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Chapter 10 Expert analysis: Facial Image Comparison

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R v Tang (2006) 65 NSWLR 681 (New South Wales, Australia)

Three armed robbers targeted a convenience store in Ultimo, Sydney at about 3.55am on 14th March 2003 and were recorded on poor-quality surveillance video. Two of the robbers were arrested approximately 40 minutes later as the car in which they were travelling was found to contain property similar to that stolen from the store. DNA tests also linked items in their vehicle to the crime scene. Both confessed.

Approximately eight months later Tang came to the attention of the police as being potentially the third robber as his fingerprint matched a print recovered on the stolen goods. An anatomist was asked to compare the images of the robbery with images of Tang. In court, providing opinion evidence as an expert witness, she concluded that one of the offenders depicted in the video and the defendant Tang were 'one and the same'. Specifically she argued:

1) That the two photographs depicted the same person

2) That there was a level of support to this conclusion by application of a six-point scale (e.g., see Table 1)

3) That certain characteristics were "unique identifiers"

Tang was found guilty and the admissibility of this evidence was challenged on appeal. In its ruling, the New South Wales Court of Criminal Appeal noted that the

anatomist had based her conclusion on the comparison of facial and body features, respectively - 'facial mapping' and 'body mapping'. The Court did not accept that there was a field of body mapping but accepted the existence of expertise in facial mapping, although doubts were raised that the field was sufficiently developed to facilitate a *positive* identification. Therefore, in the absence of evidence to the contrary, the Court ruled that image analysts were not to positively identify those appearing in images. Nevertheless, because the anatomist had spent time looking at the images of the robbery and the defendant the Court considered that she had become an *ad hoc expert*. She was, therefore, entitled to express her opinion about similarities between the defendant and the person of interest. For the Court, the fact that this was perceived as a difficult task for the jury, made it all the more important to have the assistance of an expert.

The appeal was allowed primarily because the anatomist had positively identified the person of interest as Tang. The Court accepted that the evidence of the anatomist would be admissible at the re-trial. However it would be limited to describing similarities between the facial features of the defendant and the individual in the CCTV footage of the robbery. In *Tang*, the Court explicitly rejected the need for expert opinion based on 'specialised knowledge' (required under the uniform evidence law) to be reliable.

At the re-trial the prosecutor did not adduce the 'expert' image evidence and Tang was, nonetheless, convicted.

Morgan v R [2011] NSWCCA 257 (New South Wales, Australia)

On 11th January 2008 a red Audi vehicle was stolen from a residence in Sydney and six days later, two hotels were robbed by two armed men clothed from

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head to toe - including balaclavas. One of the robbers carried a sledgehammer. A red Audi car had been parked close to each hotel at about the time of the robberies. Three months later a key to the missing Audi was found in Morgan's possession. The prosecution case was that Morgan was the robber wielding the sledgehammer.

Morgan was more than 6 foot tall, whereas four witnesses described the robber holding the sledgehammer as between 5 foot 5 inches and 5 foot 9 inches (165-176 cm). Nevertheless, based on poor quality CCTV footage and still images from both hotels, as well as moving and still images of Morgan taken at the time of his arrest, an anatomist provided expert opinion evidence that the robber holding the sledgehammer was very likely to be Morgan. The anatomist generated an indication of the frequency of points of similarity using figures he claimed to be favourable to the defendant (i.e. conservative) and provided the following summary, "I am of the opinion that there is a high level of anatomical similarity between the offender and the suspect. My opinion is strengthened by the fact that I could not observe on the suspect any anatomical detail different from those I could discern from the CCTV images of the offender."

Three additional experts, called by the defendant (so-called rebuttal witnesses), offered different perspectives. The first, a forensic psychologist, observed that by employing a morphological approach to evaluating the evidence, the prosecution expert had not used an established scientifically valid or reliable method. No anthropometrical data, statistical likelihood of error or proportion of members of the population who may possess similar anatomy had been provided. He also noted that the offender was entirely obscured by clothing, reducing the reliability of any anatomical analysis. The second expert, a forensic photographer, additionally focused on the effects of the CCTV camera lens above head height distorting the appearance

4

of the depicted offender. The final expert, the forensic anatomist who testified in *R v Tang*, supported the opinions of those above, additionally pointing out that no scientifically standardized quantitative or qualitative analysis had been conducted.

The Court of Appeal found the prosecution expert's opinion to be inadmissible, quashed the guilty verdict and ordered a new trial. According to the Court, the expression used by the anatomist went beyond the mere description of similarities. Moreover, it was unclear how the anatomist's 'training, study or experience' provided 'specialised knowledge' that enabled him to compare low quality images with police reference images, especially where the person of interest's body was covered.

Introduction

Photographs and moving visual images have been presented as evidence in courts for at least 150 years (*R v Tolson,* 1864; Finn, 2009; Feigenson & Spiesel, 2009), with the first use of CCTV images for criminal proceedings in the United Kingdom appearing in *R v Fowden and White* (1982). There were early concerns about the reliability and veracity of photographs, particularly in the second half of the nineteenth century (Mnookin, 1998). Nowadays however, courts in most common law jurisdictions accept photography as a trustworthy technology and resource because of its 'mechanical objectivity' and democratic legibility (Daston & Galison, 2007). Consequently, *most* images relevant to a crime or cause of action are presumptively admissible. Those most likely to be excluded, as unfairly prejudicial to the defendant, are gruesome crime scene images. In recent decades, technological advances (notably digitisation) have substantially reduced the cost of cameras and the recording and reproduction of images. Technological innovation has not been restricted to terrestrial

systems, with the capabilities of satellites, planes and drones improving dramatically. All of the derivative images are potentially available to assist investigations and prosecutions relating to issues as varied as car accidents, bank robberies, the activities of armies and militias (for proceedings in the International Criminal Court and tribunals), the production of narcotics, and the illegal clearing of protected vegetation. Whether as part of state security organisations, private security systems or personal communication devices, cameras and images are now ubiquitous.

With the increased availability of images, police in many jurisdictions have become obliged to trawl through crime-related recordings, though investigations often extend to exploring relationships and activities recorded on social media (such as *Facebook*) and the meta-data generated by digital devices. Images can help investigators and others to understand the sequence and timing of events, such as who delivered the first punch in a bar fight, the nature of activities and/or the number of people involved as well as details such as vehicle registrations, whether a ship or road vehicle had its lights on, whether clothing worn by a bank robber matched clothes owned by the suspect, the relative heights of persons and many other issues of interest. Imagery has been used to reconstruct the background to terrorist events (e.g. the 7th July 2005 London bombings), and UK investigators have even relied on a lip reader's interpretation of a conversation partially captured on poor quality CCTV (*R v Luttrell,* 2004). Although such images can often aid investigations, assistance is often constrained because of limited information (e.g., missing frames, events taking place off-screen, low quality storage, and serious interpretive obstacles; *R v Drollett,* 2005). These sorts of limitations have emerged most conspicuously in relation to the use of images to identify persons of interest—usually unknown offenders.

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The prevalence of cameras and images has meant that courts in most advanced jurisdictions are routinely called upon to decide on the identity of offenders, and/or those who are suspected on the basis of their proximity to a crime, at least in part relying on images. This chapter describes the manner in which courts, across a number of different jurisdictions, have responded to the use of images for purposes of identification. The primary focus is on facial comparison or facial 'mapping' analysts. These analysts have been recognised by courts as experts: deemed to possess specialised knowledge and able to assist the tribunal of fact (e.g. a jury) with opinions pertaining to identity. Regardless of whether they express opinions about the identity of the person of interest, or purport to describe similarities and differences between the defendant and the person of interest, the aim is to help establish that it is the defendant depicted in the crime scene imagery (or to eliminate them as the offender). In some cases analysts employing similar techniques have provided conflicting opinions (e.g., *R v Clarke*, 1995; *R v Gardner*, 2004; *R v Gray,* 2003; *Murdoch v The Queen*, 2007; *Morgan v R*, 2011; *Honeysett v R*, 2013).

Notwithstanding the participation of one or more analysts, judges and juries may be invited, by the prosecutor, to compare persons appearing in crime-related images with a defendant disputing the identification, in order to make up their own minds (e.g., *Morgan v R*, 2011; *R v Dodson and Williams*, 1984; *Smith v The Queen*, 2001). Judges and juries will, of necessity, be unfamiliar with the defendant. Unfamiliar face identification tends to be error prone even if the quality of the images being compared is very high and there are no memory demands or restrictions on viewing time (Bruce, Henderson, Newman, & Burton, 2001; Bruce, Henderson, Greenwood *et al*., 1999; Henderson, Bruce, & Burton, 2001; see Chapter 9 for a review of this literature). Rates of both false negatives and false positives tend to be

substantial. There is no advantage if the target is present in person (Davis & Valentine, 2009; Kemp, Towell, & Pike, 1997). Differences in facial expressions or angle of view increase errors (Bruce *et al*., 1999), particularly if taken from angles and elevations typical of street surveillance cameras (Davies & Thasen, 2000).

Simultaneously, empirical research has demonstrated the contrasting finding that even with poor-quality images, face comparison and recognition tends to be reliable when performed by those who are familiar with the person of interest (Bruce *et al*., 2001; Burton, Wilson, Cowan, & Bruce, 1999; see Chapter 9 for a review), and therefore most jurisdictions allow those who are familiar with the defendant to express an opinion as to whether the defendant appears in incriminating images (e.g., *Attorney General's Reference No 2,* 2003). An obvious difficulty is that those who are most familiar with those suspected of offending (i.e. family and acquaintances) are often reluctant to testify against them (though see *Murdoch v The Queen,* 2007; *R v Marsh*, 2005; *R v Rix*, 2005). Both the level of familiarity as well as the reliability of any identification may be questioned—particularly if the identification is made by someone perceived as potentially hostile to the defendant (e.g., police officer or estranged partner, see *Smith v The Queen*, 2001).

In England and Wales, police officers purporting to recognise offenders, usually on the basis of prior exposure, may positively identify them. A similar approach is followed in Scotland (*Her Majesty's Advocate v Henry,* 2012). In addition, if familiarity is obtained through the course of an investigation from repeated exposure to images, English and Welsh police officers may be allowed to proffer their opinions on identification at trial as 'ad-hoc' experts (e.g., *Attorney General's Reference No 2*, 2003; *R v Clare and Peach*, 1995; *cf. R v Flynn*, 2008; Edmond & San Roque, 2012). Such judgements are highly susceptible to confirmation bias (see

generally, Expert Working Group, 2012). Indeed, expert interpretation of evidence using techniques known to be basically reliable (e.g., latent fingerprint comparison) can be influenced by the provision of extraneous information pointing towards guilt or innocence (Dror, Charlton, & Peron, 2006; Dror & Rosenthal, 2008). Information about other investigators' opinions or a suspect's background can be highly influential. If evidence is ambiguous, which is often the case with disputed crime scene images, professed *independent* opinions of identity may inadvertently be prejudiced. Regardless of status, all involved in assessing evidence (e.g., judge, jury, lawyers, police and analysts) may be highly susceptible to the influence of cognitive biases.

Canadian courts allow judges and jurors to interpret images (*R v Nikolovski,* 1996), but also allow those with familiarity to express their opinions. However, only police officers with considerable familiarity with defendants are eligible to testify (*R v Leaney*, 1989). In practice, Canadian investigators and prosecutors have preferred probation officers and prison guards to act as witnesses because they can be portrayed as independent from the investigation. Officials in these roles frequently have sustained exposure to parolees and prisoners and the reason for their familiarity is typically revealed in court in ways that tend to be adverse to the defendant.

In the United States, there have been relatively few reported controversial cases around the use of images for identification (Vorder Bruegge, 1999; cf *Wisconsin v Avery,* 2012). U.S. investigators have tended to rely on photogrammetry to assist with identification through estimations of height and/or shoe size (*United States v Smithers*, 2000). Following reforms to the Federal Rules of Evidence (1975) and rulings on the use of expert evidence (e.g. *Daubert v Merrell Dow Pharmaceuticals Inc.,* 1993), in theory techniques should have been tested and gained scientific

acceptance, with assessments of the statistical likelihood of error published in peer-reviewed journals, prior to admission.

In Australia the opinions of police officers on the identity of those in images have been deemed inadmissible since *Smith v The Queen* (2001). In *Smith* their evidence was thought to add nothing beyond what the jurors could do for themselves, because they develop familiarity with the defendant during the course of proceedings. The exception is in cases in which the appearance of the defendant has changed significantly (e.g., from weight change, beard or hair loss, or cosmetic surgery). However, because of concerns about jury capabilities, this exclusionary approach prompted a rise in the use of purported experts in image analysis and facial comparison. Even so, some Australian judges have expressed disquiet about the use of body shape (morphology) to assist with identification (e.g., *R v Tang*, 2006 see box), especially where offenders are disguised (*Morgan v R*, 2011 see box). Anxieties led judges to restrict the opinions of analysts to descriptions of similarities and differences between the features discerned from the person of interest and those of the defendant (Edmond & San Roque, 2014).

In South Africa, police with limited training and experience, derived from their participation in earlier investigations and trials, are allowed to positively identify persons of interest (Edmond & Meintjes-van der Walt, 2014). South African courts do not use juries but the practice in relation to *expert* image comparison evidence is similar to the accommodating approach adopted in the UK (Edmond, Cole, Cunliffe, & Roberts, 2013).

Photographic facial comparison analysis

All advanced adversarial systems have admitted the opinions of various kinds of analysts—recognized as experts—to assist with the identification of persons

appearing in images. From the very first use of surveillance and security cameras in England (*R v Stockwell*, 1993), and following *Smith v The Queen* (2001) in Australia, a range of individuals have been allowed to express their opinions about identity on the *assumption* that they possessed abilities beyond those of lay jurors and judges. These analysts have provided opinions about clothing, gait (Larsen, Simonsen, & Lynnerup, 2008), or body size (e.g., Bridge, 2009; De Angelis, Sala, Cantore *et al.*, 2007; see Scoleri, Lucas, & Henneberg, 2014 for the difficulty in estimating stature through different clothing). However, using one or more undisputed comparison images of the defendant as a reference, identity evidence often involves facial structure and feature comparisons. In England and Wales, where there may be as many as 600 such cases per annum (Bromby, 2003), a reference from the Attorney General produced guidelines on the use of such techniques, explaining that "a suitably qualified expert with facial mapping skills can give opinion evidence of identification based on a comparison between images from the scene (whether expertly enhanced or not), and a reasonably contemporary photograph of the defendant, provided the images and the photographs are available for the jury" (*Attorney General's Reference No 2*, 2003).

The analysts comparing images originate from a variety of professional backgrounds including visual image analytics, military intelligence and surveillance, psychology, IT and computer engineering, art, forensic anthropology and medicine (e.g., anatomists; dentists and podiatrists for posture and gait). However, it is worth noting that few, if any, of these fields routinely involve members comparing a person of interest, in a low quality image, to a reference photograph of a known person. There is, in consequence, a serious and unanswered question about whether the various individuals allowed to express opinions actually possess expertise in relation

to image comparison and identification. This applies to the ability to make assertions about identity as well as discern the features of a person of interest and attach significance to them. In England and Wales, the Association of Chief Police Officers and the National Policing Improvement Agency guidance expects 'experts' to possess the following skills, although these are not admissibility rules and no court has required evidence of formal evaluation.

- Sound knowledge of human facial anatomy, anthropometry, physiology together with an in-depth knowledge of photo interpretation and image analysis techniques, including capture, process and output media.

- Be able to demonstrate an ability to compare facial morphology and facial proportions, observing the spatial relationships of facial features and facial landmarks between images, from more than one source.

- Be aware of the significance of probability factors, likelihood of repetition, and likely range of variation in images, thus demonstrating awareness and an ability to analyse the effects of distortion caused by perspective, camera angle, motion blur, lighting and transfer of data formats.

- Be familiar with relevant Home Office guidelines and current research in this field.

(NPIA, 2009; p 17.)

Regardless of their technique, all analysts must address the issue that a two-dimensional (2-D) image is a representation of a three-dimensional (3-D) reality, so that the distance between features, and the curvature or perceived depth of features will be distorted (see Figure 1). These distortions can be exaggerated by comparing images captured at different distances and through different lenses (Edmond, Biber, Kemp, & Porter, 2009; Harper & Latto, 2001). The recording and compression of

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digital images may also decrease fine detail and introduce distortion. The risk of error may be reduced if high quality, close-up images are compared. Nevertheless, even under optimal conditions, proof of identity may not be feasible, for it is always possible that one or more individuals photographed under similar conditions will generate analytics that are indistinguishable from those of the person of interest (Davis, Valentine, & Davis, 2010). Conversely, a single reliable difference, not caused by camera or image irregularities, or natural changes to appearance (e.g., expression or ageing), may provide strong evidence that two different people are depicted (Bogan & Roberts, 2011). Analysts, however, are typically asked to apply their techniques to poor-quality images where targets are some distance from the camera, with features obscured or indistinct due to disguises, movement or shadow effects produced by competing light sources (especially at night), and with differences in the perspective of the images to be compared.
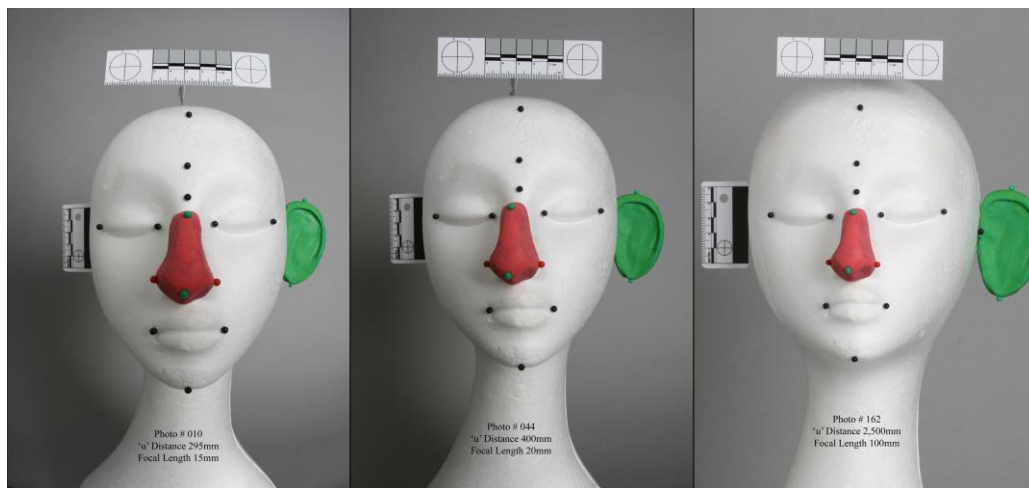

Figure 1: Image distortion in high quality rectilinear photographs. What do the 'head' and facial features actually look like? What is the shape of the actual 'head' and is the 'ear' larger than the 'nose'? From the left the photographs were taken from (a) a distance of 295mm, with a focal length of 15mm; (b) a distance of 400mm and a focal length of 20mm

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and (c) a distance of 2,500mm with a focal length of 100mm (Images courtesy Dr Glenn Porter (2009).

In addition to the analysis and comparison of images by humans, for several decades researchers have been developing computer-based algorithms (Porikli, Bremond, Dockstader *et al*., 2013). These systems convert a facial image into a biometric or digital signature, which allows comparison against a database. Under ideal conditions with posed close-up images and good lighting, algorithms can be reasonably accurate and outperform humans. However, performance is far worse in environmentally unconstrained conditions (Burton, Miller, Bruce, Hancock, & Henderson, 2001, see Chapter 11). Over time biometric systems may become increasingly efficient at profiling or short-listing potential targets from a database. However, in the foreseeable future final decisions about identity are likely to be made by humans, whether from visual inspection or by the use of facial comparison techniques.

The analysts recognized by courts as experts have tended to rely upon three broad techniques: *photo-anthropometric analysis, morphological comparison* and *photographic superimposition*. The actual methodology, or combination of techniques selected, tends to depend on the particular analyst, image quality and characteristics, as well as what is acceptable in the domestic courts.

Photo-anthropometry (or photogrammetry). With photo-anthropometry, the distances and angles between anatomical facial landmark sites on two or more photographs are measured and compared to demonstrate a match or a mismatch in their facial dimensions. It is difficult to determine absolute distances in photographs, even if the focal lens of the camera and the exact distance from the target is known. For this reason, the normalised proportional indices between facial features using a

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standardised visual reference are employed (e.g., the distance between the corners of the eyes). Nevertheless, the comparison of images captured from cameras with different lenses, even if taken from the same viewpoint, will result in photographed facial structures possessing different physical dimensions (see Figure 1).

Figure 2 illustrates an attempt to approximate facial size and angle. When presented as evidence in court, photo-anthropometrical analyses will often be supported by diagrams depicting grids superimposed over the images to assist with measurements or proportions (Bromby, 2003). Grids and other aids may also bias decision-making as they emphasise the consistencies between facial images, without addressing image variation and distortion or the frequency of similar measurements among relevant populations.
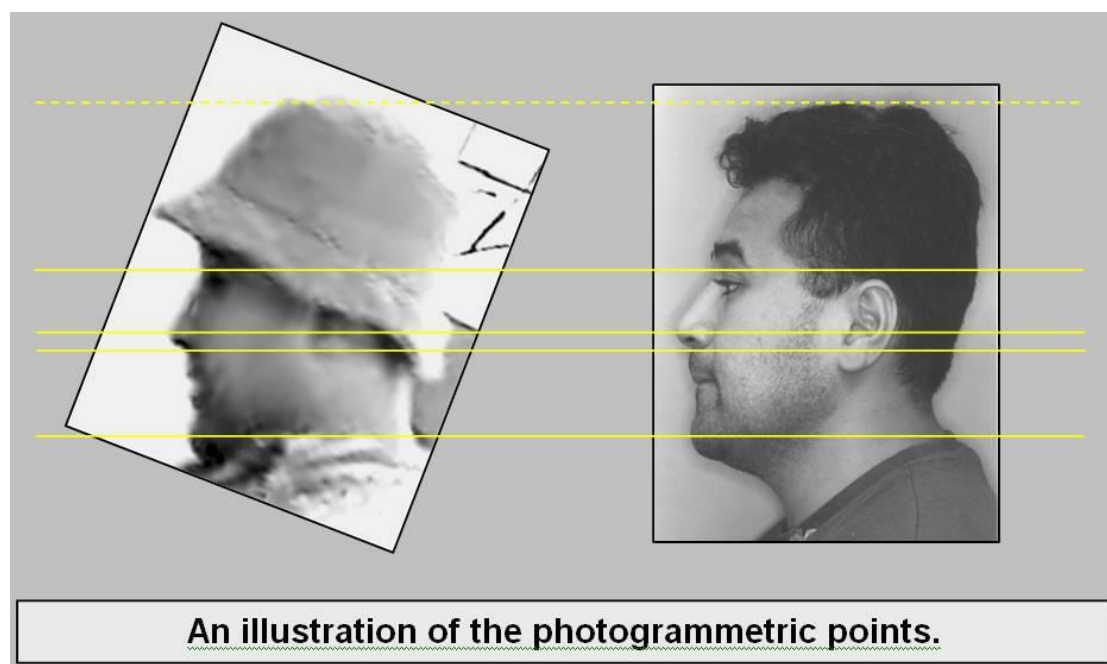

An illustration of the photogrammetric points.

Figure 2. An example of anthropometry from an investigation in New Zealand (Images courtesy of Rod McCourt).

Case studies of the kinds of photo-anthropometric techniques used in court have been published (Halberstein, 2001; Porter & Doran, 2000), as have empirical tests of the technique against a variety of facial image databases with images taken from different distances and angles, incorporating variation in the demographic and physical homogeneity of the individuals included (Catterick, 1992; Davis *et al.*, 2010; Kleinberg, Vanezis, & Burton, 2007; Mardia, Coombs, Kirkbride, Linney, & Bowie, 1996; Moreton & Morley, 2011; Roelofse, Steyn, & Becker, 2008). Few crime scene images are of high quality and taken with the same camera and from exactly the same angle as has been the primary stimuli employed in much of this research. Variations in viewpoint, that may appear deceptively minor, add substantially to the likelihood of error. In large part, this seems to be a consequence of the frequency of highly similar facial measurements belonging to different people. Even with high quality images taken from carefully posed, closely aligned viewpoints, this body of research has consistently demonstrated that photo-anthropometry is not suitable for identification or for elimination (Moreton & Morley, 2011). For this reason the Facial Identification Scientific Working Group (FISWG) (2012) has advised its members, which include the U.S. Federal Bureau of Investigation and the Metropolitan Police Service in London, not to apply photo-anthropometry to images to be presented in court.

Morphological comparison. In undertaking morphological comparison of the face, analysts visually inspect and classify facial features in two different (sets of) photographs to examine whether their size and shape are consistent (see Figures 1 and 2). In contrast to photo-anthropometry and superimposition, morphological comparison is possible with low resolution photographs taken from different angles (Vanezis, Lu, Cockburn *et al.*, 1996), and, as with fingerprint analysis, a large proportion of shared features will add to the likelihood that two different photographs

depict the same person. However, even when distorted, the topology of fingerprints is fairly consistent. In contrast, facial feature structure may be dramatically altered by changes in facial expressions, lighting, the focal length of the lens, camera angle and so forth (Mardia *et al*., 1996).

As a guide to analysts, FISWG (2013) provided a list of the primary facial features that they recommend be included in a court report. Other morphological comparison techniques have also been published, tested against databases of various sizes and demographic homogeneity (Roelofse *et al*., 2008; Ritz-Timme, Gabriel, Obertova *et al*., 2011a; Ritz-Timme, Gabriel, Tutkuviene *et al*., 2011b; Vanezis *et al*., 1996). Ventura, Zacheo, Ventura, and Pala (2004) described how the use of the technique assisted a U.S. court in a single case study. An international group of researchers have developed a morphological 'face atlas' (Ritz-Timme *et al.,* 2011a; *cf.* Ellenbogen, 2013), which requires analysts to classify 43 facial features into 136 categories. The atlas has been tested using a database of at least 900 people from different European countries (Germany, Italy and Lithuania). Significantly, due to high levels of common features, more than one person was sometimes classified into exactly the same sub-categories (Ritz-Timme *et al.,* 2011b). This limits the use of such classification for purposes of individuation. An additional problem with any system that requires classification is that a facial feature may possess properties that are hard to classify into a single category. Different analysts may classify the same features differently and the same analyst might be inconsistent over time (e.g., Dror, Champod, Langenburg, *et al*., 2011). This problem of poor reliability is likely to increase with the use of multiple photographs of the same person.

Photographic superimposition. With photographic superimposition, one image is superimposed over a second, for visual inspection of the combined image to

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identify similarities or discrepancies. Analysts can employ *visual flicker*, by rapidly switching between the super-imposed images to expose differences through apparent motion (e.g., Ramachandran & Anstis, 1986); *visual fading*, a similar but very much more gradual process; and *visual wiping*, in which the lower image is systematically vertically, horizontally or diagonally exposed. Wipe speed is variable, although slower wipes will tend to be used when there is fine detail.

Vanezis and Brierley (1996) describe the use of superimposition to provide opinion evidence in the identification of 51 individuals in 46 UK criminal cases. They claimed to provide evidence of eleven 'reliable,' sixteen 'probable,' and eight 'possible' matches, as well as three 'exclusions.' The authors propose that the technique is most useful for the matching of facial marks such as scars, moles or ear structure on two photos of the same person. However, an analyst's report that includes observations concluding that such marks can be seen in the same location on two images purportedly of the same person, will not include the statistical probability of different individuals possessing similar marks. No database exists as to the rarity of such features. Vanezis and Brierley additionally argue that minor viewpoint differences can be overlooked as, "what is acceptable depends on the experience of the examiner who should be aware of the various possible positional changes of the head" (p. 28). In contrast, İşcan (1993) argues that superimposition is really only possible on perfectly aligned images, and that wiping or fading between superimposed images at extremely slow speeds can induce a bias towards believing that images of two different people depict the same person. Consequently, if an analyst is asked to demonstrate superimposition evidence in court, the manner in which this is conducted may unduly influence those required to evaluate the evidence.

Other technical and methodological issues

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There are a range of additional technical and methodological issues associated with image comparison evidence, including contextual bias, the possibility of increased performance using 3-D imaging, and what might be described as aging effects.

Contextual bias and contamination. The way in which investigators solicit the opinions of analysts and the way analyses are normally undertaken unnecessarily introduces non-trivial risks of cognitive contamination and error. The process of comparison used by anatomists (and many other forensic analysts) often involves exposure to domain irrelevant information, and appears vulnerable to a range of insidious influences—such as suggestion and confirmation bias. The anatomists appearing in *R v Tang* (2006) and *R v Morgan* (2011) (see box cases), for example, were only asked to compare one set of images and appear to have known about the existence of the fingerprint and DNA 'matches'. That is, they undertook a difficult interpretive exercise in conditions where they knew the police believed the person of interest and the suspect were the same and that other, more powerful forensic techniques, supported that conclusion. The fact that analysts are routinely exposed to other incriminating evidence has not prevented their opinions being represented as 'independent' corroboration. Such representations misrepresent the value of opinions developed in conditions where the analyst was not shielded from gratuitous information or a process that suggests the desired answer (Edmond, Searston, Tangen, & Dror, 2014).

Three-dimensional images. Due to the high commonality of facial measurements possessed by different faces, it may not be possible to reliably individuate even carefully posed 2-D photographs. Employing multiple images taken from alternative angles may assist (Davis *et al*., 2010), as might three-dimensional

19

technology (e.g., laser surface scanning, 3-D stereo-photogrammetry; Cattaneo, Ritz-Timme, Gabriel *et al.,* 2009). Research using high-quality images taken in optimum environmental conditions has demonstrated that it is feasible to extract a 2-D image from a 3-D scan and superimpose that image over a photograph from a normal 2-D camera so that anthropometric landmarks can be located on both 2-D images with sub-millimetre accuracy (De Angelis, Sala, Cantatore *et al*., 2009; Fourie, Damstra, Gerrits, & Ren, 2011; Yoshino, Matsuda, Kubota *et al*., 2000; Yoshino, Noguchi, Atsuchi *et al*., 2002). The suggestion from this stream of research is that the police could routinely collect 3-D images – in the same manner most forces currently collect mug shot images (Yoshino *et al*., 2002). However, despite some experimental successes, 3-D images are often accompanied with distortions caused by lighting anomalies and inadvertent movement. Furthermore, anthropometric techniques using 3-D images suffer from reliability problems similar to those encountered with 2-D images (Evison, Dryden, Fiedler *et al*., 2010).

Ageing effects. Analysts may be asked to apply facial comparison methods to images taken some time apart. Indeed, the first editor of this volume (Valentine, ND[1]) describes a case in which a series of undisputed photographs taken over a number of years of a prisoner held in Guantanamo Bay were compared with a photograph that was alleged by his U.S. captors to provide evidence that the prisoner was a member of the terrorist organisation, Al Qaeda. Analysis of the images by Valentine contributed to the decision by the United States security forces to release the prisoner. The former prisoner was not charged on his return to the UK.

If images are taken some time apart, age-related changes to facial structure will occur (Gonzalez-Ulloa & Flores, 1965; Khalil, Kubota, Tawara, & Inomata,

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[1] www.valentinemoore.co.uk/recent.htm

1996; Shaw, McIntyre, & Mace, 1974; Takema, Yorimoto, Kawai, & Imokawa, 1994).

Even minor changes to hairstyle and facial hair may further impede the reliability of facial comparison methods. Due to genetic and environmental factors (e.g., alcohol, smoking, accidents, sleeping position, cosmetic interventions, sun damage, medication, diet and illness) individual rates of change are not predictable. Changes to facial structure are most dramatic in the first few years of life. This may be a particular problem when attempting to identify child victims of sexual abuse from images in cases of child pornography (Cattaneo *et al.*, 2009).

Probative value, validity and reliability

One issue associated with all the techniques described above is that analysts are unable to provide the courts with information about the margin of error tested against a large database of faces as is the case with some other biometrics (e.g., DNA). Facial databases do exist (e.g., passports, driving licenses, police files), although as these images are normally taken directly from the front or in profile, their use is limited if crime scene images are captured from alternative viewpoints. Indeed, no standardised valid or reliable methodology exists with any facial comparison analysis technique, and as a consequence the value of interpretations are unknown, and analyst susceptibility to cognitive bias would seem to be considerable (Dror *et al.*, 2006). As such, regardless of whether 2-D or 3-D images are acquired, facial comparison techniques would seem to be better suited to assisting a police investigation by creating a profile and limiting the pool of potential suspects, than for providing 'identification' evidence for a court (Ritz-Timme et al., 2011b).

Where called as expert witnesses, those analysing images have been subjected to challenges and sustained criticism (e.g., Edmond *et al.,* 2009, *Honeysett v R*, 2013; *Morgan v R*, 2011; *R v Gray*, 2003; *R v Tang*, 2006). As a consequence, over time

21

courts and analysts have gradually refined the shape and scope of testimony. These responses appear to have been driven by concerns to circumvent recurrent problems through compromises and qualifications to interpretations and opinions rather than by conducting or requiring evaluative experimental research.

We can observe changes in the way analysts proffering opinions pertaining to identity expressed their conclusions. Analysts in in England and Australia initially presented anthropometric evidence and used superimposition to support positive claims. As a response to the measurement problems associated with anthropometry, analysts switched to morphological approaches and tended to refrain from positively identifying the person of interest. In Australia analysts are required to restrict themselves to describing similarities and differences (based on morphological-style approaches) between persons of interest and known persons (*Morgan v R*, 2011; *R v Tang*, 2006). Analysts may use highly suggestive language and terminology (e.g. 'no differences' in *Honeysett v R*, 2013), and in England, analysts now tend to use verbal formulations based loosely on the reporting scales developed for quantitative forensic sciences by the Forensic Science Service (see Bromby, 2003). They might say, for example that 'the analysis lends strong support to the contention that the person in the crime scene imagery and the suspect are the same person'. The example in Table 1 taken from *R v Atkins* (2009), a case with a single low quality image, illustrates how potentially forceful though simultaneously vague such subjective conclusions might be—i.e. two whole points on a six point scale. Confronted with the obligation to limit testimony to describing similarities (and differences), lawyers and judges in Australia have struggled to prevent analysts from generating highly prejudicial numbers or suggesting that a few apparent similarities in what is often a badly distorted image

22

Edmond, G., Davis, J.P., & Valentine, T. (2015). Expert analysis: Facial image comparison. In T. Valentine and J.P. Davis (Eds.), *Forensic Facial Identification: Theory and Practice of Identification from Eyewitnesses, Composites and CCTV* (pp. 239-262). Chichester: Wiley-Blackwell.

constitute 'a high level of anatomical similarity' (e.g., *Morgan v R*, 2011; *R v Dastagir*, 2013).

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Level	Description
0	Lends no support
1	Lends limited support
2	Lends moderate support
3	**Lends support**
4	**Lends strong support**
5	Lends powerful support

Table 1: An example of a verbal scale often adopted by image analysts in England and Wales. This version is taken from the analyst's report in R v Atkins (2009).

In England, image analysts and investigators are entitled to positively identify an individual in low quality images provided that they acknowledge weaknesses such as the fact that there is no database behind the assertion (*Attorney General's Reference No 2*, 2003; *R v Atkins,* 2009). In practice they tend to present weaker conclusions, along the lines that the evidence 'lends powerful support' (*Otway vs. The Queen,* 2011; *R v Atkins,* 2009; see also Edmond, Kemp, Porter *et al*., 2010; *R v T,* 2010). The revelation of limitations in Australia tends to be more serendipitous—depending on the resourcing and abilities of defence lawyers.

Qualifications to conclusions have been promoted primarily by judges responding to occasional defence concerns. They have not been driven by analysts, and are not the result of analysts attending to sustained scholarly criticisms. The provision of conclusions that are weaker than positive identification (i.e. individualization) effectively insulates image analysts from some of the methodological criticisms they might otherwise confront. They do not, as we explain, make weaker forms of opinion reliable or even better suited to the limits of legal institutions and the capabilities of trial personnel. It is revealing that, notwithstanding the Australian proscription on positive identification, the actual 'expert' reports and

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sometimes testimony continue to embody the analyst's belief in their ability to positively identify persons of interest.

Several image analysts have been discredited by mistakes or criticized for questionable practices, performances and conclusions (e.g., *Morgan v R,* 2011; *R v Gray,* 2003; *R v Tang,* 2006). Somewhat curiously, these problems have been interpreted as limited to the case or the individual analysts and any wider implications for image interpretation and identification have been dismissed (e.g., *R v Atkins,* 2011; *Honeysett v R,* 2013). Authoritative legal criticism has led to some analysts being 'dropped' by investigators and prosecutors and replaced by others using remarkably similar techniques and drawing similar conclusions. The failure to have formally evaluated techniques and standardised practices is typically treated, like the absence of a database of face and body features, as issues for the jury to somehow consider as part of their evaluation of the evidence—in the context of the overall case (*Morgan v R*, 2011; *R v Gray,* 2003; *R v Tang,* 2006).

Jury interpretation of forensic evidence

Image evidence, the opinions of putative experts and the images themselves are often admitted in criminal proceedings because judges maintain inordinate confidence in the effectiveness of adversarial trials (and appeals) to identify, explain and convey any problems with the evidence to the tribunal of fact—very often a jury. Anyone who follows trials and appeals (or reads some of the judgments cited in this chapter) might come to a less sanguine view about the capabilities of lawyers and judges. Very often cross-examination is perfunctory and judicial understandings, as manifested in admissibility determinations, directions and warnings, do not consistently identify serious methodological limitations (e.g., no validation testing, lack of standards and inattention to contextual bias), relevant scientific literatures

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(such as those discussed above), or provide means of rationally evaluating the opinions of analysts. The judges themselves do not seem to have appreciated the magnitude of problems, and often compound risks by ignoring the effects of combining the opinions of analysts, recognized by the courts as experts, with jury access to the images.

In too many cases, serious problems with images (and many other kinds of expert evidence, purporting to be scientific and technical) are not identified or explained to the jury by lawyers or the trial judge. There are, for example, very few cases where trial judges provide assistance with the kind of issues raised in this chapter. In England, for example, jurors will be told that the analyst did not use a database in developing their incriminating opinion about the significance of the alleged similarities. In Australia, the jury will be presented with a list of similarities and, perhaps, no more. In both jurisdictions, jurors are expected to interpret this 'expert' evidence, in conjunction with the images and any other incriminating evidence, in the absence of validation studies, error rates, databases, insights into the dangers posed by contextual biases and the extensive literature on the difficulties of unfamiliar face matching.

There is a need for genuine caution before accepting legal claims of interrogation and critical engagement at face value. Legal safeguards can work, particularly where the defendant is well resourced. In the vast majority of cases, however, admissibility rules and safeguards appear to be far from effective (Law Commission, 2011; Edmond & San Roque, 2012).

Anamorphic law

Legal use of image analysts to proffer evidence pertaining to identity raises difficult ethical dilemmas for psychologists capable of providing courts with rebuttal

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testimony and, more importantly, advice. Embodying concerns expressed in *R v Turner* (1975), trial and appellate courts have not been responsive to the methodological criticisms and the serious problems highlighted by psychological research occasionally raised by lawyers in cross-examination or via rebuttal experts.

It is doubtful that explaining interpretive and methodological problems, such as the lack of validation studies, to juries after they have been allowed to compare the images with the defendant, usually in conjunction with the opinion of an 'expert', will counteract suggestive interpretations of the images *even if mistaken*. If a lay person or jury is not explicitly encouraged to deduce the identity of those depicted in images, they are likely to implicitly judge evidence from 'experts' on the basis of their own opinion. There is probably little a court could do in forewarning them about the high risks of error when performing face matching judgements. When it comes to the comparison and interpretation of images, jurors and judges are rarely placed in a position that is conducive to the rational assessment of the images or the opinions of those presented as experts.

By participating in such proceedings, where the problems are unlikely to be fully explained or taken seriously by fact-finders or appellate courts, psychological researchers would seem to be lending legitimacy to a process that does not appropriately value their knowledge or contributions. Courts have been far too accommodating of image analysts and far too ready to recognize, but in effect create, 'fields'. Courts have accepted face and body mapping and identification via gait analysis (*Otway v The Queen*, 2011; *R v Aitken,* 2012) as reliable and widely accepted and valuable practices. As this chapter has endeavoured to explain, this is not a reasonable response to what is *known* beyond the courts.

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The question arises of whether psychologists should participate in legal proceedings, in an attempt to assist those accused and prosecuted with questionable evidence. Alternatively, should they criticize legal ignorance and obduracy from the outside—where there is no need for deference to traditions that do not engage seriously with scientific knowledge or credibly review their own performances? Or, should they do both, in more creative and strategic ways? Recently, the U.S. National Academy of Sciences (2009), as one example, adopted a conspicuously critical and perhaps contemptuous approach to American legal practice in its attempt to inaugurate the reform of forensic science.

In their approaches to image comparison evidence, courts in most jurisdictions have been remarkably insensitive to the difficulty of interpreting images and comparing the faces of unfamiliar persons. Instead of directing their attention to a substantial, though largely critical, scientific literature that has repeatedly identified the difficulty and error-prone nature of image interpretation, courts have allowed highly credentialed analysts to express their incriminating opinions because the task was seen as beyond the abilities of lay jurors and judges. In so doing, our courts have allowed those without demonstrated expertise, and who have not tested their techniques, to provide opinions about the identity of persons in images. These analysts, frequently identify or suggest the identity of, individuals accused of the most serious crimes and the courts have gradually developed a range of naïve responses to some of the most obvious criticisms. They have consistently demonstrated their inability to understand the importance of validation studies, measuring error rates, and the desirability of shielding analysts from suggestive information or environments. Instead of relying upon experimental evidence to develop reliable standards and practices that should be in place as a condition of admissibility, courts around the

28

world have preferred to rely upon cross-examination and witness demeanour, the

occasional use of rebuttal witnesses, and judicial directions as a means of overcoming

the lack of rigorous scientific research. Legal responses to identification evidence of

offenders from images reinforces the need to require expert evidence in criminal

proceedings to be demonstrably reliable as a condition of admissibility (Law

Commission, 2011; *Daubert*, 1993; Edmond, 2008). Given the current situation courts

should be cautious about the admission and use of the opinions of analysts presented

as facial comparison experts.

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