper "Presenting expert evidence opinion evidence in Australian Courts" summarised the principles stated by Heydon JA in *Makita (Australia) Pty Ltd v Sprowles* into 10 useful points:

- 1. There must be agreed or demonstrated that there is a field of 'specialised knowledge'.*
- 2. There must be an identified aspect of that field in which the witness demonstrates that by reason of specified training, study or experience, the witness has become an expert.*

3. *The opinion proffered must be 'wholly or substantially based on the witness' expert knowledge'.*
4. *So far as the opinion is based on facts 'observed' by the expert, they must be identified and admissibly proved by the expert, and so far as the opinion is based on 'assumed' or 'accepted' facts, they must be identified and proved in some other way.*
5. *It must be established that the facts on which the opinion is based form a proper foundation for it.*
6. *The opinion of an expert requires demonstration or examination of the scientific or other intellectual basis of the conclusion reached: that is, the expert's evidence must explain how the field of 'specialised knowledge' in which the witness is expert by reason of 'training, study or experience', and on which the opinion is 'wholly or substantially based', applies to the facts assumed or observed so as to provide the opinion propounded.*
7. *The report and evidence must furnish the jury or trial judge with the necessary scientific criteria for testing the accuracy of its conclusions?*
8. *It must enable the formation by the jury or trial judge of an independent judgment by applying the criteria furnished to the facts proved?*
9. *It must be intelligible and testable.*
10. *It must go beyond a bare assertion without proof"*

The concern is, even if a report does not appropriately follow the above guidelines, it can still be admissible. In fact it may still be admissible, even if bias is found.<sup>7</sup>

Recently the High Court unfortunately has failed to decide on the issue of Forensic Evidence at trial. In the case of *Forbes v The Queen* [2010] HCAASP 18 (17 May 2010) the High Court refused special leave for an appeal on the following two points:

*"Whether the verdict was unjust or unsafe because DNA evidence standing alone was not capable of proving the applicant's guilt beyond reasonable doubt; and*

*Whether the verdict was unjust or unsafe having regards to the exculpatory evidence when the only evidence identifying the applicant was DNA evidence"*<sup>8</sup>

The concern is that in refusing special leave on these questions (and similarly in the case of *R v Parker* [1912] VLR 152) the High Court is putting in place precedent that a conviction based on a single piece of forensic evidence is safe.<sup>9</sup> It is the hope of many that there will be a case raising this issue which will soon go to the High Court, but at this stage practitioners

<sup>7</sup> *Kyluk Pty Ltd v Chief Executive, Office of Environment and Heritage* [2013] NSWCCA 114

<sup>8</sup> Short Particulars of Appeal, *Forbes v The Queen* [2010] HCAASP 18

<sup>9</sup> See Jeremy Gans, 'A tale of two High Court Forensic Cases' 2011 Sydney Law Review Vol. 33

have do to the best they can to combat this idea that Forensic Science evidence (especially DNA and fingerprint) is infallible.

As a result practitioners need fight at trial to either convince the Court that the piece of evidence's probative value is either low or non-existent, that the evidence should be deemed inadmissible at trial, or to be able to successfully argue that it is not relevant. Again in this area, the law is sometimes stacked against the Defence. In Victoria the Court has applied Justice Gaudron's views in *Adam v The Queen* (2001) 207 CLR 96 on probative value and its assessments. In this decision he stated that when assessing probative value one does not take into account reliability (here of the opinion). The Victoria Court of appeal in *Dupas* [2012] VCA 328 refused to follow Spigleman CJ in *Shamouil* (2006) NSWLR 228 where he stated that reliability and credibility were to be taken into account in determining probative value.<sup>10</sup> This is concerning when the findings of the PCAST described below raise significant issues on not only reliability of some forensic sciences but also their foundational validity. New South Wales on the other hand has followed a different course, holding that *Shamouil* was good law and should be followed.<sup>11</sup>

A Defence practitioner's arsenal includes using the steps in *Makita* to form an argument that reliability is a paramount consideration to the assessment of **scientific specialised knowledge**. Among other options include the discretions pursuant to section 137 of the Uniform Evidence Act. The concern in this course is that commonly the court will address any prejudice by directions to a Jury rather than by way of refusing to put the evidence before a Jury.<sup>12</sup>

As Judge Haesler stated in his paper at page 7 "court all too readily allow any expert forensic evidence no matter how unreliable to go into the mix at trial, resulting in injustice to an accused and consequent undermining of the reputation of the justice and jury system".

## Need for foundational validity

In order to be foundationally valid a scientific method must:

1. Be able to be reproduced;
2. Provide supported empirical studies of both the error rate and the sensitivity of the method.

The answer of the PCAST report is that black box studies are required to provide a scientific support to the science. Because many of the fields have a subjective element, concerns include the impact of human errors as humans "(1) may tend naturally to focus on

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<sup>10</sup> *Shamouil* (2006) NSWLR 228 at [60]

<sup>11</sup> *XY v R* [2013] NSWCCA 121

<sup>12</sup> See Haesler A, 'Presenting Expert Opinion Evidence in Australian Courts', Presented at Legal Eagles Conference in Hanoi 3/1/2014-8.1.2014

similarities between samples and discount differences and (2) may also be influenced by extraneous information and external pressures about a case".<sup>13</sup>

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<sup>13</sup> PCAST page 49

## Fingerprint Evidence

Foundationally valid but with a high error rate

*“Uniqueness does not guarantee that prints from two different people are always sufficiently different that they cannot be confused, or that two impressions made by the same finger will be sufficiently similar to be discerned as coming from the same source”*

Surprisingly, for an area of Forensic Science evidence which has been relied on in Criminal Courts for more than 100 years<sup>14</sup>, latent fingerprint evidence was only recently validated.<sup>15</sup>

### Methodology

In Australia, similarly to the US and the UK, the ACE-V system is used by Police and investigators. ACE-V is short for Analysis, Comparison, Evaluation and Verification.

1. Analysis – requires an expert to review the latent fingerprint (fingerprint taken at a crime scene for instance) and assess whether the print is of good enough quality to compare. Factors considered include clarity, surface type, development method and distortion.<sup>16</sup>
2. Comparison – subjective observation by the examiner of the latent fingerprint and an impression of a suspect (often obtained from a police database). In this stage an expert will review the ridges in each print to determine whether or not there is agreement.
3. Evaluation – Based on the information concluded in stage 1 and 2, the examiner can then make the following conclusion:
  - a. Identified
  - b. Not Identified
  - c. Exclusion
  - d. Insufficient
4. Verification – After the examiner has concluded steps 1, 2 and 3, another examiner undertakes the same steps and confirms whether they agree with the conclusion of the first examiner.

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<sup>14</sup> See J M Tangen, M B Thompson and D J McCarthy, ‘Identifying fingerprint expertise’ (2011) 22 *Psychological Science* 995; PCAST page 87

<sup>15</sup> J M Tangen, M B Thompson and D J McCarthy, ‘Identifying fingerprint expertise’ (2011) 22 *Psychological Science* 995; B T Ulery, R A Hicklin, J Buscaglia and M A Roberts, ‘Accuracy and reliability of forensic latent fingerprint decisions’ (2011) 108 *Proceedings of the National Academy of Sciences of the United States of America* 7733. See G Edmond, K Martire, R Kemp, and others, ‘How to cross-examine forensic scientists: A guide for lawyers’ (2014) 39 *Australian Bar Review* 180.

<sup>16</sup> See Annexure A



## Reliability - Studies and their findings

### 1. Identifying Fingerprint Expertise – A 2011 Australian Study

The study, published in 2011, came at the back of the National Academy of Sciences' report in 2009 condemning experts' claims to infallibility and requiring urgent need for research around latent fingerprint analysis.<sup>17</sup>

The study compared 37 lay persons to 37 qualified fingerprint experts. We are not provided with the details of their qualification or "specialised expertise". The study showed each examiner prints taken from the Forensic Informatics Biometric Repository. Each print was then randomly associated with a fully rolled print which was either from the same individual, a different individual with similar print features (similar-distractor) or a 'random nonmatching' print.

The study found that the qualified, trained experts, "performed exceedingly well" finding that "on the 12 similar-distractor trials, experts correctly declared nearly all of the pairs (99.32%) to be nonmatches (correct rejection); only 3 pairs (0.68%) out of 444 in this condition were incorrectly declared to be matches..."

The conclusion was that "... *Court-practicing fingerprint experts are exceedingly accurate compared with novices, but are not infallible. Our experts tended to err on the side of caution by making errors that would free the guilty rather than convict the innocent. Even so, they occasionally made the kind of error that can lead to false convictions*".

#### CRITICISM:

It is worth noting that the study did not research the impact of bias and 'domain irrelevant information' on validity and reliability. The study in this respect may not be a true reflection of what occurs when examiners examine prints from a crime scene.

Further the study required all examiners to rate their decision from a 1 to 12 basis – 1-6 as identifying matches and 7-12 as identifying exclusions. The *Report to the President. Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods* criticised the studies approach, stating that "the approach does not correspond to the procedures used in conventional fingerprint examination" that is ACE-V method in Australia. It thus makes it problematic for experts using the ACE-V method, to rely on the findings of this study to describe themselves as 'exceedingly accurate' when the study did not use the same rating system. The President report noting "the study does not constitute a black-box validation of latent fingerprint analysis because its design did not resemble the procedures used in forensic practice..."<sup>18</sup>

The study had a limited scope and focus, however it provides good basis to build on and assists the Courts in determining the relevance of fingerprint expert evidence. Given its

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<sup>17</sup> Above n 12

<sup>18</sup> PCAST page 93

findings support that experts using their specialised knowledge can provide an opinion which is more accurate than that of the lay person – making their opinion capable of rationally influencing the assessment of a fact in issue.<sup>19</sup>

## **2. Accuracy and reliability of forensic latent fingerprint decisions – FBI Study – recently supported by the Report to the President as a black-box study – 2011<sup>20</sup>**

In this study the FBI assembled 744 pairs of fingerprints – 520 were matches which 224 were non-matches.

169 examiners examined 100 prints and were asked to use the ACE system (no verification). Out of 3628, 6 were wrongly identified as matches. It found a 7.5% false negative error rate with 85% of examiners making at least one false negative error.<sup>21</sup>

The error rate in the study was found to be as high as 1 error in 306 cases. The false positive rate was 1 error in 604 cases or 0.17%.

## **3. Miami-Dade Study – 2014 – American black-box study<sup>22</sup>**

This study found 42 false positives in 995 comparisons. The false positive error rate of this study was 4.2% - 42 false positives in 995 examinations. This study was the first to look at the impact of bias. The conclusion is an error rate as high as 1 in 18 cases.

Despite what appears to be a low error rate, its impact can be much higher than expected. The PCAST report concluded that these error rates need to be made clear to the Jury in criminal trials; “it would be appropriate to inform jurors that (1) only two properly designed studies of the accuracy of latent fingerprint analysis have been conducted [of the ACE-V system] and (2) these studies found false positive rates that could be as high as 1 in 306 in one study and 1 in 18 in the other study. This would appropriately inform jurors that errors occur at detectable frequencies, allowing them to weigh the probative value of the evidence”.

Identification in expert opinion

NSW District Court Judge Andrew Haesler SC in his paper “Presenting Expert Opinion Evidence in Australian Courts” formulated his concerns about fingerprint evidence, echoing the NAS report on the issues of uniqueness of fingerprints. He stated that “To date some

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<sup>19</sup> Evidence Act 1995 (NSW) ss55, 56.

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<sup>21</sup> Ulery, B.T, Hicklin, R.A, Buscaglia, J. and M.A. Roberts. ‘Accuracy and reliability of forensic latent fingerprint decisions’ 2011 vol 18 No 19 *Proceedings of the National Academy of Sciences*. See also PCAST page 94; Gary Edmond and Kristy Martire, ‘Forensic science in criminal courts: The latest scientific insight’, 2016 42 *Australia Bar Review* 367

<sup>22</sup> Pacheco, I., Cerchiai, B., and S. Stoiloff. ‘Miami-Dade research study for the reliability of the ACE-V Process: Accuracy & precision in latent fingerprint examinations’ (2014) [www.ncjrs.gov/pdffiles1/nij/grants/248534.pdf](http://www.ncjrs.gov/pdffiles1/nij/grants/248534.pdf)

problems with long accepted areas of expert opinion have yet to be identified and acted on by Australian Courts. I am particularly concerned about our continued complacency in accepting fingerprint evidence about identification".<sup>23</sup>

In their extensive academic research on the subject of forensic science and the law Professor Gary Edmond and his collaborators, including Bryan Found have criticised the reports provided by experts in criminal proceedings, especially with reference to evidence of identification.<sup>24</sup> There are not the only persons in our profession who hold concerns about opinions which provide that an accused is identified through a latent fingerprint.

Lord Campbell's inquiry in 2011 on Fingerprint procedures in Scotland made several recommendations. Among them was that experts, when providing their opinions, should refrain from identifying individuals as the source of a latent fingerprint.<sup>25</sup> His recommendation was that "examiners should discontinue reporting conclusions on identification or exclusion with a claim to 100% certainty or on any other basis suggesting that fingerprint evidence is infallible".<sup>26</sup>

The 2009 NAS Report went further than that stating that "population statistics for fingerprints have not been developed, and friction ridge analysis relies on subjective judgments by the examiner"<sup>27</sup>. This led to its recommendation that examiners should "not report or testify, directly or by implication, to a source attribution to the exclusion of all others in the world".<sup>28</sup>

The main reasons<sup>29</sup> behind this recommendation include:

1. The reliance of the ACE-V process on latent fingerprints. Latent fingerprints can be impacted by the elements including the surface it is left on, the oils on the skin and they can be distorted.
2. The inability to pin-point specific features which should be compared. Unlike the process for analysing DNA (which relies on comparing in each sample the same 13 segments of DNA), friction ridge analysis can only compare features which have been captured in the original latent print. Examiners cannot have a pre-determined set of features to analyse because they may simply not have been captured.
3. The lack of any real research or statistics focused on the uniqueness of fingerprints.
4. Subjectivity. This again goes to the issue of human error. It includes issues relating to bias and the examiner's abilities.

Yet, despite the professions' close look (in Australia and overseas) at late on Forensic Science (and fingerprint evidence in particular), it seems experts have not amended the

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<sup>23</sup> See Haesler A, 'Presenting Expert Opinion Evidence in Australian Courts', Presented at Legal Eagles Conference in Hanoi 3/1/2014-8.1.2014 page 6

<sup>24</sup> Edmond G, Kristy M and others, 'How to Cross-examine forensic scientists: a guide for lawyers' 2014 39 Australian Bar Review HOW TO CROSS EXAMINE PAGE 189

<sup>25</sup> A Campbell, *The Fingerprint Inquiry Report*, APS Group Scotland, 2011

<sup>26</sup> Above n 10, p 740.

<sup>27</sup> NAS REPORT PAGE 139

<sup>28</sup> NAS report 142-5

<sup>29</sup> SEE NAS AND PRESIDENT REPORT GENERALLY

reporting process to address the recommendations that were made, including those of the NAS Report in 2009. Even today Criminal law practitioners are not surprised to read Expert statements not only declaring that a fingerprint found at a crime scene matches that of an accused, but also that the expert opines that the accused person is identified as the source of the fingerprint.

## Case study: Australian Fingerprint expert statement

Applying international research findings to currently used expert statements, it is clear that, as described, the desire for experts to support their finding beyond their scientific value is not only current but concerning.

In NSW, it is common for Police Fingerprint expert reports to be based on a pro-forma documents. Annexure A of this paper is a copy of an expert statement tendered in a brief in support of a charge of break and enter. The only evidence available to support the charge was that the accused resides a short distance from the premises and that the accused's fingerprint was located on a movable object (a lamp) in the premises. Evidence was relied on from a witness to express that the lamp had not moved from the premises for 20 years.

Using the principles from the NAS and PCAST report, there are many issues which can be gleaned from the report. It is worth noting that this report was created in December 2016. The findings of the NAS and PCAST were available. Two significant problems include:

1. Identification conclusions made by the report;

Paragraph 8 of the report provides that from the latent fingerprint on "the standing lamp in the living room" the accused was identified. The issues outlined with identification were made clear in the NAS and PCAST reports.

"Uniqueness does not guarantee that prints from two different people are always sufficiently different that they cannot be confused, or that two impressions made by the same finger will be sufficiently similar to be discerned as coming from the same source"

2. Failure to state the error rate appropriately;

Page 7 of the report provides one paragraph about the potential for error. It does not within the contained paragraph provide any quantifiable data regarding error rates and up to date studies on the subject. It fails to note the limitations of the science, including the last of validation studies. In my view, it provides only a vague indication that errors can occur without providing any empirical data.

But further to that its choice of words is particularly interesting. It states that "studies have demonstrated that qualified, practicing fingerprint experts are 'exceedingly accurate' when performing fingerprint identification".<sup>30</sup> Given the fact that this quote references the Tangen, Thompson and McCarthy Australian study comparing novices to experts – the quote is misleading. It does not qualify that the study's conclusion was that the accuracy of expert is measurable compare with the lay person. The full quote is in fact "exceedingly accurate compared with novices but are not infallible".

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<sup>30</sup> Annexure A page 7

3. Failure to provide any information about the specific conclusions from this case and any information available to the examiner;

The report fails to provide an outline of what information was provided by to the examiner before a conclusion was reached. It also fails to provide any information about who the verifier is and what information they had. The ACE-V system provides for verification, but as stated in the body of the paper, confirmation bias can occur, especially in circumstances where the verifier knows the conclusion of the examiner and knows the examiner.

Studies have shown that, in subjective analysis, bias can play a significant role. It is important when such evidence is left to a Jury or a Magistrate, that a report contains as much information as possible to assist the court in making a conclusion on the potential for bias and thereby its impact on probative value.

*The views expressed in this paper and its contents are the views of the author alone and do not represent the Legal Aid Commission of NSW.*

## DNA analysis

*“It is often impossible to tell with certainty which alleles are present in mixture or how many separate individuals contributed to the mixture, let alone accurately to infer DNA profile of each individual” – PCAST report page 76.*

DNA evidence is well established and has been the bench mark against which other forensic science evidences are compared, both in their scientific method and reliability. The advantage DNA testing has over many other forensic sciences is that it is in large parts objective. A human factor remains and in all areas where humans are involved in the conclusion, there is room for error. However, the errors appear mainly limited to contamination, testing of the wrong samples, incorrectly reported information.<sup>31</sup>

In the criminal system, DNA evidence is mostly seen in two fashions. Again a science which purports to provide identification evidence in most cases, the commonly seen tests include:

1. Evidence of DNA from a single source – DNA of a known person (often the victim or a witness) and from another source (generally the evidence tries to link that source as the accused);
2. Evidence of DNA from several sources – for instance a blood stain, DNA on an object or in a property;

While evidence tested from a single source, or two sources where one is known to the examiner, is considered not only foundationally valid in its method but also reliable<sup>32</sup>, DNA analysis from complex sources unknown to the examiner (2 or more) received a lot of criticism from the PCAST report.

The benefits of DNA analysis from a single source is that it is “an objective method”. Where a DNA sample contains a mixture of two individuals but one is known, it is a simple and recognised process. It allows for the extraction of the known DNA sequences (alleles) leaving the examiner with the unknown source. The results can be clearly read and analysed and it “involves little or no human judgment”. Laboratory protocols are also clearly defined and quality assurance has been at the forefront, trying to ensure that human errors are limited.<sup>33</sup>

The strength of DNA analysis, beyond that of other forensic sciences, is its limited human involvement in the scientific conclusion. However, when an examiner reviews DNA evidence from what the PCAST calls “Complex-mixture Samples”, the methodology now requires human judgment – and that is where the problems begin.

When examining DNA from a single source or a complex mixture source, the scientific process remains the same – that is the DNA sample is put through an enzyme reaction which results in a specific segment of 13 loci. Each loci has two sets of alleles (paternal and maternal).<sup>34</sup> The way the methodology differs is that in complex mixture source analysis, the examiner is required to make judgment on the produce alleles and reach a conclusion as to whether the results are consistent

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<sup>31</sup> PCAST report page 73

<sup>32</sup> PCAST report page 7.

<sup>33</sup> PCAST report page 77. See Bieber, F.R, Buckleton, J.S, Budowie, B., Butler, J.M, and M.D. Coble, “Evaluation of forensic DNA mixture evidence; protocol for evaluation, interpretation and statistical calculations using the combined probability of inclusions” BMC Genetic – [bmegenet.biomedcentral.com/articles/10.1186/s12863-016-0429-7](http://bmegenet.biomedcentral.com/articles/10.1186/s12863-016-0429-7)

<sup>34</sup> PCAST report pages 69-73

with a specific DNA profile. As the PCAST put it – the question is “could a suspect’s DNA profile be present within the mixture profile?”

Amongst the scientific issues associated with the process of answering that question, it also leaves an examiner open to bias.<sup>35</sup> Providing a suspect profile and looking for a probability of match increases the desire to interpret data in such a way to find the suspect profile within the sample. The PCAST found that “because many different DNA profiles may fit within some mixture samples, the probability that a suspect “cannot be excluded” as a possible contributor to complex mixture may be *much higher* (in some cases, millions of times higher) than the probabilities encountered for matches to single-source DNA profiles”.<sup>36</sup>

The PCAST found that “the interpretation of complex DNA mixtures with the CPI [Combined Probability of Inclusion] statistic has been an inadequately specified – and thus inappropriately subjective – method. As such, the method is clearly no foundationally valid”.<sup>37</sup>

Why is this a problem? Examiners provide conclusions in DNA expert statements about the presence of a matching DNA profile to the accused with statistical frequencies – eg 1 in a million cases. Yet this is inaccurate and should not be done. Because the task undertaken in coming to that conclusion is extremely subjective and requires an examiner to make a judgment on the “Combined Probability of Inclusion” or CPI, the conclusions can change depending on the examiner and “lead to inaccurate answers”<sup>38</sup>. This was made very clear in the case of *Winston v Commonwealth* 604 S.E.2<sup>nd</sup> 21 (va. 2004), a US death penalty case. The accused was convicted and sentenced to death. Evidence was adduced at trial that his DNA profile was consistent with the mixed DNA sample found on a glove. It was reported as a 1 in 1.1 billion chance of a match. Yet further research in 2009 revealed that the accurate representation was closer to 50% of the population – that is 1 in 2 persons could have been a contributor. This appeared to be a systematic issue with research concluded in 2016 in US finding that the lack of consistency in the use of CPI and the poor understanding of its limitations means the practice requires an overhaul.<sup>39</sup>

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<sup>35</sup> See Dror, I.E, and G. Hampikian, “Subjectivity and bias in forensic DNA mixture interpretation” *Science & Justice*, Vol 51, No. 4 (2011). This study reviewed the decision of two examiners in finding the accused a match. They tested a further 17 experts without providing them with the information the two original examiners had on the nature of the crime, plea bargain and evidence of co-accused. Only one in 17 found the accused’s DNA profile was present.

<sup>36</sup> PCAST page 76

<sup>37</sup> PCAST page 78

<sup>38</sup> PCAST page 76

<sup>39</sup> PCAST page 78. For further reading on the systematic issues in the systems of using CPI and differing outcomes depending on the examiner – see Bieber, F.R, Buckleton, J.S, Budowie, B., Butler, J.M, and M.D. Coble, “Evaluation of forensic DNA mixture evidence; protocol for evaluation, interpretation and statistical calculations using the combined probability of inclusions” *BMC Genetic* – [bmcgenet.biomedcentral.com/articles/10.1186/s12863-016-0429-7](http://bmcgenet.biomedcentral.com/articles/10.1186/s12863-016-0429-7)



## Case study: Australian DNA expert statement

Similarly to the Fingerprint expert statements, the explanations and scientific support for the opinion is contained in a pro-forma document. Annexure B is an expert statement from a complex mixture DNA sample analysis from NSW. It was included as part of a brief of evidence. It purports to identify the accused person with a ratio of 1 in 100 billion.

The pro forma document in my view, and supported by the findings made in the PCAST fails in several ways. It should be noted it is dated 27 July 2017 – yet there is no mention of the PCAST findings and its conclusions.

1. It fails to provide any information about error rates;
2. It fails to reference any information about the risks and limitations of subjective comparison analysis and of ratios;

## Conclusion

The recent research that has come out of our friends across the water has a significant impact on our use of expert evidence at trial, especially when the evidence purports to provide identification of accused persons. This is strengthened when the prosecution case is lacking.

The content of this paper is a short overview of a large pool of research and papers from Australia, the US and other countries. It hopefully provides a new context in which defence practitioners can use findings from the NAS and PCAST reports to challenge expert evidence at trial.

The conclusions of the reports are that much work needs to be done in the areas of Forensic Science and the Legal profession should not take expert findings as foolproof.