The Reliability of CCTV Images as Forensic Evidence

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Doctor of Philosophy

University of Western Sydney
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Statement of Authentication

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Glenn Porter

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**NSW Supreme Court Decisions from Case Studies**


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Abstract

Forensic evidence originating from CCTV images is admitted as evidence into various criminal courts in Australia and overseas. It is used predominately to identify persons of interest from images captured by CCTV cameras but other forms of forensic evidence and intelligence are also possible. Using a mixed method research design, this study examines the reliability of CCTV images when used as forensic evidence. A range of strategies including case studies, empirical experimentation and phenomenological inquiry is used to investigate the application of this new form of evidence. Understanding the reliability of evidence derived from photographic sources requires a highly complex interdisciplinary and multifaceted approach. This study has found serious reliability problems with the current use of CCTV images when used as forensic evidence. Serious miscarriages of justice are inevitable if the reliability of photographic evidence practices are not more carefully considered and validated. The study argues that reliability will be improved by establishing more robust methods that enhance the scientific model of repeatability and validation. This study also establishes a new theoretical model that examines the application and relationship between photographic evidence and physical evidence. Furthermore, the work develops a method for more reliable photointerpretation. The study also recommends that the principles cited in the Daubert ruling be considered for photographic evidence to provide safeguards and improve the reliability of this new form of forensic evidence.
Chapter 1

1.0 Introduction

If no theoretical distinction has been made between the photograph as scientific evidence and the photograph as a means of communication, this has been not so much as an oversight as a proposal.

John Berger [Berger & Mohr 1982, p100]

Western culture has increasingly become a society that uses visual images as a method of communicating ideas, meaning and concepts. The reliance on visual information has significantly increased in the 21st century with the evolution of newer imaging technologies. Images form a critical role in many facets of contemporary society including the media, advertising, popular culture, personal memories, medical science and forensic science.

This research examines the reliability of CCTV images when it is used as forensic evidence. It examines critical theory such as visual culture that underpins the
perception of photography as a purveyor of truth and develops new thinking in how to describe forensic photography and its relationship with physical evidence. The study also provides a practical insight into how this form of evidence is used in contemporary forensic cases and further investigates details associated with CCTV images when used for identification. It also introduces a new model for photointerpretation of images to promote concepts of reliability of forensic evidence when derived from photographic sources.

1.1 Research Problem Statement

The introduction of closed-circuit television (CCTV) into the public landscape has provided a new level and type of surveillance within contemporary society. Never before have vast numbers of individuals been under this level of surveillance. The density of surveillance cameras positioned within the community has increased exponentially in recent years and other technologies, such as cameras in mobile phones, provide an itinerant source of surveillance [Wilson et al., 2006]. Lyon suggests, ‘Surveillance is a central feature of modernity’ [Lyon 1994, p 37] and this condition is difficult to deny. CCTV surveillance has also raised ethical issues regarding privacy and various social debates have arisen. Some issues include the effectiveness of the technology to increase security over privacy, whether the security results in better or real protection of citizens and whether the technology can be used as an effective crime deterrent tool.

Police investigation practices have quickly adapted and are exploiting this new social condition. The examination of CCTV images has become a common investigation procedure [Bruce 1998, Ferllini 2002, Brooks 2004, Braithwaite & Cubby 2007]. Police also seek assistance from the public by publishing images sourced from CCTV and using the critical mass of the media. The recognition of persons of interest depicted in images may provide valuable investigation leads. However, the application of CCTV images also has wider applications for law enforcement.

Images sourced from CCTV are used by investigators as a mechanism for capturing evidence. CCTV and other surveillance sources may be examined by detectives and forensic experts for the following purposes;
• The reconstruction and interpretation of criminal events.
• Identification of persons depicted in the images.
• Provide forensic intelligence to an investigation.
• Provide physical evidence.

Since an Australian High Court decision in 2001 involving the alleged identification by two police officers of Mundarra Smith from a bank security camera\footnote{Smith \textit{-v- The Queen} (2001) HCA 50}, police officers are now restricted from making identifications of suspects from surveillance or CCTV images. The High Court determined that police officers do not generally possess specialised knowledge to identify people recorded on CCTV with any greater degree of accuracy than that of a lay jury. Therefore, the exemption to give opinion evidence under Section 79 of the \textit{Evidence Act (1995)} was not granted making this form of evidence from police officers inadmissible for the Smith case and others following. Law enforcement agencies and the Crown are now using forensic scientists to make a more scientifically based identification of persons of interest [Biber 2002, Edmond \textit{et al.}, 2009]. Lay witnesses who know the accused or were witness to the crime, are also permitted to provide lay identification evidence using CCTV images based on the fact they know the accused or have witnessed the event first-hand.

Identification evidence from CCTV sources is a recent form of forensic evidence currently being presented in Australian and overseas courts. Several questions arise from this new evidence and include;

• How well can criminal events be recorded by CCTV?
• How can this recorded vision be translated accurately to produce forensic evidence?
• Can the identification of people be made directly from photographs?
• What science or forensic science discipline would have the specialised knowledge to make identification examinations from images?
These questions have not yet been answered by practitioners in law enforcement, forensic science or forensic photography despite the fact that forensic science practitioners are currently using this form of evidence in court including identifications made directly from CCTV images.

In Australia, it is practitioners in anatomy who claimed to have specialised skills to distinguish anatomical features and that anatomy should be the basis of this type of forensic identification examination. In the UK, various disciplines have been used including forensic artists experienced in drawing faces [Atkins & Atkins -v- The Queen (2009)].

Identification using anatomical features made from photographs presents a very different forensic environment than the examination of anatomy from real life specimens. The reliability of contemporary identification methods that use CCTV images based on anatomical examinations is seriously questioned in this study and by several forensic science and law scholars [Biber 2002, Edmond 2008, Edmond et al., 2009].

Issues regarding the reliability of identification are; i) the methods used by anatomists, ii) the misunderstanding of photographic evidence, iii) the misunderstanding of concepts associated with individualisation (identification concepts), iv) a lack of methodology associated with photointerpretation, v) a lack of any method validation or error rate, vi) examination methods are highly subjective and vii) a lack of transparency in forensic reporting [Regina -v- Murdoch (2005), Saks & Koehler 2005, Regina -v- Jung (2006), Regina -v- Tang (2006), Regina -v- Johnson (2007), Saks & Koehler 2008, Edmond 2008, Saks & Faigman 2009, Cole 2009, The Queen -v- Atkins & Atkins (2009), Edmond et al., 2009].

In addition to identification, CCTV images may provide other forms of forensic evidence and forensic intelligence. Obtaining reliable evidence from photographic sources requires careful consideration of photointerpretation methods which considers aspects of photographic truth, visual culture, photographic science and photography practices. There are also several problems associated with photointerpretation within contemporary forensic photography and forensic science.
The most predominant problem is the lack of any recognised photointerpretation methodologies and the relationship between forensic photography and physical evidence is not well defined.

The absence of photointerpretation methodologies, or an understanding of the relationship between photography and physical evidence, may result in evidence derived from CCTV or other photographic sources being misrepresented, exaggerated or erroneous. A lack of transparency in the forensic reports further exacerbates the problems of reliability when the results cannot be further tested by other forensic specialists. This is a significant problem with contemporary photographic evidence and questions its level of reliability to provide evidence that is accurate and not unfairly prejudicial.

Significant gaps in the knowledge exist in understanding reliability concepts associated with identification evidence made directly from CCTV images. This situation presents a serious risk of misidentification of persons of interest, which can lead to wrongful convictions. This is a critical jurisprudence problem. It is imperative that forensic science and the judicial system understand the limitations of such evidence and commence a culture of validation and systemisation of photographic evidence and identifications made directly from those sources. Halberstein (2001) argues;

*The reliability of photographic evidence, however, is still subject to a number of practical, scientific, and thus legal limitations.* [Halberstein 2001, p1438]

**1.2 Aim and Scope of Project**

This study investigates the reliability of CCTV images as evidence within the forensic photography and forensic science domains. It addresses the central research question (described in Chapter 2) using a range of knowledge sources and strategies. This study;

- Discusses concepts associated with photographic truth and visual culture within forensic science and how it affects evidence reliability.
Develops a new pragmatic model that illustrates the function and differences in forensic photography and describes its relationship with physical evidence.

Develops a taxonomy specifically for forensic photography.

Investigates the reliability of contemporary CCTV evidence using case studies to develop an understanding of how this form of evidence is presented in Australian courts.

Conducts experimentation that tests the reliability of current interpretation methods and describes how image perspective influences facial morphology representation.

Examines the epistemology of identification evidence using anatomical techniques and the concepts and debates associated with individualisation.

Develops a new pragmatic model that enhances the understanding and reliability of evidence derived from photographic sources and photointerpretation.

1.3 Overview of the Study

This study resides within the discipline of ‘forensic photography’ which may be described as a sub-discipline of forensic science and uses concepts and practices associated with general and scientific photography. The following forensic science professional bodies recognise forensic photography as a discipline within the forensic sciences; The National Institute of Forensic Science (Australia), The Forensic Science Society (UK), Midwestern Association of Forensic Scientists (USA), International Association for Identification (USA). Peer reviewed International forensic science journals also recognise and accept articles on ‘forensic photography’.

1.3.1 Forensic Photography

Contemporary forensic science is heavily reliant on photography to record, document and analyse evidence. Anthropologist Bill Bass from the University of Tennessee pioneered body decomposition research at the ‘Anthropology Research Facility’ he founded. Bass also conducts casework for law enforcement agencies in his home
state with a team of forensic anthropologists from the University [Bass & Jefferson 2003]. Bass makes the following suggestion regarding the recording of evidence during forensic investigations;

_I consider the cameras the most important part of our equipment; they are essential in documenting the scene, the search, and particularly the recovery of human remains. I know of only two types of scientific research that require utterly destroying the very thing you’re studying: excavating an archaeological site and investigating a death scene. By the time you’re finished, it’s gone, dismantled, so you better make damned sure you’ve got an exhaustive record on film; there’s no going back to check for something you overlooked – say, footprints on the surface of a shallow grave – after you’ve trampled or dug up the ground. [Bass & Jefferson 2003, p73-74]_

Bass’s comments also illustrate the purpose of photography in the context of forensic investigation. It characterises its role and the ability of a camera to function as a mechanical apparatus to record reality (the scene and evidence). Bass’s statement is supportive of the importance of photography within forensic science; however, it also illustrates an understanding of the medium that presents some problems. Bass describes several modes of forensic photography without considering the different values and codes that may be represented when photography is used as evidence. In his quote, Bass is describing modes of photographic evidence including; photo narratives (scene), evidence recording or documentation (human remains) and photo analysis of physical evidence (footprints). The problem with Bass’s thinking is that the application of forensic photography evidence is considered as a homogeneous function of representation and, because the camera functions as a mechanical device, images automatically represent reality and therefore truth.

While the applications suggested by Bass are of important value to forensic science, the absence of any disparity within forensic photography evidence itself, and within the forensic science domain, places this form of evidence into question. There is some evidence to suggest that forensic science practitioners consider all types of photographic evidence as the same. This research investigates the concept of defining different modes of photographic evidence and provides a new framework to understand the attributes of reliability of evidence derived from photographic sources.
John Tagg (1993) argues from a Marxist perspective, that photography was an active component of the technological revolution that witnessed the state engaging in new modes of control through the surveillance of its people using record keeping. He suggests photography provided a new form of documentation that could also record people’s likeness and provide identification. Within the law enforcement institutions, other modes of identification were also developed including the physical anthropometric system developed by Bertillon and fingerprinting. Fingerprinting eventually superseded Bertillon’s anthropometric system and remains in use today together with the ‘mug shot’\(^2\) photograph, which was also devised by Bertillon. Tagg (1993) claims;

*Understanding the role of photography in the documentary practices of these institutions means retracing the history of a far from self-evident set of beliefs and assertions about the nature and status of the photograph, and of signification generally, which were articulated into wider range of techniques and procedures for extracting and evaluating ‘truth’ in discourse. Such techniques were themselves evolved and embodied in institutional practices central to the government strategy of capitalist states whose consolidation demanded the establishment of a new ‘regime of truth’ and a new ‘regime of sense’. What gave photography its power to evoke a truth was not only the privilege attached to mechanical means in industrial societies, but also its mobilisation within the emerging apparatuses of a new and more penetrating form of state.* [Tagg 1993, p60-61]

Photography practices within contemporary law enforcement institutions, remains ‘procedurally and technique’ driven. With more recent requirements of forensic laboratories and practices to be certified and accredited by a professional body, forensic procedures have increased the consciousness towards working from discipline based ‘procedure manuals’. Law enforcement and forensic institutions are reinforcing technique driven operations and creating a further divide between ‘technique’ and ‘content’ that is inherent in forensic photography evidence. The content or context of photographic evidence should also be included in the pursuit of truth, fairness and reliability of this form of evidence.

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\(^2\) ‘Mug shots’ are a term used for identification photograph and includes a full frontal shot and a profile.
1.3.2 Photography and Truth

Theory gained from ‘photography theory’ or ‘visual culture’ suggests that a single photograph may have a range of different interpretations and meanings. The idea that a photograph mirrors real objects and the resultant photograph must therefore reflect reality, is one that considers photographs as purely ‘objective’ in nature. This condition is based on the thinking that a camera is simply a mechanical apparatus that produces a facsimile of the real. Several theorists including Sontag (1973), Berger (1972), Sturken and Cartwright (2003), Tagg (1993) and Clarke (1997) have critically challenged this concept of objectivity. They suggest the objective nature of photographs is mostly a superficial aspect of meaning and other deeper conscious and subconscious interpretations are present. This study takes the position that further meaning may also manifest as ‘inferences’ imposed onto the photograph and is often not recognised during court hearings when photographs are used as evidence during the search for the truth.

When the application of photographs is applied to various discourses, they can wield immense power and influence. This influence is well recognised by theorists and has been extensively discussed in the context of advertising, media, politics and art [Sontag 1973, Berger 1982, Tagg 1993, Wells 2000, Sontag 2003, Levi Strauss 2003]. The application of photographs to ‘objectifying’ objects, scenes and people, is a position that is supported by this study. However, if courts are conditioned to interpreting evidential photographs exclusively in this context, problems arise when the context of the oral evidence does not match the meaning of the photographic evidence. Recent cases have shown that witnesses have used photographic evidence to support oral evidence that may be exaggerated or even erroneous (see Zak coronial inquiry in Chapter 9). Because photographs elicit a strong sense of objectivity, their evidence becomes validated and believable through the representation of photographs. This presents a dangerous situation for jurisprudence and especially when identification evidence is presented from sourced photographs.

The Cottingley fairy photographs, taken in 1917 and 1920, are a good example of how evidence, facts and truth can link together in a convincing narrative despite the highly exaggerated claim that fairies actually existed. The Cottingley fairy
photographs were taken by two girls who lived in Cottingley (UK) [Conan Doyle 1920, Conan Doyle 1921, Conan Doyle 1922, Hodson 1925, Gardner 1947, Gardner 1975, Gardner 1982, Cooper 1990, Bord 1997, Harvey 2007]. Arthur Conan Doyle (1859-1930) and Edward Gardner (1870-1970) used a rationalist perspective to ‘prove’ fairies really did exist because they were photographed, without trickery, onto film. It fits into the axiom ‘seeing is believing’ and many people actually believed these photographs were actual evidence that fairies existed for over half a century³ [Cooper 1997].

Rationalism is an epistemological philosophy that forms knowledge from the treatment of reason. Scruton (2001) argues;

\[
\text{Rationalism derives all claims of knowledge from the exercise of reason, and purports to give an absolute description of the world, uncontaminated by the experience of any observer. It is an attempt to give a God’s-view of reality. [Scruton 2001, p21]}
\]

Scruton’s definition of rationalism can be equally given to the perception of how photography records evidence. Providing the Cottingley fairy photographs were genuine, meaning not falsified through fakery, Conan Doyle believed fairies must exist solely on the basis they had been photographed. The reasoning here is the fairies must be real to be photographed. The photographs not only verify but also provide an objective independent witness.

Immanuel Kant (1724-1804) argued a different type of reasoning in his ‘Critique of Pure Reason’ (1781). Kant suggested, that knowledge must combine reason with the experience of the observer and he rejected the notion that knowledge could be gained from reason alone. He argued that neither experience nor reason exclusively could provide knowledge and believed just experience provides content without form, while reason provides form without content. Kant’s position suggested that knowledge is the synthesis of both elements; experience and knowledge [Scruton 2001, Guyer 2006].

³ Until the girls, by then elderly women, admitted the photographs were faked and the fairies were paper cut-outs.
Photographs as evidence can enhance rationalist ideas by way of validation and verification of the facts. They can easily combine experience and reason of the observer from a Kantian perspective and enhance notions of reality. Furthermore, photographs can provide a substituted experience or an experience without actually being at the scene when the photograph was taken. Conan Doyle was not present when the fairies were photographed however he can substitute that experience by viewing the photographs. His experience is a combination of life experience and culture that also includes one of witnessing the event via the photographs. Experience and reason is a variable between individuals that result in different interpretations of photographs. This theoretical response to photography recording truth becomes problematic for forensic evidence.

Conan Doyle (1922) and Gardner (1947) claimed that if fairies can be seen in the photographs, and the photographs were genuine, the existence of these creatures must be a reality. Conan Doyle was also a strong supporter of spiritualism photography, which gained a following after the WWI, and he would often defend the integrity of spiritualist photography practitioners like William Hope (1863-1933) who were, not surprisingly, found by investigators to be a fraud [Stashower 1999].

There are indications that the same underlying level of confidence in photographic evidence still exists today when photographs are presented as forensic evidence. This confidence suggests that photographs can produce incontrovertible proof because they mirror or provide a trace of reality due to the mechanical nature of the camera and its objectivity [Tagg 1993, Brugioni 1999, Strauss 2003, Ticker 2005, Doyle & Williams 2006].

Truth may be defined as ‘a state of being true’ or ‘a property of certain of our ideas’ [James 1910]. A pragmatist perspective of ‘truth’ that stems from an early American philosopher William James (1842-1910) suggests, truth is the relationship between an idea and its object, which is verified by our experiences. James (1907) further suggests;

*The truth of an idea is not a stagnant property inherent in it. Truth happens to an idea. It becomes true, is made true by events. Its verity is in fact an event, a*
process: the process namely of its verifying itself, its verification. Its validity is the process of its valid-action. [James 1907, p77-78].

Pragmatism as an ideology evokes notions that are conceived through practical consequences. Cherryholmes (1992) also suggests there are many versions of pragmatism. The product of truth is a critical concept when photographs are considered as evidence in the judicial system. The obligation of witnesses to ‘tell’ the truth should also extend to ‘show’ the truth through the photographic medium. In relation to photographs as evidence, a pragmatist model supports the notion that the context [Cherryholmes 1994] of the images is an important consideration when determining truth. Edmond (2002) also suggests;

.........there is no epistemic framework capable of guaranteeing absolute truth. All claims of truth are therefore contextually situated but this does not mean that they are unreliable, of equal value or insufficient to do things. [Edmond 2002, p55]

Edmond’s (2002) position is one that this study supports. The epistemological arguments of where truth is positioned or constructed within a sociological framework are less important than understanding that meaning and photographic truth is reliant on interpretation and contextualisation. This means that photographs cannot be considered as independently true or that photographic truth cannot exist in isolation without considering that they are influenced by a collection of ideas, experiences, culture, meaning and context.

Perspectives of truth has also caused concern when forensic science examined the reliability of new technology – digital imaging. The application of digital imaging within forensic science caused some initial concerns regarding the concepts of truth and reality based on the ease with which an image could be altered digitally. Several committees, directed by the forensic science fraternity, were formed to investigate the new digital technology’s reliability as forensic evidence. Working committees were formed in England [House of Lords 1998], America [SWGIT 2000] and Australia [SMANZFL 2004]. All the committees accepted digital imaging as being another form of photography.
Forensic science is very much a ‘visual science’ and photography is a critical component in most forensic disciplines to record, document, examine and analyse forensic evidence. Photographs are frequently presented in court to support the evidence of a witness, both lay and expert. These images are mostly used in support of oral evidence as a way of telling and offer further suggestions that the oral testimony is based on truth and rational or scientific principles.

Images also provide assistance when articulating simple and complex concepts by offering an increased level of communication. However, images used as evidence also function at another level. They offer an increased degree of believability or persuasiveness that projects an inference of honesty and accuracy of the witness. For example; a witness claims they saw an item at the scene and then produces a photograph of that said item to support the oral evidence. While this is a simplistic example for photographic evidence, its application enhances the level of believability by producing the photograph in addition to the oral evidence. David Levi Strauss’s (2003) essay titled ‘Photography and Belief’ begins with this description of photography;

*Seeing is believing. It’s been that way from the beginning, long before Messrs. Niépce and Daguerre changed the technology of seeing by inventing photography. But photography materialized seeing in a new way, and significantly changed the relation between seeing and believing. Photography as a mechanical reproduction almost immediately altered the aura of the work of art, and over the next 150 years photography acquired its own aura – the aura of believability.* [Levi Strauss 2003, p71]

Levi Strauss’s suggestion is consistent with contemporary forensic science when photographs are presented as supporting visual evidence and especially supporting the notion of an ‘aura of believability’.

All witnesses are legally obliged to take an oath or make an affirmation before giving evidence before a court. This has been a principal tenet of court proceedings since the development of early law in England and is expressed by ‘swearing to tell the truth and nothing but the truth’ [Forbes 2005]. The oath places emphasis on the ‘telling of the truth’, which is directed more towards the oral aspects of the evidence, the telling through speaking. It does not emphasise the ‘showing’ of the truth through photographs or visual narratives.
There is a significant danger of photographic evidence being misused within the judicial system due to the highly persuasive power of photography. Tagg (1993) suggests;

\[\text{The important thing is that the photograph possess an evidential force, and that its testimony bears not on the object but on time. From a phenomenological viewpoint, in the Photograph, the power of authentication exceeds the power of representation.}\ [Tagg 1993, p1]

Sturken and Cartwright (2003) also support this notion and suggest scientific photographs, those particularly from medical science and the law, possess an inherit authority. Inferences of total objectivity within the photographs presented as evidence can be problematic if used within an inappropriate context. CCTV is also often considered more objective because it is not controlled by human intervention\(^4\) and records the image without consideration of framing and the time the image is captured. This notion is, of course, false because somebody, at some stage, has set up the camera and considered camera angles, framing, exposure and lighting [Sturken & Cartwright 2003].

Photographic evidence can carry considerable influence regarding proof or the rationalisation of photographs when used as evidence. Furthermore, when photographic evidence is used inappropriately, misleadingly or erroneously, it has the potential to cause serious jurisprudence consequences. This important point is however, not well considered within the contemporary judicial environment.

David Bell’s (2004) editorial in the Australian Journal of Forensic Sciences makes the following claim regarding the level of misleading evidence given by expert witnesses. Bell claims;

\[\text{Miscarriages of justice due to misleading expert testimony continue to occur at the same appalling rate.}\ [Bell 2004, p47]

Bell discusses aspects of the rules of evidence and further argues;

\[\text{The provision that the expert witness should indicate where the report is incomplete or inaccurate is particularly quaint. It can only apply to the expert}\]

\(^4\) Referring to static CCTV cameras without panning and zooming by security monitors.
who has insight and is dishonest. No honest expert would knowingly transmit inaccurate information. The far more likely reason for inaccuracy or inadequacy would be deficient training, unreliable memory and the failure to know everything about everything. It requires identification of negatives. It calls for the impossible. If dishonest expert witnesses exist, this provision would be utterly futile.

The rules have the outstanding deficiency of the formula laid down by Lord Woolf. They do not require the expert witness to substantiate the reliability of the information on which the opinion is based. The rules allow the expert to mix fact with fantasy and reliable science with speculation indiscriminately and without warning, notice or distinction. What manner of unreason impels these rules? [Bell 2004, p47]

Bell’s (2004) statement supports the position that inaccurate evidence from expert witnesses is a current problem with our judicial system. He further asserts the court rules do not provide adequate standards attributed to expert evidence. The problem is further exacerbated when photographs are used to support truths by bringing an artificial level of creditability to possibly inaccurate evidence or pure speculation. This situation becomes quite dangerous when evidence is based more on speculation rather than on a sound science or robust criminalistic methods. Speculative evidence can be dramatically enhanced when photographs are included as support, regardless of whether the photographs themselves are accurate or are given in the appropriate context. Bell suggests ‘The court relies on belief.’ [Bell 2004, p 48] and asserts the solution is for the judges to accept their responsibility and only admit reliable science and consider the evidence. This study supports this idea and adds that the reliability of photographs as evidence should also be included into this debate. Sturken and Cartwright suggest;

Since the origins of photography in the early nineteenth century, scientific images have been an important area of photography’s history and development. The role that photographs have played as scientific and legal evidence has been significant’ [Sturken & Cartwright 2003, p279].

The value of photographic evidence will continue, however, the reliability of the evidential images must be established through similar discourse and consideration like photography theory of the media, advertising and photojournalism. Scientific and legal photographs appear more ‘objectified’ than other modes of photography by its very nature. Sturken and Cartwright further suggest;
Because scientific imagery often comes with confident authority behind it, whether we view it through the press or through professional work and study, we often assume it represents objective knowledge. [Sturken & Cartwright 2003, p279]

The objectification of evidential photographs is not always a negative consequence. Several modes of forensic photographs are designed to communicate conditions that need a simplistic representation of an object or scene. This work argues that the content and context of the evidence photographs must be congruent with the other modes of evidence the photographs support. This is a key principle of reliability. The reliability of the photographic evidence is conditioned by the content and context of the evidence. This consideration in forensic photography is missing within the current forensic science literature and is not witnessed within forensic science practice, legislated rules of evidence or court processes.

Photographer Taryn Simon was commissioned by the New York Times magazine to photograph thirty-one men and one woman who were freed from prison after being found innocent of the crimes they were originally found guilty [Simon 2003, Courtney & Lyng 2007]. These people, several on death row, were freed because of the Innocence Project which was devised by two American lawyers Peter Neufeld and Barry Scheck. The project uses post-conviction DNA testing to exonerate innocent people and have released over two hundred convicted people since its inception in 1992 [Cole 2001, Scheck et al., 2003, Leo 2005, Gross 2008]. Simon’s compelling portraits make a poignant statement about the frailties of the US justice system and remind us that the people found innocent while awaiting a death sentence, are actually people and not just some state statistic. Her humanistic work brings a face to each of these victims of an injustice by the judicial system. Simon (2003) sums up the dangers of photography when it’s misused and misunderstood in the criminal justice domain;

Photography’s ability to blur truth and fiction is one of its most compelling qualities. But when misused as part of a prosecutor’s arsenal, this ambiguity can have severe, even lethal consequences. Photographs in the criminal justice system, and elsewhere, can turn fiction into fact. As I got to know the men and women in this book, I saw that photography’s ambiguity, beautiful in one context, can be devastating in another. [Simon 2003, p7].
Simon’s quote above, and her photographic portraits of the victims of the criminal justice system, provides a pivotal caution regarding making sure photographic evidence is carefully and appropriately considered during the investigation and prosecution of suspects of crime. Simon’s comment is central to the position of this study, which suggests the reliability of photographic evidence is a fundamental element of supporting the search for truth using forensic evidence.

Forensic science and the judicial system have a responsibility to the community to administer justice and ensure that justice and punishment is served on people committing crimes. Following an axiom developed in medicine which states, ‘first do no further harm’, this responsibility also extends to the accused to ensure the evidence used during the prosecution is fair and reliable. This presents a precarious balance between justice for the community and justice for the accused. Understanding the reliability of forensic science evidence being brought before the courts, including CCTV and other photographic evidence, provides significant advances in establishing this important balance of justice and provide basic human rights of protection.

1.3.3 The Application of CCTV Surveillance

The number of CCTV cameras within communities is unknown. Some sources have suggested there are over four million CCTV cameras installed in the UK [BBC 2007, Epstein 2007]. Epstein (2007) reported that, on average, a person moving through London will be captured on CCTV approximately three hundred times in a day. The prolific application of CCTV within the Western communities is a modern reality.

A report for the Australian Research Council (ARC) by Helene Wells, Troy Allard and Paul Wilson from Bond University, examined crime and CCTV in Australia [Wells et al., 2006]. The study was more specifically focused on the Gold Coast (Queensland) and the Queensland Rail (QR) Cityrail network and was not Australia wide. The report suggests the original objective for installing CCTV was to reduce crime by addressing alcohol related violence and anti-social behaviour and was an attempt to improve public safety [Wells et al., 2006]. It also reported on the number of CCTV cameras installed by Queensland Rail at railway stations and their carparks.
The Well’s, Allard and Wilson report states there were a total of 283 CCTV cameras installed by QR in 1995 and by 2003, that number had grown to 3,369 cameras. This is an increase of over 1,000% in eight years. Although the data is a little out-of-date, it illustrates the trend during that period. Well’s et al., also noted that by 2006 there were 3,398 cameras installed on Queensland Rail stations and their carparks, which is only a slight increase from 2003. However, the report further suggested that the inclusion of cameras installed in train carriages had brought the total number of CCTV cameras in 2006 to approximately 5,500.

There is little doubt that the application of CCTV has grown enormously over the last decade. Today we see CCTV installed in streets, ATM’s, public transport, shopping centres, hotels, universities, public buildings and private homes. Citizens are now frequently recorded by CCTV while they traverse through public and private spaces.

It has been suggested that the intrusion of CCTV into our privacy is off-set by the increased security CCTV provides to citizens while transiting through public spaces.

This study will not examine the civil liberty debates associated with privacy issues of law-abiding people; however, it does accept that CCTV also captures criminal
activity in action. It is the reliability of these images to provide forensic evidence that is the focus of this research.

1.3.4 Evidence from CCTV Images

There are a number of recent criminal cases that have used evidence which has been obtained from CCTV sources [Regina -v- Jung NSWSC (2006), Regina -v- Tang NSWSC (2006), Regina -v- Murray NTSC (2005), Regina -v- Johnson NSWSC (2007), Police -v- Morgan (2009), Atkins & Atkins -v- The Queen EWCA (2009) (UK)].

Evidence obtained from CCTV can be separated into two categories; i) identification evidence and ii) all other evidence. Identification evidence consists of methods employed to identify persons of interest depicted on CCTV. These methods predominately consist of a comparison between questioned images of unknown identity (sourced from CCTV) with exemplar photographs taken from a person of known identity. The second category comprises of all other evidence including determining forensic intelligence from a visual narrative of the event, reconstruction of the scene and simple documentation or witness evidence. Both categories involve an extensive use of photointerpretation practices. Visual narratives, forensic intelligence and photointerpretation methodologies is examined in Chapter 9.

Identification of persons depicted on CCTV may be achieved by recognition by a lay person who knows the suspect or was witness to the crime, or through a scientific identification process by a forensic expert. The case studies used in this study (Chapters 5 and 7) examine how both types of identification (expert or lay) have been used in recent criminal trials in Australia.

The identification of offenders using forensic science techniques is not a new concept. Fingerprint identification has been used in law enforcement for more than one hundred years [Cole 2009].

Raymond (2006), the NSW Police Chief Scientist, advocates that the forensic practice of ‘identification’ is heading towards more rigorous scientific methods due

Perhaps the most inexcusable mistakes have been made when a decision was made primarily or almost exclusively on the basis of forensic evidence. The McLeod-Lindsay, Rendell, Splatt, Chamberlain and Blackburn cases strongly suggest that, when forensic evidence is relied upon in the absence of convincing primary evidence or motive, grave errors can be made. A 1989 analysis of 20 Australian cases of actual or possible miscarriages of justice suggested that inconclusive expert evidence or experts acting as advocates were significant factors in well over half of those cases. Evidence presented in a narrow, biased manner, or evidence impartially presented where it is basically speculative and inconclusive, can cause severe problems. So too can circumstantial evidence that is nevertheless suspect, as in the Chamberlain case. [Wilson 1994, p87]

Wilson (1994) echoes the same concerns in 1994 as the recent case studies used in this research. He highlights the dangers of expert witnesses when they present ambiguous evidence or with a significant degree of bias towards a party (generally to the prosecution in these cases). Photographic evidence can be used to support the dangerous situation Wilson is suggesting. The weighting of the evidence can be significantly influenced or enhanced by supporting photographic evidence. Photographic evidence in the hands of witnesses described by Wilson (1994) further supports the possibility of miscarriage of justice, especially with CCTV identification evidence using poor quality images.

There are currently no validated standards within forensic science for the identification of persons of interest using CCTV images. The Association of Chief Police Officers of England, Wales and Northern Ireland (ACPO) published a guide to assist with this situation titled ‘National Working Practices in Facial Imaging’. This publication was the result of findings made by the ‘ACPO Working Group for Facial Identification’ and its purpose is to aid practitioners conducting cases in this field. No recommendations are made regarding any standards for the sourced material for
identification, however the report strongly recommends practitioners should possess sound knowledge of human facial anatomy, anthropometry and physiology with an in-depth knowledge of photointerpretation and image analysis. Porter and Doran (2000) assert that an important aspect of facial identification requires the amalgamation of two distinct disciplines; gross anatomy and forensic photography.

Iscan (1993) claimed there are three novel methods of identification of persons of interest from photographs. These methods include; i) facial morphological comparison, ii) photoanthropometric analysis and iii) photo-superimposition [Iscan 1993, Yoshino 2004, Edmond et al., 2009]. Yoshino’s (2004) confirmed these methods in his survey of the literature and included another method using three-dimensional exemplar images that allow adjustments to the camera angle. Porter and Doran (2000) provide a model that uses a holistic method of identification which includes the three methods described by Iscan and introduces a further concept consisting of distinctive marks or what is termed in criminalistics as ‘individual characteristics’.

Identification using facial morphology is comprised of a qualitatively determined matching of facial morphological features between persons depicted in questioned and exemplar photographs [Iscan 1993, Yoshino 2004]. Vanezis et al., (1996) tested the accuracy of a facial morphological comparison using seven different examiners using the same 39 classifications of facial features. The work found there was some correlation from only five of the examiners and recommended further research is required to enable a more scientific method. Identification from facial feature morphology relies on the concept that the combination of similar morphological characteristics would provide a low frequency among the population [Vanezis et al., 1996].

There are several problems with the reliability of this method of identification including;

- The frequency among the population is unknown and requires statistical inferences of known values to support the claim of identification.
• It is unlikely morphological features can produce identifying features and can only be considered as 'class characteristics' (belonging to a group, rather than individual features) and do not use individualising features.

• The photographic representation of facial morphology is highly dependent on photographic conditions like perspective and camera angle. (This is a considerable disadvantage for this identification method and is examined in more detail in Chapters 5, 6 and 7.)

• The comparison of morphological features is highly subjective.

• The morphological descriptors used in the classification do not offer a high level of resolution (e.g. described as either small, medium or large).

Roelofse et al., (2008) measured the facial morphology of two hundred South African males to establish whether differences can be observed between individuals. The study found that some features were more common than others and concluded by recommending that a larger sample size was needed. They further recommended that facial morphology could not be relied upon until a larger population database is obtained [Roelofse et al., 2008].

Ferrario et al., (1993) used a controlled photographic method to evaluate craniofacial morphology of a homogeneous sample (young healthy white northern Italians between 20-27 years). This study was examining facial morphology to seek data for clinical medical purposes and not for forensic identification. The study examined the angles and location or coordinates of anatomical landmarks. The experiment used strict control over the photographic recording of the experimental samples to provide consistency with the photography and minimise any variables caused by the photographic recording processes. These controls including using the same ‘u’ distance of 2.55 metres and the angles of the face were also controlled for consistency [Ferrario et al 1993].

Ferrario’s (1993) findings are interesting in the context of facial identification using morphology as the component of individualising different people. Ferrario’s study indicated that with the homogenous sample used in the study (same race and age group), there was a correlation between the position and angles measured from
specified anatomical landmarks. This correlation was also consistent across genders with 51 females and 57 males used in the population sample [Ferrario et al., 1993].

This finding (Ferrario et al., 1993) places serious doubt on the ability to distinguish individuals of similar race, gender and age using facial morphology as the identification method. The result also confirms the position of this study, that facial morphology should be considered as a ‘class characteristic’ (belonging to a specific group) rather than an ‘individual characteristic’ used in the process of identification. This is an important distinction not recognised in the case studies used in this study (Chapters 5 and 7). However, it further confirms the ability to eliminate suspects if a high degree of dissimilarity is observed in the facial morphology when examining questioned and exemplar photographs. Another important component of this type of examination is the matching of the photographic comparison material (camera angle and image perspective) otherwise the representation of facial morphology could display differences caused by photographic elements rather than a variable in facial morphology.

Photoanthropometric analysis is another identification method described by Iscan (1993). It is an objective method that uses physical measurements of anatomical

![Figure 1.2: Anatomical landmarks used by Roelofse et al., (2008) 1 = vertex, 2 = Trichion, 3 = glabella, 4 = nasion, 5 = endocanthion, 6 = latal canthus (exocanthion), 7 = alare, 8 = subnasale, 9 = labiale, 10 = stomion, 11 = labiale inferus, 12 = gnathion, 13 = cheilion, 14 = zygion [Image sourced from Roelofse et al., 2008, p169].](image-url)
landmarks recorded on the photographs [Iscan 1993, Porter & Doran 2000, Yoshino 2004]. An objective method would provide a more scientific approach than the subjectivity of qualitative facial morphology comparisons. Yoshino (2004) suggests that anthropometry is traditionally performed on living specimens or on bones in osteology and not from photographic sources. Photoanthropometry however, uses photographs as the data source for measurement in contrast to real specimens.

Halberstein (2001) proposed that photoanthropometric indices can provide a higher degree of accuracy than absolute linear measurements due to variations in image magnification or the object size within the photographs. However, this method remains problematic due to differences of morphology representation caused by image perspective in two-dimensional photography and camera angle. Like facial morphology, the population frequency of photoanthropometric indices also remains unknown because anthropometry population frequencies and databases have not been established.

Catterick (1992) has examined the frequency of two indices on various passport photograph samples. The study found that there was a discrimination rate for pairwise comparisons of 72%. However, it was further suggested that this method could not be relied upon exclusively without considering other forms of identification [Catterick 1992].

Introna et al., (2007) tested the reliability of photoanthropometric indices, as proposed by Halberstein (2001), when the same person was photographed using different sizes and facial projections or rotations (subjects looking in different directions to change angle of face in relation to a static camera). Their results indicated there was high variability of photoanthropometric indices from the same individuals when the images did not match parametrically (meaning same image size, camera angle and head positioning). This is not a surprising result when considering how objects are represented on a two-dimensional medium.

Introna et al., (2007) concluded that it was theoretically possible to achieve reliable photoanthropometric indices if the parametric conditions were identical. They further elaborated that this meant the exemplar images must match the same camera angle,
subject position, perspective, lighting, lens and recording parameters as the questioned photographs. They further suggest the exemplar images should be taken at the same location with the same camera and the subject positioned at the same angle to the camera [Introna et al., 2007].

This recommendation presents an ideal situation to replicate parametric conditions of CCTV images, although there are several practical problems associated with this suggestion when applied to CCTV applications. It can be more practically applied when comparing identification photographs made by static cameras such as the cameras installed for the purpose of photo drivers licences or passport cameras. Passport style photographs are also taken with the subject looking directly at the camera (norma frontalis view) which minimises the variation of camera angle and subject position. The difference between passport type identification photographs taken using norma frontalis views compared to CCTV images depicting acute angles, is an important distinction when considering methods described for facial identification.

While it is somewhat inferred in Introna’s (2007) description of the photographic condition as being parametric, they do not directly mention the influence of image perspective. Image perspective may be a considerable influence on the representation of size, shape and form (morphology) of facial features in two-dimensional images. Photoanthropometric indices are significantly influence by the representation of size of the facial morphology. From a photographic science perspective, this significantly reduces the value of these findings although, while not specified, the sample photographs appear to be taken at the same camera distance which would reduce image perspective as a possible independent variable. Furthermore, Introna’s results are what would be expected when different camera angles and subject positions are used. The work does not offer any new knowledge in this area.

Kleinberg et al., (2007) also tested the reliability of photoanthropometry from a series of experimental photographs of known subjects. Kleinberg’s experiment uses norma frontalis views of the subjects although it was expressed that some images had a 10° rotation because the images were sourced from a previous experiment when camera angle was not as critical [Kleinberg et al., 2007]. Kleinberg’s
The experiment compared the photoanthropometric indices measured from video images with traditionally produced photographs. The video and photographs were taken on the same day to eliminate any possible changes of the subject over time [Kleinberg et al., 2007].

Kleinberg’s (2007) findings suggested that the comparison of photoanthropometric results indicated significant variations even under ideal experimental conditions including *normal frontalis* views. They further argued that this technique was found to be unreliable. This result appears to be consistent with Introna et al., (2007) findings. However, there are two critical components of Kleinberg’s experimental design that must be cautiously contemplated.

Both studies (Introna et al., 2007 and Kleinberg et al., 2007) have not successfully advanced the knowledge regarding the reliability of photoanthropometric analysis for identification. Introna’s results are exactly what would be expected when measuring anatomical features from photographs with the subject using different camera angles. Kleinberg’s results have two significant problems with their experimental design that would cause variations in the photoanthropometric results rather than the anatomical landmarks being measured.

The two experimental design issues in Kleinberg et al., (2007) include; i) there is no mention in the experimental methods regarding image perspective and the exemplar and question images used in the comparisons appear to be different parametrically and ii) all photoanthropometric indices measured in the experiment use the *stomion* as an anatomical landmark (see Figure 1.2, landmark number 10).

The *stomion* is positioned at the midpoint of the vertical facial midline and horizontal labial fissure (top and centre of the bottom lip when the mouth is closed) [Kleinberg et al., 2007]. This landmark is not a stable anatomical feature due to the prominent degree of movement possible with the *mandible*. Variation in the subject’s mouth position, including changes of facial expression, would alter any measurements made using this anatomical landmark. The *stomion* cannot be considered as a reliable landmark to test the accuracy of photoanthropometric absolute values or indices. The
six different photoanthropometric indices used by Kleinberg all use the stomion as a component of the index calculation rendering these results as unreliable.

The lack of any control over the image perspective caused by the photographic condition of reproducing three-dimensional objects into two-dimensional photographs is also a significant problem with Kleinberg’s experimental design and results. The affect of using images of different perspective when comparing photoanthropometric indices is a significant problem with this experiment. Different image perspective will produce differences in the size relationship of various facial morphological features. The resulting differences of morphology representation caused by image perspective are a significant independent variable within Kleinberg’s results. Without any consideration or control of this variable within the experimental design, the results must be considered with some caution. Any difference in size relationship between objects would produce difference in the measured indices. The influence of image perspective on facial morphology is further discussed in Chapters 5 and 6.

The issue of not considering image perspective in Kleinberg’s results is consistent with the problems earlier described. That is, the assumption that photographs produce an accurate replication of the object is widespread; not only in the general community but also among forensic scientists using photographs as their primary source of evidential material. This situation highlights the need for further research and education among forensic science practitioners and the important requirement of using qualified forensic photography experts during any casework that involves using photographs as the primary source of evidence.

The photo-superimposition method of identification from photographs involves the overlaying of two-dimensional images (questioned and exemplar) to visually match the morphological outline of the facial features [Iscan 1993, Vanezis & Brierley 1996]. This technique was originally developed to identify unknown deceased using a skull with known photographs of the victim. This technique mostly uses video editing equipment to produce screen swipes that may be stopped to compare the correlation between the skeletal anatomical features with soft tissue anatomical structures shown in the photographs. The dentition is used as a more suitable
comparison feature because the teeth can be seen in the same condition in both images, unlike soft tissue [Brown 1983, Dorion 1983, McKenna 1985, McKenna 1988, Maat 1989, Ubelaker & O’Donnell 1992, Yoshino et al., 1993, Iscan 1993, Seta & Yoshino 1993, Aulsebrook et al., 1995, De Angelis et al., 2007, Jackson & Jackson 2008]. DNA analysis has mostly replaced photo-superimposition technique to identify unknown victims from skeletal remains, although photo-superimposition has been re-invented for application in CCTV identification methods.

A problem with the photo-superimposition method is how the comparison of both images is achieved. By the nature of this technique, that is the overlaying of images, one image always obscures the other. The transparency of the overlayed image can be reduced to allow both images to be seen however, a level of indistinctiveness remains creating problems with image masking. This ambiguity can also easily introduce unintentional examiner bias.

Photo-superimposition also requires the exact parametric matching of camera angles and image perspective for the anatomical features to align and display a correlation between features. This is critical for this method to be successful. It is also a difficult parameter to achieve; especially when acute camera angles common with CCTV images are used.

A solution to the critical alignment problems associated with two-dimensional photo-superimposition methods (identical camera angles and image perspective) has been suggested by several recent studies using new imaging technology. These studies have examined the possibility of improving photo-superimposition alignment by recording the exemplar image using a laser scanning imaging system with three-dimensional modelling software. This method is discussed by Yoshino et al., (2000), Yoshino et al., (2002), Ruifrok et al., (2003), Goos et al., (2006) and Cattaneo (2007).

The method suggests taking three-dimensional scanned images of the suspect using specialised digital scanning cameras and by incorporating three-dimensional modelling software. The scanned image can then be manoeuvred around a central projection axis to change the relative camera angle [Ruifrok et al., 2003, Goos et al.,
Several medical imaging systems, like computerised axial tomography (CAT scans) also use this technology and various positions of the body may be viewed by rotating the image on the screen. These technologies are predominantly screen based applications.

The image presented in Figure 1.3 is from Cattaneo (2007) and demonstrates how the scanned and rendered exemplar image is positioned over the two-dimensional questioned image. The angle of the scanned image can be changed to match the camera angle without the need to reconstruct this condition when photographing the exemplar material [Yoshino et al., 2000, Yoshino et al., 2002, Ruifrok 2003, Yoshino 2004, Goos et al., 2006, Cattaneo 2007].

This type of image is described as three-dimensional imaging based on its ability to view the subject from different positions using the three-dimensional modelling software. It is, however, essentially a two-dimensional image with the viewed image only presenting dimensions in height and width, and not depth. Due to the recording mechanism via scanning, the image produced has an isometric perspective, meaning it has equal or no perspective.

Figure 1.4 provides an illustration of two different reproductions of a rectangular prism. Figure 1.4a is an isometric perspective which has reproduced the structure
accurately with the vertical lines being of equal size, the horizontal lines remain parallel and structure is without perspective. Figure 1.4b is also a rectangular prism. However, this structure displays significant perspective with the vertical lines being of different sizes and the horizontal lines converging. This illustration is typical of two-dimensional photographic reproduction. Objects reduce in size when they are positioned at a greater distance from the camera lens. The isometric perspective image does not alter size or shape.

Three-dimensional\(^5\) images produced by specialised scanning cameras produce an isometric perspective as seen in Figure 1.4a. While the use of this type of exemplar image allows the ability to rotate the image to match the camera angle of the questioned image, which is an advantage, it does however, result in the comparison of significantly different image perspectives. This mismatched perspective will also display misalignments in areas of differing magnification caused by rectilinear perspective. Yoshino \textit{et al.}, 2000, Yoshino \textit{et al.}, 2002, Yoshino 2004, Goos \textit{et al.}, 2006 and Cattaneo 2007 all display this method with a highly cropped exemplar images to disguise this mismatching of perspective (see Figure 1.3).

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\(^5\) Technically they are not three-dimensional and viewed as two-dimensional.
Photo-superimposition methods using scanned three-dimensional exemplar images compared with two-dimensional questioned images may provide some solution to obtaining identical camera angles, however it does not correct the issues associated with image perspective. The method consists of a comparison between images that are not parametrically identical and this aspect remains problematic for the photo-superimposition technique. However, the experimental work in Chapter 6 indicated images captured from a ‘u’ distance greater than three metres, may provide more accurate correlation of image perspective between these two forms of photographic representation.

1.3.5 CCTV Image Quality

A significant problem arising from the forensic examination of CCTV as forensic evidence is the image quality of the sourced material. While there are no known technical surveys of CCTV cameras that empirically measure the image quality, there is strong anecdotal evidence to suggest the quality of contemporary CCTV equipment is poor (see Figures; 5.6, 5.11, 7.1, 7.2, 7.3, 7.4, 7.5 and 7.6). Cases studied and cited in this research also confirm this issue of poorly resolved images including; Regina -v- Murray NTSC (2005), Regina -v- Jung NSWSC (2006), Regina -v- Tang NSWSC (2006), Regina -v- Johnson NSWSC (2007), Police -v- Morgan (2009), Atkins & Atkins -v- The Queen EWCA (2009) (UK).

Case studies examined in this research indicate forensic evidence acquired from CCTV images has been presented to Australian courts that contain serious image quality issues. In addition to poor image resolution, the photographic evidence suffers from various image artefacts including extensive curvilinear distortion, lens flare, poor shadow and highlight detail, image pixilation and rectilinear distortion.

The introduction of CCTV standards has being forthcoming from various agencies including Standards Australia and the Home Office in the UK. The Home Office has produced a range of guideline publications that offer information relating to operational requirements of CCTV, monitoring procedures, determining qualitative resolution measurements and photogrammetry [Griffiths 1998, Sands 2001, Cohen et al., 2006, Cohen et al., 2007].
Standards Australia has published standards for CCTV in four parts including; management and operation, application guidelines, PAL signal timings and levels and remote video [Standards Australia 2006a, Standards Australia 2006b, Standards Australia 2006c, Standards Australia 2006d]. However, these standards are designed for the technology developers and have no relation to end-user applications like forensic science and how the images may relate to the requirements necessary for physical evidence and forensic identification.

There remains a significant gap between how the technology is developed by manufacturers and how this technology can support the needs of physical evidence examination, including the identification of individuals. Cotterill (2008) examined the resolution requirements using modulation transfer functions (MTF) to determine the minimum resolution requirements to resolve the morphology of the ear. Her work examined the resolution thresholds at various screen heights (size of subject within the photographic frame) and the technical requirements specifically for forensic evidence. Cotterill (2008) recommends further work needs to be undertaken in this area.

It is strongly anticipated that CCTV technology will improve in image quality in the future. However, forensic practitioners are currently forced to react to the specifications of the technology, rather than the technology developers asking forensic science what they may require for reliable forensic science evidence.

1.3.6 Evidence Act 1995

The submission of physical evidence to a court follows procedurally based rules of evidence that ensures fairness is maintained during the hearing. In most Australian Federal, State and Territory jurisdictions, the application of evidence is governed by Evidence Act 1995. This legislation was introduced by the Federal Government to provide a framework that would provide a more unified approach to the process of evidence across the broader Australian Federal, State and Territory jurisdictions [Bellamy & Meibusch 1995]. Most State and Territories have also produced their own Evidence Act 1995 legislation and is based or modelled on the Federal Act.
The application of photographs as evidence is set down in the Evidence Act 1995 under sections 115.1 to 115.10 and titled ‘Exclusion of Evidence of Identification by Pictures’. Identification of persons being charged with an offence is a critical standard of proof that must be legally satisfied and is the onus of the police and prosecution to verify. Several methods are used to gain knowledge of the accused’s identity, for example fingerprinting and DNA. Photographs are also employed to identify suspects of crime when a witness sees a person committing an offence. In these cases, police show the witness a series of photographs and ask whether they can identify the person they saw during the incident. Evidence Act 1995 establishes rules of evidence that defines how this identification procedure must take place to ensure creditable application of the photographs and to ensure the evidence is not unfairly prejudicial.

The Act significantly reduces the application of identification using photographs, unless other avenues of inquiry are not available or are unreasonable. There are also restrictions on the type of photographs that may be used in a photograph identification array. A photograph taken of the accused whilst in police custody is not permitted due to the inference that may be drawn from the image that suggests the person depicted in the photograph has been arrested. ‘Arrest photographs’, also colloquially known as ‘mug shots’ are usually clearly identified as photographs that were taken during processing of a person charge with a crime. An inference of guilt may easily transcend across to the witness’s ability to identify the suspect for police.

The rules regarding the use of photographs for identification are articulated in the Evidence Act 1995 legislation. The exclusion of photographs taken while in police custody is suggestive the Act is sensitive to inferences that may be drawn from photographs and photographic evidence. What is missing in the legislation however, is the application of photographs used for other modes of evidence outside photo identification arrays and, in particular, photographs that require interpretation. No further requirements of photographic evidence, with the possible exception of ‘relevance’, are expressed in Evidence Act 1995 that provide a legal framework to ensure appropriate representation of photographic evidence.

*Also known as ‘photo identification boards’ and consist of a series of twelve photographs including the POI (person of interest).*
The Evidence Act 1995 does not address issues arising from the misappropriation of photographic evidence (except for photographic identification arrays). Photographs are, at times however, challenged when they depict violent scenes and include images of deceased victims or photographs of wounds sustained by victims of crime. It has been successfully argued in previous cases that images depicting horrific or gruesome scenes are unfairly prejudicial and that they could influence the jury’s thinking unfairly against the accused due to the emotional content of the photographs. Horrific images are usually challenged on grounds they are unfairly prejudicial and use section 137 which attempts to balance the prejudicial nature of the evidence against its probative value.

1.4 Thesis Chapters

The following section outlines the content and contextual aspects of each chapter during the investigation of the central research question.

The Introduction chapter introduces concepts associated with CCTV evidence and includes an examination of the current body of work. It also identifies the importance of the research in relation to the current literature and contemporary forensic science practice. This is followed by a chapter describing the research design.

Chapter 2 presents the thesis research design, defines the central research question and provides a research strategy that investigates this question. It also establishes the knowledge sources used in the investigation.

Chapter 3 provides a discussion regarding the application of visual culture principles to forensic science. It establishes a debate that provides focus on the current issues in photography and visual culture theory and the misconceptions within forensic science regarding photographic representation when using photographs as evidence. The debate establishes a position regarding the arguments developed in the thesis.

Chapter 4 forms a theoretical framework that defines physical evidence, forensic photography and the relationships between both forms of evidence. The chapter develops and defines a new model that articulates the conceptual aspects of physical
evidence and forensic photography. This model is critical in providing a theoretical framework to underpin the arguments relating to the central research question. This chapter also develops new taxonomical descriptors regarding modes of inquiry for physical evidence and modes of inquiry for photographic evidence. It discusses legal aspects relating to law developed to ensure the integrity of evidence and its admissibility in Australian courts. The chapter finally considers the reliability of photographic evidence to provide a contextual framework when photography is used as forensic evidence.

Chapter 5 examines a double murder case that was heard in the NSW\(^7\) Supreme Court in 2006 (Regina -v- Jung). The Crown produced facial identification evidence against the accused using photographs obtained from an ATM in Queensland. This case has particular interest due to the lengthy legal argument (lasting almost three weeks) during the *voir dire* regarding the validity of the scientific methodology used by the Crown’s expert. Two published court decisions resulted from the *voir dire* regarding the identification evidence. This chapter examined the methods used by the Crown’s expert and the complex problems that were presented in the forensic evidence. Experimental work conducted to test the theories established with facial morphology comparisons using CCTV images as the source of analysis is described in the following chapter.

Chapter 6 examines, through experimentation, the effect of image perspective on facial morphology. The experiment was designed as a result of the *Jung* case study, which used qualitative facial morphology comparison methods using unknown image perspective or ‘u’ distances from the questioned and exemplar photographs. The experiment raises important considerations that affect the reliability of qualitative comparisons of facial morphology using photographic material that display significant variations in image perspective. This experimental work also develops significant advancements in the understanding of facial identification methodologies used in forensic science and, in particular, stresses the importance of understanding photographic science principles when preparing exemplar photographs for comparison.

\(^7\) NSW – New South Wales, an Australian State situated on the east coast of Australia.
Chapter 7 examines a second (unrelated) double murder case which was heard in the NSW Supreme Court in 2007 (Regina -v- Johnson). The Crown provided identification of the accused using a forensic anatomical expert and two lay witnesses who made an identification from CCTV images. The case study provided evidence that demonstrates the risks and dangers associated with photographic evidence. It also introduces the idea of intertextuality when oral and visual evidence is combined.

Chapter 8 examines the concepts associated with forensic identification and the contemporary issues surrounding this form of evidence. It examines traditional forms of forensic identification and considers the difficulties associated with the current methods based on concepts of ‘individuality’. This is an important debate because reliability of any form of identification is conditional to aspects of uniqueness or distinctiveness between individuals.

Chapter 9 examines evidence that may be derived from CCTV images. It produces a paradigm that illustrates a method of photointerpretation and how this form of evidence may be used to improve transparency and validation of forensic practitioner findings when using CCTV images as evidence.

The penultimate chapter develops an evidence-based discussion regarding the central research question, while the concluding chapter provides a summing-up of the research findings relating to the central research question, further questions and the research aims.

1.5 Chapter Discussion

An examination of current literature and case studies has revealed significant gaps in the current knowledge concerning the reliability of CCTV images as forensic evidence. The application of photographic evidence within the judicial system is pivotal to contemporary practice within the criminal and civil judiciary. Understanding the reliability issues when sourced images such as CCTV footage transitions between being an image to when it becomes forensic evidence, has very little understanding within the contemporary judicial system, forensic sciences and
visual communication domains. This research brings together the key elements that are required when considering how the reliability of photographic evidence may be considered. The following chapter examines the central research question, research aims and objectives, and the research design principles used throughout this work.
Chapter 2

2.0 Research Design

Although it seems deceptively simple, the comparison of two or more photographs remains one of the most difficult types of identification. As yet, no standard procedures have been developed for the analysis of photographs or video images.

Mehmet Yaşar Iscan [Iscan 1993, p58]

This research adopts a ‘mixed method’ methodology using a concurrent transformative strategy of inquiry. Mixed method research is a relatively new concept in research design and utilises both qualitative and quantitative data. Used predominantly in the social science disciplines, this method allows the research to explore the aspects associated with evidence represented in images from various viewpoints. It allows the examination of theory while incorporating pragmatic concepts of contemporary practice and case studies. A more traditional research method would restrict the different levels of inquiry necessary to construct new thinking in this area of study. Information sourced from several modes is an essential
component of understanding the nature of photography as evidence and is important during the analysis and discussion phase of the research. Tashakkori & Teddlie (1998) suggest mixed method research methodology has been used in social science disciplines including education, nursing, public health, sociology, clinical research, administration sciences, community psychology and school effectiveness research.

A concurrent transformative research strategy allowed both modes of data collection (qualitative and quantitative) to occur simultaneously throughout the course of the study. Each data source has the potential to build on the various knowledge sources during the progression of the study and is particularly useful when knowledge is sourced from an interdisciplinary base. The integration of each data source comes together in several phases of the research.

A mixed method research design model also provides several advantages over more traditional research models. Creswell (1993) suggests;

A researcher is able to collect the two types of data simultaneously, during a single data collection phase. It provides a study with the advantages of both quantitative and qualitative data. In addition, by using the two different methods in this fashion, a researcher can gain perspectives from the different types of data or from different levels within the study [Creswell 1993, p218].

This research is phenomenologically based and draws on a wide range of primary visual sources including; case studies, experimental work and critical theory. It first establishes a critical framework that defines physical evidence and forensic photography and then describes their relationship when establishing evidence. This framework provides the structure of the central argument and discussions based on the conceptual aspects of identification evidence and photointerpretation. The framework model also introduces new thinking into forensic science and, in particular, it introduces new taxonomic descriptions when using photographs as evidence.

2.1 Researcher Bias

The researcher’s forensic science experience includes several forensic cases that have required examinations regarding the identification of persons depicted in
photographs. Cases involving the identification of suspects were conducted for both sides of the adversarial justice system, the Crown prosecution and the Defence. Cases for DPP\(^8\) were conducted during employment with the Australian Federal Police (AFP) and further examinations for other authorities including Australian Customs, The National Crime Authority (NCA) and private investigators. Cases have also been conducted on behalf of the Defence counsel of the accused.

The experience gained by representing both sides of the legal system, has provided a valuable insight across aspects and issues of forensic science and photographic evidence. The research takes the position that this experience has provided a balanced view of how photographic evidence is used and presented in a court of law by both sides of the adversarial justice system. This research examines the central research question from an objective position that is motivated to develop more reliable evidence methodologies when deducing evidence from CCTV images. It is anticipated the work will assist police and forensic experts to obtain and prepare CCTV evidence that is based on principles that are more scientific in nature and considers the constructs surrounding the photographic evidence more clinically.

### 2.2 Research Question

This research investigates the reliability of photography as evidence when sourced from CCTV surveillance images. The study is interdisciplinary and because it examines forensic evidence it resides mostly within the forensic photography and forensic science domains. However, the work also uses critical theory in visual communication and visual culture that establishes levels of an interdisciplinary approach.

The research investigates the following central question;

- What are the critical considerations required to improve the reliability of forensic evidence sourced from CCTV images?

\(^8\) DPP – Office of the Director of Public Prosecutions
Further to the central question, the research also explores the following;

- What type of evidence may be gained from CCTV images?
- Can accurate identification of persons depicted in surveillance photographs be made directly from the sourced photographs?
- What methods may be considered to provide a transparent application of photographic evidence that can more reliably represent truth?
- How important is the validation of photographic evidence when used in forensic science and sourced from CCTV?
- What safeguards are necessary to ensure reliability when images undergo photointerpretation?

2.3 Research Aims

The aims associated with this research are to;

- Provide new knowledge regarding content, context and physical attributes of CCTV photographic evidence when used in a court of law.
- Recognise and articulate the gaps in the knowledge and practice when current identification methods are used as evidence.
- Provide new knowledge to forensic science when validating the potential and reliability of CCTV images as evidence.
- Improve justice by recommending safeguards to evaluate more critically the manifestations of truth embedded into photographic evidence.

2.4 Research Map

Figure 2.1 illustrates the knowledge sources used during the research of the central question. These knowledge sources form the foundation of critical theory when constructing models associated with physical evidence, forensic photography forensic identification and photointerpretation methodologies.
The knowledge sources used to research the central question are also interdisciplinary. They reside mostly in the context of forensic science and how forensic evidence is applied within a legal framework. While the case studies used in this research are Australian and were heard in the NSW Supreme court, the legal concepts of forensic evidence can be considered across several jurisdictions and may be considered to have some universal commonalities with most jurisdictions using an adversarial legal system. An example of this universal thinking is the Daubert ruling from the United States Supreme court [Edmond & Mercer 1997, Bingham et al., 2003, Christensen 2004]. While the Daubert ruling does not apply in Australian courts, it is often cited in cases and the thinking associated with this ruling is discussed within the context of Australian law, but not within the context of photographic evidence.

Furthermore, a recent case in the Court of Criminal Appeal (Criminal Division) in the United Kingdom, [The Queen -v- Atkins & Atkins, 2009] cited two Australian CCTV identification cases including Tang and Jung. Jung is a case study used in this research.
Knowledge sourced from the visual culture domain is also critical to this research and provide an understanding of how images may influence peoples thinking and decision-making. It also provides a basis to examine visual culture within the forensic sciences, an area that has not been previously considered.

Figure 2.2, provides a map that summarises the research design and illustrates what investigation strategies are used in the ‘mixed method’ research method. The diagram further illustrates the relationship between each discipline relating to the central research question.
2.5 Research Validation

This research advocates a new way to consider the application and reliability of CCTV images as forensic evidence. The research also develops new thinking in the critical theories associated with physical evidence applications and develops taxonomic descriptors for the applied notions of forensic photography. It further produces a working model for photointerpretation specifically designed for forensic evidence. The conclusions of the research will advance professional practices in the context of providing more reliable photographic evidence when images are sourced from CCTV.
Chapter 3

3.0 Visual Culture in Forensic Science

The forensic photograph is a fragment scissored from time: a powerful form of evidence and an official document, but one that is authored by an individual and therefore marked by a personal vision. And every crime scene photograph is also a form of intrusion on private pain, justified because the detective will use it later to arrive at the truth of what happened.

Caleb Williams [Doyle & Williams 2006, p13]

The function of this chapter is to examine key photography theory and contextualise this theory within photography applications in forensic science. The chapter forms a basis for the development of a conceptual model that specifically addresses applications of physical evidence and photography. It also highlights the shortcomings of photographic evidence in contemporary forensic science and provides a discussion regarding the current key intellectual issues concerning the application of photography as evidence and contemporary photography theory. The chapter also serves as a review of relevant critical theories associated with photography theory in the context of forensic evidence.
Dino Brugioni, a retired Central Intelligence Agency (CIA) photographic interpreter and a cofounder of the Agency’s National Photographic Interpretation Centre, makes the following comment in his photo fakery book regarding the use of photographs as evidence in a court of law;

*The evidentiary nature of a photo is accepted in most courts without question. What is said or written about an event is open to interpretation and question, but the power of the visual image is considered unimpeachable testimony that an event has transpired.* [Brugioni 1999, p194]

### 3.1 Visual Culture

Cultural studies as an academic discipline was first established at the Centre for Contemporary Cultural Studies at the University of Birmingham in 1964 [Sardar & Van Loon 1997]. The discipline has since made a presence within several academic fields including the social sciences, humanities, arts and visual communication. In addition, visual culture is an emerging academic discipline that studies social phenomena that seeks to explain concepts of visual representation, meaning and communication. Biber and San Roque (2006) propose visual culture themes are beginning to emerge within the law landscape [Biber & San Roque 2006].

Sturken and Cartwright (2003) suggest that our culture is an increasingly visual one and that over the last two decades Western culture has become dominated by visual rather than oral or textual media. Marguerite Helmers (2006) defines ‘visual culture’ as;

*The term visual culture is of recent origin and derives from work in art history, sociology, and cultural studies. The three primary modes of communication in contemporary society are the written word, the spoken word, and the use of images. Visual culture studies emphasise that images convey meanings, perhaps even more so than the written word* [Helmers 2006, p2]

*.......the term visual culture applies to the world of visual expression and the history of visual representation* [Helmers 2006, p26].

Nicholas Mirzoeff (1999) also provides a succinct explanation of visual culture that relates to this studies research question very well. Mirzoeff states;
Visual culture is concerned with visual events in which information, meaning, or pleasure is sought by the consumer in an interface with visual technology. By visual technology, I mean any form of apparatus designed either to be looked at or to enhance natural vision, from oil painting to television and the Internet. [Mirzoeff 1999, p3]

Several key theorists have contributed to a foundation of visual culture thinking that examines the influences of visual images and defines social constructs surrounding their application. Marxist theorist Walter Benjamin (1936) describes photography’s function as a form of representation that documents objects and suggests this concept of objectification is caused by the camera functioning as a mechanical device. Benjamin argued that the mechanical reproduction of photography and its ability to circulate multi-copies of images radically changed how society dealt with visual phenomena [Wells 2000]. Traditional representations made by artists included the creative influences of the artist and a certain level of subjectivity was expected. Photography on the other hand, could be seen as a more objective form of visual media. Concepts that describe photographs as a ‘trace’ or a ‘mirror’ of reality stem from the notion that the camera operates objectively as a mechanical apparatus.

In 1972, John Berger published a text called ‘Ways of Seeing’ in which he provides a model for understanding the meaning of images across a range of visual media [Sturken & Cartwright 2003]. Other influential theorists in photography theory and visual culture include Susan Sontag (1973), Roland Barthes (1981) and Victor Burgin (1982). They examine, from different theoretical perspectives, the function of photography as a social tool and discuss methods of interpreting meaning from images. Semiotician Umberto Eco (1982) also attempted to codify the photograph as text and produced a category of visual codes [Wells 2000]. The process of how the photograph influences thinking using semiotic (Barthes and Eco), phenomenological (Berger and Sontag) or psychoanalytic (Burgin) perspectives has found an accord with aspects of visual culture and sociology that include advertising, media, popular culture, film and political rhetoric.

Barthes (1981) proposed there are two distinctive levels of meaning when interpreting photographs. He defined these levels as denotative and connotative meaning [Barthes 1981, Clarke 1997, Sturken & Cartwright 2003]. Denotative
meaning refers to the literal meaning of the photograph or its referent. For example, the photograph is of a boat, or a river, or a person and or a pipe. While connotative meaning is the photograph’s second meaning and considers a deeper interpretation that exploits a coded visual syntax. Clarke (1997) suggests connotative meaning is not just a second meaning, but also the ‘message proper’.

A central theme in contemporary visual culture theory is the challenge photography faces when representing reality and truth. Constructs surrounding the photograph and its representation of truth have been described in the visual culture literature as ‘photographic truth’ [Sturken & Cartwright 2003]. This construct considers the photograph’s function as a form of objectification of its subject and is based on the camera’s ability to operate exclusively as a mechanical device. This objective representation of the subject supports the notion of photographic truth which can be understood in the common axiom ‘the camera never lies’. This notion further suggests that the camera’s optical and light sensitive recording mechanisms can only image what it can see, and the objects must be there in real life for the camera to produce an image. This mechanistic quality means the objectivity is closely associated with reality and produces an enhanced level of believability of the medium – the camera never lies [Winston 2001].

The construct of photographic truth is, however, widely disputed in the visual culture literature and Sturken and Cartwright (2003) suggests it is a myth. Rose (2005) affirms that the interpretation of images is just that, ‘an interpretation’, and is not the discovery of truth. The notion that photographic truth is a fallacy is based on the premise that there is, and will always be, some subjectivity within the photographic practice. Subjectivity is introduced into the visual dialogue from the photographer’s initial choices (of framing, aesthetics and lighting etc) and when the viewer uses cultural and life experiences to interpret the message. Other external contexts, like a caption or title, will also add to the level of interpretation. The context in which the image is viewed also produces significant subjectivity [Barrett 1996, Banks 2001, Helmers 2006]. A common position among visual cultural theorists suggests that all images are contextualised and, at some level, meaning is internalised. René Magritte’s painting titled ‘The Treachery of Images, 1928-29’ challenges the way we read simple images of representation. Magritte’s painting depicts a smoking pipe on
a plain but tonal background with text written underneath the pipe which reads in French ‘Ceci n’est pas une pipe’ translated into ‘this is not a pipe’ [Sturken & Cartwright 2003]. Magritte’s painting is making a statement about the complex relationship between the referent (the object or pipe in this case) and how we interpret and translate that image into a real object or its representation. The work is designed to challenge how readily we accept representations as reality. The painting is in fact not a pipe, but a painting.

3.2 Photographic Truth

If visual cultural theorists do not support the concept of photographic truth, then what implications does this have when photographs are presented as evidence in a court of law? As with all other modes of evidence, photographic evidence must also satisfy a court’s principal tenet of ‘truth’. This is particularly so for photographs that support forensic science evidence. Simply ignoring contemporary visual cultural thinking by dismissing it as theoretical rhetoric that does not apply to science or law is a dangerous position to hold. The community is influenced because of these visual cultural ideas in most other modes of visual media. Forensic science and law must also examine constructs of truth and reliability that are pertinent to photographic evidence.

Issues impinging on truth and reliability of photographs are highly complex and very little research has examined aspects of truth and reliability of photographs when used as forensic evidence. Forbes (2005) suggests that since the development of early law in England, witnesses have been required to swear an oath to ‘tell the truth, the whole truth and nothing but the truth’. The emphasis in this oath is in the telling of truth. The following chapter explores visual methodologies used in physical evidence to ensure that the showing of truth through visual modes of evidence is also considered and consistent with the evidence given by the forensic expert or lay witness.

Bell’s (2004) editorial regarding the responsibility for misleading expert testimony could have also included misrepresentations made by visual evidence. Recent cases [HMTQ -v- Cooper (2000), Regina -v- Tang (2006), Police -v- Hooper, Regina -v- Jung (2006), Regina -v- Johnson (2007)] have revealed that unintentional
misrepresentations of evidence is occurring in Australian courts and are caused by the witness’s interpretation of photographic evidence without a sound knowledge of forensic photography or an understanding of visual culture models. Several interesting questions surface when the reliability of photographic evidence is explored. These questions include;

- What visual culture models are used in forensic science?
- What models of photographic truth underpin the thinking of forensic science practitioners?
- What photographic evidence practices are employed in forensic science?

3.3 The Application of Photography within Forensic Science

Photography was applied to law enforcement shortly after its invention. Nickell and Fischer (1999) suggest Belgium police were using daguerreotypes for prisoner records as early as 1843. In 1870, England and Wales made photographing all prisoners mandatory [Tagg 1993] under new legislation. According to Tagg (1993) a British parliamentary report in 1873 noted that 43,634 photographs were taken of prisoners during 1870 and 1872. Photography had become institutionalised within law enforcement early in its technological development.

Its application also spread to photographing items of evidence and scenes of crime although acceptance of the new technology had to be developed. The introduction of photography into law enforcement in the nineteenth century clearly used the medium as a form of representation of prisoner’s likeness. Attached to the prisoners’ records, officials were able to make comparisons between a prisoner’s facial photograph to the physical likeness of the prisoner. Prisoner identification (ID) photographs continue to be used within law enforcement agencies even though fingerprinting and DNA present a more accurate identification method. Photographs continue to provide a cursory identification method that can be made by untrained officials. This application further extends to other forms of personal identification including drivers’ licenses, workplace ID and credit cards.
Recent research by Kemp et al., (1997), tested whether the inclusion of an ID photograph on credit cards would reduce the level of fraud at point of sale transactions. Kemp’s et al., (1997) experiment found that slightly more than 50% of cashiers accepted cards from people using a fraudulent card with another person’s ID photograph on the card [Kemp et al., 1997, Martin 2001]. Kemp et al., (1997) suggested that identification photographs on credit cards do not reduce the potential for fraudulent use and that lay people have difficulty when determining identity from these types of images of unknown people [Kemp et al., 1997].

Physical evidence and crime scenes are also photographed as a record or document to suggest that certain items did exist or to record the condition of the scene. This pragmatic form of representation of evidence has served forensic science well in the past and the construct of objective representation is strongly embedded into forensic science and law visual traditions. This condition places photographic evidence into the realms previously described as photographic truth. It contradicts contemporary visual cultural theory and places some modes of photographic evidence into a vulnerable position.

Visual culture theory has evolved with the social constructs surrounding photography and imaging which includes technological developments and the application of visual media within the community. Photographic evidence within the forensic science domain has also advanced into more complex applications. However, a critical point suggests forensic science uses all modes of photographic evidence as a single construct of ‘objective representation’ and does not consider other visual modes. This condition creates problems for some modes of photographic evidence particularly those heavily reliant on photointerpretation, reconstruction and identification.

Photographic documentation of evidence has an important function within forensic science and will continue to do so; however contemporary applications of photography evidence are more complex than previously experienced. Nickell and Fischer (1999) describe photography for crime scene documentation as;
A good photographic record helps document the facts and physical circumstances at the crime scene, records evidence that because of size or other reasons cannot easily be brought to court, permits reconstruction of the crime, and reveals evidence that might otherwise be missed. It can also assist in refreshing the investigator’s mind at any time, especially in preparation for court testimony. [Nickell & Fischer 1999, p26]

Initially this statement appears quite simplistic. However, when the content is carefully examined several key phrases appear including; ‘record’, ‘facts’, ‘reconstruction’, ‘reveal evidence’, ‘memory’ and ‘preparation for court’. These notions are principles that describe the application of photography evidence and concepts like ‘reconstruction’, ‘reveal evidence’ and ‘memory’ are significantly outside the parameters of representation.

Photography’s role in forensic science has shifted in recent years. No longer can a simplistic objective representation model be exclusively applied to the complexities of visual evidence. Photographs are now employed in forensic science to; i) document evidence and scenes, ii) to reconstruct events, iii) to identify suspects and iv) to enable forensic analysis. The homogenous treatment of all forensic photographic evidence as objective representations is no longer appropriate. Images that involve interpretation, reconstruction, identification or analysis demand a model (or models) that can reflect truth and reliability without problematic ambiguity.

3.4 Dangerous Driving Case using Photography Evidence

An example of how a simplistic visual construct can cause difficulties was presented in a recent case (2006) involving dangerous and negligent driving. A driver of a vehicle reported a traffic incident of the previous day to police and gave police four photographs taken by his passenger (Fig 3.1). Two images depicted a truck driving on the incorrect side of the road, crossing a painted island and approaching a significant bend in the road. The other two images were taken after the incident occurred and depicted the rear of the truck to allow an identification of the trailers registration plate. The driver of the car claimed to police that the truck was being driven in an erratic manner and proceeded to overtake his vehicle across a painted island. He also claimed the truck driver commenced his overtaking manoeuvre close to an approaching corner, which was an unsuitable and dangerous location to pass.
Police interviewed the driver of the truck who willingly made a statement to police. The truck driver indicated he recalled the actual incident very well because of the actions of the driver of the car. The truck driver claimed he commenced his overtaking manoeuvre in a safe manner shortly after the start of a long straight in the road. He further suggested that once his vehicle drew alongside the other, the driver of the car accelerated and refused to let him complete the passing manoeuvre. The car remained alongside his truck for a lengthy period until both vehicles approached the corner and he was able to manoeuvre his truck back to the left side of the road. He further claimed the actions of the car driver resulted in his truck being on the wrong side of the road at the section of road approaching the corner. The truck driver was charged with various serious driving offences.

The truck driver made the claim he was a victim of road rage, which kept his vehicle on the wrong side of the road. The driver of the car claimed he was a victim of dangerous driving by the truck driver. During the court hearing, evidence was heard from; i) the passenger of the car who had taken the photographs, ii) the driver of the car who made the complaint to police and iii) the truck driver. The photographs depicting the truck on the wrong side of the road were tendered as evidence.

The passenger of the car indicated in his evidence that the truck commenced his overtaking manoeuvre shortly after the commencement of the straight (consistent with the truck driver’s account). He also provided the court with a description of how he came to photograph the truck on the wrong side of the road after getting the camera stored in the back seat in a carry bag. When questioned by the defence counsel on the time it took to get the camera ready, replace its batteries and take the photographs, the witness claimed it took approximately 30 seconds.

The driver of the car also gave evidence. He suggested the truck commenced the overtaking manoeuvre close to the corner and that he instructed the passenger to take the photographs. Under cross-examination he denied ever speeding up to prevent the truck driver from overtaking.

What did the photographs indicate? When the photographs presented as evidence are examined from a photographic truth construct, the truck driver appeared to have
committed the offences. The photographs did demonstrate the truck was on the wrong side of the road and had crossed a painted island near an approaching corner. However, what was disconcerting with the visual evidence presented by the prosecution was the complete lack of any evidence (visual or otherwise) of the condition of the whole roadway where the incident occurred and, particularly, of that section of road immediately before the photographs was taken.

An examination of the scene revealed the road leading up to the area of interest had a long stretch of flat straight road with a distance between unbroken line to unbroken line measuring \( \approx 629.1 \) metres. The area after the corner also presented with another flat straight section of road. There appeared to be ample sections of the roadway that would allow for overtaking in a safe manner. The photographic evidence, however, did not illustrate this condition of the case (Fig 3.2). If an examination of the visual cultural constructs surrounding this evidence was made, several conditions of visual inquiry may be applied. Firstly, the objectification of the facts; the truck certainly appeared to be on the wrong side of the road. Secondly, the sequence of photographs formed a photo or visual narrative and thirdly, the images combined with the digital meta\(^9\) data provided a condition of visual data that could be analytically examined. This presents quite a comprehensive array of evidential possibilities for the forensic investigator. The speed of the vehicles can also be calculated using the time values in the metadata and the distance travelled between two visible landmarks.

This case however, only supported the visual model that considers the photographic evidence as a simple objectification of facts (representation). The truck driver was found guilty of dangerous and negligent driving and received a severe sentence. The case against the accused appeared to be significantly weighted on the photographic evidence and on what the photographs represented. There was also a strong sense of misrepresentation of the photographic evidence in the context of a visual narrative. According to the truck driver and the witness who took the photographs, the truck commenced overtaking close to the beginning of the straight, some 650 metres before the area of interest. There was also a suggestion the camera operation took some time to complete which could indicate the truck was in fact on the wrong side

\(^9\) Metadata is information pertaining to the digital cameras functions and other information including date and time etc. Metadata is embedded into the digital image file and may be extracted for analysis.
of the road for some time trying to overtake the car. If this is so, then the question remains why it took so long for the truck to overtake the vehicle, if the car driver did not impede the truck driver’s overtaking manoeuvre. There also appeared to be some correlation between the witness who took the photographs and the truck driver’s evidence but not between them and the driver of the car. The photographic evidence did however strongly support the car driver’s (complainant) evidence and not the truck driver’s version of events.

If the complete incident from the commencement of the passing manoeuvre is considered, the photographic evidence presented to the court only records the final moments of the event. This visual narrative is a significantly edited version of events. Like all narratives that are edited, misrepresentations are highly plausible. The visual narrative did not illustrate the following aspects of the case;

- The long and flat straight of road leading up to the area of interest.
- The commencement of the overtaking.
- The length of the overtaking procedure.

An argument can be made that the photographic evidence in a visual narrative form presented critical gaps in the narrative and was unintentionally edited in such a way it could be considered as misleading evidence to support the prosecution’s case. There was some oral evidence given from both sides during the hearing that may also support this misrepresentation. The fact that the truck was on the wrong side of the road was never disputed. The question that was raised in court was whether this was an incident of road rage caused by the driver of the car (complainant) or dangerous driving by the truck driver. In reality, the dangerous driving could have been attributed to either driver (car or truck) or to both drivers. The photographic evidence could not effectively support any claim and the oral evidence of the witnesses must be considered without the visual narrative.

Another critical component of this case is how the photographic evidence supported the oral evidence of the witnesses. The photographic evidence appeared to support the car driver’s evidence; he claimed the truck dangerously overtook his vehicle by crossing a painted island while approaching a bend in the road. The photographs
demonstrate this did occur, however is the representation of this evidence providing all the facts?

The truck driver claimed he was on the wrong side of the road because of aggressive driving by the car driver who he believed created the dangerous situation. There was no photographic evidence available to support the truck driver’s claim. The photographic evidence was selective in its representation of facts, which placed an unfair onus on the accused to prove the photographic evidence wrong. This task is of course almost impossible because the representation is true, maybe not completely true, but certainly in part. Half-truths in any argumentative forum are extremely difficult to dispute. When the perceptions of photographic truth are added to the mix, the defence becomes somewhat powerless to rebut against the possibly bias photographic evidence. Understanding that the representational photography evidence may not be communicating all the facts is the critical point of this discussion. Remember Magritte’s ‘this is not a pipe’.

The question this case raises is to what level the photographic evidence supports one witness while not supporting the other. From a representation of facts perspective, the photographs indicate the offence was committed, while the visual narrative form produced some significant gaps in the complete narrative and raises doubt about the whole story. Is this form of photographic evidence reliable? The evidence provided by the witness who took the photographs provides some indications that some time was taken between the commencement of the overtaking and the time the photographs were taken. This fact may support the truck driver’s evidence and challenge the weight of the photographic evidence.

Photographic representation also functions on another level. A level of believability is inherently perceived in photographs due to the relationship between objectivity and reality. Does this suggest a witness’s evidence is more believable if supported with photographic evidence than one without such support? There are some suggestions the dangerous driving case did place weight on the witness that had the photographic proof even though it may not be precisely reliable. Getting to the truth associated with the incident is more complex than the visual representations may have suggested.
Figure 3.1; Photographic evidence presented by the Police Prosecutor regarding the dangerous driving case. Photographed by a witness in car.
Figure 3.2: Scene of incident looking back from the unbroken line to the area of road situated before the evidential photographs were taken and where the overtaking manoeuvre occurred. This area of the roadway was not presented as evidence by the Police Prosecutor.
3.5 CCTV Images as Evidence

Other complexities involving photographic evidence are emerging with surveillance photographs. The omnipresence of portable mobile phone cameras and static CCTV\textsuperscript{10} cameras within the community has created a new social condition of surveillance. The type of surveillance is also new. Millions of portable digital cameras carried by mobile phone users are not static but mobile. The cameras are transient within the community and are controlled by millions of individuals rather than by organisations or Government authorities. In addition, recent technological changes have also seen an exponential growth in the number of CCTV cameras installed within public and private spaces.

Covert and overt surveillance cameras are situated in many public spaces including shops, shopping centres, public transport, petrol stations, carparks, ATM’s\textsuperscript{11}, banks and footpaths outside commercial and private premises. There is also a growing application of surveillance cameras installed in homes and most police vehicles are now fitted with video cameras. People engaging in criminal activity now face the increased chance of being captured in action by some form of surveillance camera.

Police investigation practices have quickly adapted and are now exploiting this new social condition. This policing practice has also lead to newer modes of forensic examination including identification of suspects using images captured by surveillance cameras or images captured by witnesses. Surveillance images can be described as ‘witness photographs’ that capture the events surrounding the incident and the person’s identity. In some cases, multiple viewpoints of the same incident can be obtained from several witnesses using mobile phones. This form of witness photographs can be used in the following forensic examination methods;

- The reconstruction and interpretation of events and/or criminal activity.
- Identification of persons depicted in the images.
- Determination of whether an offence has being committed.
- Provision of forensic intelligence to an investigation.

\textsuperscript{10} CCTV – Closed Circuit Television  
\textsuperscript{11} ATM – Automated Teller Machine
• Provision of physical evidence for prosecution.

This form of photographic evidence falls outside the purview of simple photographic representation. Extrapolating concepts of interpretation, identification, intelligence and physical evidence requires a more complex application of visual cultural concepts than that is currently employed in forensic science. Cases involving the identification of suspects depicted in surveillance photographs are now presenting in Australian courts as forensic evidence.

3.6 The ‘Rodney King Video’ Evidence

Interpretative and reconstructive photographic evidence must also satisfy the legal tenet of truth when presented as evidence in a court of law. This concept may not be as simplistic as it seems for some types of visual inquiry. In 1992, several LAPD\(^{12}\) police officers appeared before a court charged with various offences associated with their arrest of motorist Rodney King in 1991 [Bloss 1995, Schwartz 2009]. A significant degree of force was used by the police officers during the arrest and a witness covertly filmed the incident from his apartment using his new video camera [Sturken & Cartwright 2003, Doyle 2003, Biber 2007]. What the media labelled as the ‘Rodney King Video’ was broadcast by the media suggesting it provided evidence of police brutality.

The video footage filmed by George Holliday, was continuously filmed without editing or stopping the camera. It appeared to be hand held and shot rather amateurishly. Sturken and Cartwright (2003) suggested this crude film technique aesthetic and because it was continuous, added to the truth-value of the evidence [Sturken & Cartwright 2003]. Sturken and Cartwright provide this insight regarding how the evidence was introduced into the case against the police officers;

\[ \text{King’s lawyers introduced the tape in court because they thought it held incontrovertible evidence that the officers used excessive force on King. However, there was a surprise turn of events when the defense turned the tables, using the exact same footage to argue that the police acted appropriately and that King had been out of line.} \]

\[ [\text{Sturken & Cartwright 2003, p286-287}] \]

\(^{12}\) LAPD – Los Angeles Police Department (USA).
The prosecution (against the police officers\textsuperscript{13}) claimed that police used excessive force after King became compliant, suggesting police had control of the situation and the force made on King was unnecessary and excessive. The video footage was submitted by the prosecution to support this argument. King can be seen in the video footage lying on the ground while several police officers were hitting him with batons and other weapons. The prosecution considered the video evidence as a factual representation of reality because the camera provided an objective witness of the event.

The defence however, took another approach using the same video footage. The video footage was analysed frame-by-frame in a method used in visual anthropology. This mode of inquiry considered the imagery as visual data rather than representational evidence. The defence argument claimed that King himself was in control of the situation [Goodwin 2002, Sturken & Cartwright 2003] and while the police officers were trying to handcuff him, King’s actions were aggressive rather than defensive. The defence claimed police did use reasonable force against a hostile suspect and that the footage viewed as a representation of the events, actually distorted the reality. They further suggested that the initial appearances were deceiving and the visual evidence needed an analysis that revealed the truth underneath the representation. The defence persuaded the jury that King was the aggressor [Sturken & Cartwright 2003].

Interestingly, a very similar case was described by Hart Cohen in 1987, some years before the Rodney King case. Cohen (1987) describes an incident involving an altercation between an off-duty police officer and a civilian in a supermarket. The civilian was arrested and later attempted to sue the police officer for assault and false arrest. The incident was filmed on the stores video surveillance camera and was widely broadcast by the media suggesting it was incontrovertible proof of police brutality, which was enhanced by the media’s narrative through talk shows and phone-ins [Cohen 1987].

\textsuperscript{13} California -v- Powell, Koon, Wind and Briseno (1992)
The original charges against the civilian were dismissed and Cohen suggests this may have been caused by the extensive media coverage. However, during the lawsuit against the police officer the truth associated with the media’s narrative changed. Cohen suggests:

The controversy raged for a second time. Again media audiences joined the debate. This time round, however, the legal discourse dominated the interpretation of the video material. Presented as evidence for the prosecution, the defence lawyers generated a number of ambiguities in the interpretations of the images suggesting that the policeman had been set up. The more the video text was subject to legal arguments about its ‘meaning’, the less it could sustain its function as guarantor of truth it initially appeared to represent. As the trial progressed the prosecution tried to leave the video tape of the incident behind as it no longer functioned ‘for’ them. [Cohen 1987, p2]

The case studies discussed in this chapter highlight the dangers associated with photographic meaning and truth when scrutinised or interpreted by lay knowledge. They further illustrate the need for photographic evidence to be examined by forensic practitioners possessing specialised knowledge in photointerpretation and including visual culture theory.

3.7 Chapter Discussion

Contemporary applications of photography within forensic science have developed into more complex visual tasks than previously observed. Photographs in forensic science can now function in several modes including representation, interpretation, visual narrative, reconstruction and identification. What remains crucial is how photographic evidence can maintain a function of truth within a construct of evidence. The conundrum that faces photographic evidence is whether it is reliable and when should we view the evidence with caution? As discussed, genuine\textsuperscript{14} photographic evidence may at times be misleading when taken out of context and can misrepresent the facts as easily as represent them. The reliance on photography’s objectivity is also considered as a misleading notion in other photography applications outside forensic science.

\textsuperscript{14} The term ‘genuine’ in this context means photographs that were taken with the intention of accurately recording the object or scene. It also distinguishes between photographic fakery, which is the deliberate attempt to fool the opinions of the viewers through image manipulation and falsifying facts (i.e. flying saucer photographs).
Forensic science requires the most reliable human and technological methods available to communicate concepts of reality and truth when presenting and evaluating evidence. The application of photography must continue, however further considerations and protocols to ensure its reliability must become institutionalised within law and the forensic sciences. The threat of photographic truth being eroded or not trusted by current and future cultures is a growing concern. Julianne Newton (2001) makes this point with respect to photojournalism in her book titled ‘The Burden of Visual Truth: The Role of Photojournalism in Mediating Reality’. In some respects, there are parallels between photojournalism and forensic photography. The essence of the imagery is to communicate a concept of the real, reality or truth. While numerous forensic and law practitioners would reject the notion that there is some commonality between photojournalism and forensic photography, based on the notion that the media is commercialised while the law is a neutral search for the truth, both types of photographs (media and forensic) are attempting to record concepts of reality.

The possible corruption of any image’s meaning generally manifests in the post capture by photointerpretation, presentation, manipulation and bias by the person communicating the ideas of the image. Vicki Goldberg (1991) suggests;

*There are two levels of belief in a news photograph. One is confidence that what is depicted was not staged but actually occurred and that the depiction has not been tampered with - faith that the document was not deliberately faked and that it accurately represents what was in front of the lens at the moment the exposure was made. The second level of belief is acceptance of the interpretation the culture places on the photograph, the meaning that adheres to an image within a particular society at a particular time.* [Vicki Goldberg, 1991, p250]

Unfortunately, several news bureaus and print media organisations, including the bastions of media truth and reliability such as ‘The National Geographic’ have been exposed and embarrassed by producing images that have been significantly manipulated to the extent that they no longer signify reality but a more visual or aesthetic representation of the image [Brugioni 1999, Newton 2001]. Newton (2001) suggests this desecration of the previously virtuous image in the media is causing people to mistrust photographs. Newton claims this could eventually destroy visual reportage, an extinction initiated from within its own domain. Without a level of faith
in the image representing reality or photographic truth, the need for images of news is no longer justified. Newton uses two theoretical frameworks to examine her ideas; surveillance theory and visual perception theory.

Photography evidence in forensic science echo the same concerns Newton describes in the media. Certain areas of the photographic media have developed ethics to ensure its reliability and future in the media [Brugioni 1999, Newton 2001]. Forensic science also needs to critically examine how photographs are used in the context of producing evidence that reflect reality and truth.

Forensic photography practices should focus on the scrutiny of photographic evidence based on its reliability, particularly when used to support other modes of forensic evidence. Photographic evidence must also be congruent with the evidence it is supporting. The challenge facing photographic evidence is that there are no taxonomies that apply specifically to photographic evidence within the context of forensic science. This problem requires attention so as to ensure photographic evidence can be used effectively within forensic science and to ensure misrepresentation of photographic evidence is minimised. The most pragmatic method of inquiry to realise this challenge is to explore concepts already established within visual culture and adapt these to forensic science. The visual literacy of forensic science need to be parallel to those currently experienced in other visual culture modes represented within the community.

The following chapter examines and develops a theoretical framework to support the arguments derived from this research.
Chapter 4

4.0 Developing a Forensic Photography & Physical Evidence Theoretical Framework

At one level there are no photographs which can be denied. All photographs have a status of fact. What has to be examined is in what way photography can and cannot give meaning to facts

John Berger [Berger & Mohr 1982, p98]

In an early edition of Langford’s ‘Basic Photography’ (4th Edition, 1977) Langford attempts to define a theoretical model that identifies the differences between objective and subjective recording between contrasting photography domains such as science and art, or science and philosophy, or technology and art. In particular, Langford developed a hierarchical model that lists a range of photography applications he calls the ‘Spectrum of Applications’ and is scaled across a range of photography activities defining photography as; ‘predominantly objective’ or ‘predominantly subjective’. The concept of ‘objectivity’ and ‘subjectivity’ from
photographs is highly relevant when examining the reliability of photographic evidence. Forensic photography practices should embrace an objective model and it often does, especially during more controlled forensic photography applications. However, forensic evidence derived from photographs is not always sourced from carefully constructed photographs using forensic photography procedures. Instead, a range of sources, including CCTV, provide visual material that may undergo a forensic examination.

This chapter conceptualises forensic photography and develops a theoretical framework that provides an insight into various levels of objectiveness and subjectiveness of photographic evidence. This model introduces new thinking regarding how physical evidence functions within forensic science. The purpose of this chapter is to construct a new theoretical framework that models the application of physical evidence and provide a basis from which to examine the relationship between forensic science, physical evidence and photography as a mechanism for

Figure 4.1; Langford’s model describing the difference between objective and subjective recording [sourced from Langford 1977, p361]
providing evidence. The model’s central position is that not all photographs used for forensic evidence are the same and have different levels of reliability. The theoretical framework defines the parameters of the research and provides some context to support the central arguments presented in this study.

4.1 Modelling Physical Evidence

Criminal investigations principally use physical evidence to provide answers to the common questions of; ‘what’, ‘who’, ‘when’, ‘where’ ‘how’ and ‘why’. A theoretical framework articulating the process and function of physical evidence has not been extensively discussed in the literature [Inman & Rudin 2001]. Fundamentally, physical evidence undergoes a process of detection and recognition, documentation and collection followed by the examination and then reporting of forensic findings. An important principle regarding physical evidence is the concept that the items examined are actually ‘evidence’ pertaining to a particular criminal activity and are relevant to the case. The probative value of the evidence should be consistent with the criminal activity and be obtained lawfully.

The core role of forensic science in criminal investigation is to seek information that will; i) assist in the discovery of facts or truth surrounding criminal activity, ii) provide the identity of any victims and iii) provide the identity of the perpetrator/s of the crime. The search for the truth is the paramount principle of the forensic scientist regardless of what side of the legal system they are representing. From an ethical perspective, expert witnesses must present evidence from an autonomous position or as a servant to the court and not show bias towards the defence or the prosecution.

Physical evidence may be described by three distinctive modes; the ‘process’ of physical evidence is the sequence of events that are used during the investigation and formation of physical evidence; the ‘function’ may be described as the examination methodologies used; and the ‘principles’ are what determines the items as evidence and its relationship to the case and law. These three modes are fundamental to developing a theoretical construct of physical evidence used in forensic science.
Inman and Rudin (2001) describe a paradigm that identifies the values concerning physical evidence within forensic science. They admit their model is somewhat fragmented and that the literature has not previously addressed these definitions. Initially they provide five principles and then add a further principle for consideration. Inman and Rudin’s six values form a model of physical evidence that includes; i) transfer, ii) identification, iii) classification/individualisation, iv) association, v) reconstruction and vi) divisible matter [Inman & Rudin 2001].

Inman and Rudin (2001) produced a diagram to illustrate this paradigm and they make a distinction between the generation of physical evidence with the examination using forensic science principles. Inman and Rudin’s model is included below;
Lee et al., (2001) have also produced a model that appears to combine all physical evidence elements including process, function and principles. The model differs from Inman and Rudin however similar principles appear in both including; recognition, identification, individualisation and reconstruction. Lee’s et al., model, like Inman and Rudin’s is linear in its construction and suggests all evidence travels through the same linear progression. The difficulties with Inman and Rudin’s (2001) and Lee’s models, is the fact that the process, function and principles are all encompassed in a single linear model. This results in a somewhat oversimplification and does not indicate critical difference in examination concepts.

Figure 4.4: Lee’s et al., Forensic Investigation Process
[sourced from Lee et al., 2001, p 17]
4.2 A New Theoretical Framework for Physical Evidence

The submission of physical evidence to a court must follow procedurally based rules of evidence and is governed by State or Federal laws including *Evidence Act 1995* [Bellamy & Meibusch 1995, Biber 2002, Edmond 2008] and the *Crimes (Forensic Procedures) Act 2000*. The collection of physical evidence directly from suspects or victims of crime falls into two categories; intimate and non-intimate evidence. Police powers enable forensic investigators to obtain sources of evidence directly from suspects and certain caution and procedures must be applied when collecting intimate evidence from suspects or surviving victims.

This thesis develops a theoretical framework regarding how physical evidence is utilised as evidence within the criminal justice system in Australia. It is important for this work to describe the context of physical evidence to enable a discussion based on the relationship between evidence and photography. The theoretical framework illustrated here is significantly different to those previously described by Inman and Rudin (2001), Lee *et al.*, (2001) and Saferstein (2004). While it does suggest some common concepts described by these workers, notable differences include:

- The model considers there are three separate levels of describing physical evidence including: i) the process, ii) the function (examination methodologies) and iii) principles (concepts of evidence) (refer to Fig 4.2).
- Physical evidence function or methodologies are described by their mode of inquiry.
- Physical evidence outcomes are central in the model while the functions provide separate pathways into those outcomes.
- The model is not a linear process.

The following sections define in more detail what the ‘process’, ‘function’ and ‘principles’ of physical evidence represent in the model.
4.2.1 Physical Evidence: Process

The ‘process’ of physical evidence examinations may be expressed in three separate phases. The initial phase is mostly conducted at primary and secondary crime scenes. A primary crime scene is the location where the crime event occurred while secondary crime scenes are locations where evidence relating to the original scene is also discovered (e.g. a vehicle used in the commission of the crime or directly from the body and/or clothing of a suspect or victim whom had left the scene). A post mortem conducted on a deceased victim is also considered as a secondary crime scene.

The second phase of the process involves the forensic examination of the items, while the third phase is when physical evidence principles are considered and the findings are presented. Jackson and Jackson (2008) also describe the role of forensic science in the investigation as having three distinct phases and suggest a similar model to the one suggested in this study. The ‘process’ may be explained in three separate phases and Figure 4.5 provides an illustration of this concept:

Cook et al., (1998) also propose a three-phase process model that is based on a more business-model approach. Cook considers the UK forensic science service model which works more independently from law enforcement agencies and is strongly financed by a ‘user pays’ system. Cook’s model includes the following phases; i)
customer requirements (which includes police as a customer) ii) case pre-assessment and iii) service delivery.

In many respects, Cook’s model still works through the same process as the one suggested in Figure 4.5 with the exception of collection, detection and preservation of the physical evidence. Cook’s model relies on ‘the customer’ bringing the physical evidence to the laboratory. Another significant difference in Cook’s proposal is the application of the pre-assessment phase and the suggestion that this is the most valuable phase by providing a Bayesian inference evaluation of the evidence before the actual examination. The underlining motivation to this approach is more financially focused and an attempt to pre-judge the value of the evidence based on statistical inferences before resources are committed to the case, or to provide value judgements for ‘the customer’ to consider before accepting the cost of the forensic examination [Cook et al., 1998].

This approach may have some difficulties if the value of evidence is misinterpreted before the examination takes place. It also does not consider that the forensic intelligence developed by the physical evidence could be of some level of significance even if the evidentiary value is low. Information or forensic intelligence given to investigating police can lead to further physical evidence gained from an extended investigation. The investigation or forensic intelligence value from evidence should not be pre-assessed by forensic scientists but only by the investigating police who have a broader understanding of the investigation details and objectives.

4.2.2 Physical Evidence: Function (Methodology)

The ‘function’ of physical evidence is defined in this model as the examination methodology. This model proposes there are four modes of methodological inquiry associated with most physical evidence. These inquiry modes include; i) empirical analysis, ii) comparative analysis iii) interpretative analysis and iv) observation. The empirical analysis, comparative analysis and interpretative analysis modes are all related to forensic science practices. However, the observation mode of inquiry is more represented in ‘eyewitness’ accounts. Figure 4.6 illustrates the various types of
physical evidence that may be examined using the major modes of inquiry methodologies.

Most physical evidence falls into one of the major methodologies and forensic photography can support all four.

Empirical analysis examination is a method that relies on scientific instrumentation to provide quantitative data that can mathematically represent values. An example of this form of examination is drug identification. Forensic chemists can use a variety of scientific instrumentation that can provide spectrometric analysis of the sample. Forensic chemists usually provide evidence that suggest the identity of the narcotic, the purity of the drug and the quantity. Empirical analysis examination of physical evidence is quantitative analysis that can provide an absolute result or percentage likelihood. Control samples, instrument calibration and standards must also be applied to ensure accurate results. Empirical analysis methodologies also requires some intelligence stored in databases that can provide confirmation of the material analysed.
Comparative analysis examination is a method that involves the comparison of a questioned item of evidence against a known item. Footwear impression evidence is an example of this form of physical evidence and involves the comparison between a questioned impression left at the scene to an exemplar impression made by the forensic practitioner from the suspect’s shoes. Comparative analysis evidence relies on corresponding characteristics to form the result. Exclusion results are also valid determinations for this type of examination. Fingerprints are another form of comparative analysis evidence whereby a questioned fingermark found at the scene or on an object is compared with an exemplar prints from known sources.

Interpretative examinations provide evidence usually gained by the ‘reconstruction’ of visual clues left at the scene. This form of physical evidence demands a high level of intuitive skill developed in highly trained and experienced practitioners. An example of this form of physical evidence examination is determining the cause and origin of a construction fire. Fire investigators use burn patterns and the remaining structure to determine aspects of how the fire commenced and travelled through the scene. A hypothesis is developed based on a best-fit scenario and relies on logical deduction. It is not intended to be absolute evidence. Definitive results are usually difficult to produce with this form of physical evidence examination because other hypotheses may also be possible. Elimination of certain causes can also be more strongly supported in this form of evidence inquiry.

Another form of physical evidence that may be considered as a mode of inquiry is the simple method of ‘observation’. This type of evidence can support circumstantial evidence and does not necessarily involve a forensic examination or expert opinion. An example of this form of evidence is items found at the scene used by lay witnesses who may have seen an event or person that is relevant to the investigation. The value of this form of evidence varies and depends on the other evidence surrounding the case. ‘Observation’ evidence is different to ‘interpretative analysis’ evidence. Interpretative analysis evidence requires skilled reconstruction and deductive reasoning by a forensic expert with experience and training, while observation evidence is simply witnessing an event, item or person.
4.2.3 Physical Evidence: Principles

The ‘principles’ of physical evidence are considerations that make aspects of the examination results evidentiary. Principles provide an intellectual link between the examination results and the application of evidence. Inman and Rudin (2001) provide a comprehensive list of principles including; transfer, identification, classification/individualisation, association, reconstruction and divisible matter.

Principles are derived from various theories established in forensic science. The most notable is ‘Locard’s exchange principle’ that suggests with every contact some transference of materials result [Cole 2001, Inman & Rudin 2001, Houck 2001, Horswell 2004, Jackson & Jackson 2008, McCartney 2006]. Transfer evidence can be seen as material that is left at the scene by the suspect or material that is transferred onto the suspect from the scene. Transfer evidence may provide a link between the suspect and the crime scene or criminal event. Transfer of human biological material such as hair, blood, saliva and semen may further provide the identification of individuals using various analytical techniques.

A critical principle of physical evidence is the notion of ‘individualisation’ when determining identification of offenders or victims. The distinction between ‘individual characteristics’ and ‘class characteristics’ is also a fundamental principle with comparative analysis of physical evidence such as toolmarks and footwear impressions. Concepts of individualisation are further discussed in Chapter 8.

Physical evidence principles are complex and a complete discussion is outside the purview of this study. This study does, however, identify the purpose of evidence principles and their impetus when developing physical evidence models. It accepts the notion of complex principles and this chapter focuses on examining the correlation between physical evidence examination methodologies (function) and the application of photography to support these methods. The emphasis of this research is the photography modes as evidence used in forensic science.
4.3 Holistic Theoretical Model for Physical Evidence

The multiplicity of various evidential methodologies (functions) is what defines forensic science as a discrete discipline within science. Another defining aspect is that it is pertinent to the law. No single form of evidence examination holds any higher status over another. The most effective evidence is based on the corroboration of various modes of evidence and may vary case-by-case. Some empirical scientists (not forensic scientists) often dispute this and insist that evidence should be solely based on empirical data and dismiss other modes of scientific evidence as trivial ‘non-scientific’ methods. This misconception is mostly by scientists with little knowledge or understanding of forensic science principles or how evidence relates to concepts and processes of law. Forensic science should be considered within its own discipline but utilise methods from other scientific domains.

![Diagram of Physical Evidence Model](image)

*Figure 4.7: Physical evidence model defined by outcomes central to the model and functions forming separate pathways. The model also illustrates different result types from those modes of inquiry.*
The forensic application of physical evidence is complex. Figure 4.7 maps the structure of physical evidence examination from a holistic perspective. The examination methodologies or function, form separate pathways into centralised outcomes, rather than via a linear model as described by Inman and Rudin and Lee et al. The model described in Figure 4.7 identifies distinctive outcomes relating to the type of results that are possible from the type of forensic inquiry employed.

The model described in Figure 4.7 also provides a framework to examine how photography supports examination methodologies. The remainder of this chapter examines how photography is used as evidence and its role in supporting physical evidence.

**4.4 Collection of Physical Evidence**

The collection and preservation of physical evidence is a fundamental element within forensic science. Forensic science can only be as effective as the quality of the crime scene investigation and the integrity of the samples and evidence collected. There are six principal methods of evidence preservation and photography forms a critical component. The photographic recording of evidence, scenes and items provides a visual record that endures over long periods of time without alteration. The six principal methods of evidence preservation include:

- Physical collection of the evidence item.
- Photography.
- Sampling (e.g. saliva, blood, DNA and fibres).
- Casting (e.g. toolmarks and footwear impressions).
- Sketching and physical measurements of crime scenes.
- Contemporaneous note taking.

Photography offers several advantages as an evidence preservation method, particularly because of its ability to record fine detail quickly and preserve a moment in time. The instant a photograph is captured it becomes an historical document; a previous moment in time that can preserve the condition of the scene, object or person.
4.5 Photography as Evidence

Photographs were admitted into courts of law shortly after its invention when Daguerre first published his photographic process in 1839 [Trachtenberg 1980, Goldberg 1991, Clarke 1997] some thirteen years after Niépce made his first image at Gras, France [Clarke 1997]. Guilshan (1992) suggested US courts admitted photographic evidence as early as 1860 (Luco -v- United States, 1860). In 1866, photographs taken of a damaged cellar were admitted into a US court as evidence of the condition of the scene (Cozzens -v- Higgins, 1866). Harris reported;

*The photographic view of the cellar was an appropriate aid to the jury in applying the evidence, as it was taken in the month of November, and showed the condition of the premises at that time* [Harris 1892].

May (1987) also claimed that photographic evidence was presented in court as early as 1864 when the trial judge, Willes J allowed a photograph of the accused’s first husband in a bigamy case as an evidence exhibit. The photograph was admitted to confirm the identity of her alleged first husband [Harris 1892, May 1987] as proof the person actually existed. While the court admitted the photograph as a form of identity, the jury found the accused not guilty [Harris 1892].


*Photography was one of the first forensic sciences: Documenting crime scenes is as old as photography. In fact, the only record we have of some crimes are the photos. Evidence of the Jack the Ripper murder scenes of 1888, for instance, exists today only on film. Photography remains an essential tool in the morgue as well as at the crime scene.* [Baden & Roach 2001, p28-29]

Scotland Yard recognised the value of crime scene photography in the late nineteenth century and, in some respects, these specialised crime scene photographers formed the basis of what is known today as crime scene investigation. The application of photography also featured in England’s first application of fingerprint evidence
involving a murder trial. In 1905, England’s Scotland Yard and India’s Bengal Police were the only two law enforcement agencies to use fingermarks found at the crime scene as evidence [Beavan 2002].

Photography assisted in an English case (*Rex -v- Stratton & Stratton, 1905*) which involved the murders of a husband and wife who were shopkeepers at Deptford. Two brothers, Alfred (22 yrs) and Albert (20 yrs) Stratton were charged with their murders at a paint shop in Deptford [Beavan 2002]. There were some difficulties with eyewitnesses who could not positively identify the two accused, although one witness did identify Alfred. A single fingerprint was found on the empty cash box found at the paint shop which became critical for the Crown’s case. During the trial, Charles Collins from Scotland Yard, presented photographs of the single right thumbprint found at the scene and an exemplar fingerprint taken from Alfred Stratton. Collins identified Alfred Stratton as the owner of the fingerprint found on the cash box. Both men were hanged for the murders on May 23, 1905 [Polson 1950, Polson 1951, Beavan 2002]. The Stratton & Stratton case, also known as the Deptford murders, was an important test case for the validation of fingerprint evidence, particularly when the identification was made from a single fingerprint rather than ten prints. It established a standard that is still considered today.

A fundamental function of crime scene investigation is for the forensic investigator to bring and articulate aspects of the crime scene to a court. Members of a court, such as jurors, judges and legal counsel, never get to see the crime scene in real life or visit its location. Photographic evidence functions as a conduit of information relating to the condition of the scene. Photography provides an excellent visual communication tool to allow the crime scene to be explained and demonstrated in court together with sketches and oral evidence from the investigator.

The value of this function cannot be underestimated. Helmers (2006) describes how photographic evidence provided an 1871 Congressional Committee (USA) considering the creation of Yellowstone National Park, with evidence that could not

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15 On some occasions, a court will preside at a scene to clarify complex aspects of the case. Courts do have the facility to visit the site, however this would be a long time after the crime scene has been processed and handed back to the owners.
be expressed effectively in any other format. Helmers (2006) claims the scale of the landscape and its beauty was thought to be greatly exaggerated when expressed in the verbal or written format. The visual evidence included photographs from William H. Jackson and paintings from Thomas Moran. Both men were part of the 1871 survey expedition (Hayden expedition) into the region [Helmers 2006]. Helmers suggests:

By December 1871, with the assistance of an accurate map and supporting photographic and artistic evidence, Congress voted to create Yellowstone National Park. On March 1, 1872, President Ulysses S. Grant signed the bill into law. Jackson commented that his photographs and Moran’s watercolours ‘were the most important exhibits brought before the [Congressional] Committee’ because they finally allowed the disbelievers\(^{16}\) to see the wonders of this strange and beautiful land. In these days of Expedia, Hotwire, digital modems, and cable TV, it is worth reiterating that many members of Congress had not seen Yellowstone in person or in pictures. There simply was no way to gain sight of the landscape other than an extensive journey. The importance of these early images was immense. [Helmers 2006, p65]

While Helmers’ point has an historical significance, the application of visual evidence is very similar to contemporary practices in crime scene photography. That is, it brings highly complex visual information to an authoritative audience (jurors, and judges) who make critical decisions based on the evidence provided to the court. The reliance on visual evidence may however, be problematic.

Langford et al., (2005) suggests forensic photography is carried out in three different situations; i) in the laboratory under a controlled situation, ii) at the crime scene and iii) using specialist equipment such as light microscopes, electron microscopes and other specialised equipment. While Bass\(^{17}\) (2003) and Baden’s (2001) descriptions of forensic photography are fundamentally based on documentation of crime scenes, other workers discuss various photography techniques that provide several methods to photographically record evidence. Some technical methods include:


\(^{16}\) Details regarding the reports of earlier expeditions were though to be exaggerated descriptions of the landscape [Helmers 2006] and did not include any visual except for some very crude sketches.

\(^{17}\) See chapter 1 for more detail.


Digital imaging techniques [Slater 2001, Wen & Chen 2004].

Photogrammetry [Bruschweiler et al., 2003].

Footwear impression evidence [Creer 1987, Bodziak 2000, Salthouse 2000, Shor et al., 2006].


This chapter does not focus on the various forensic photography techniques or technical aspects used in forensic photography. Its purpose is to discuss a model based on how photography relates with physical evidence and its ability to provide reliable evidence. The model is based on the ‘principles’ of evidence rather than photography mechanics.

The term ‘evidence’, with respect to the examination of photographs, may also be interpreted in different ways. Social scientists, including visual anthropologists and visual sociologists, use photographs as source material in their research methods [Collier & Collier 1986, Prosser 2001]. Evidence in this context is derived from analysis of the visual material. Rose (2005), Helmers (2006), Ball and Smith (1992)

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18 As discussed in section 4.2.3
describe different research methodologies when using photographs for social science research. The general research methods include; compositional interpretation, content analysis, semiology, psychoanalysis and discourse analysis [Ball & Smith 1992, Rose 2005, Helmers 2006]. While there may be some grounds to investigate these methods for the purpose of forensic interpretation, particularly surveillance footage of crimes being committed, this work does not cover this ground in this context.

The term ‘photographic evidence’ in the context of this work, refers to images that are used to support physical evidence examination and photographs that are submitted to a court of law as an evidence exhibit. Photographic evidence can be in the form of; photographs, digital images, video, moving image, court charts or surveillance images taken by CCTV cameras.

There is a tendency in forensic science to consider photographs as objective representations of items, places and people. This homogenous reference to photography evidence considers photography as representations of reality and further suggests they provide incontrovertible evidence [May 1987, Guilshan 1992]. Guilshan suggests;

*Ever since the invention of photography just over 150 years ago, photographs have been introduced as evidence in courts throughout the United States. As the importance of demonstrative evidence has expanded along with the prevalence of visual media in modern society, photographs have gained recognition as one of the most effective modes of evidence. This recognition has resulted primarily from the fact that photography has traditionally been seen as a medium of truth and unassailable accuracy. Virtually without exception, people and courts believe that what they see in a photograph is factually true. As a result, photographs introduced as evidence have generally been accorded substantial weight* [Guilshan 1992, p365-366]

Guilshan articulates the power of photography regarding its ability to be believed by the courts and the significant weight photographic evidence can introduce to a case. The impact of photographic evidence has been discussed in the previous chapter from a visual culture perspective. However, Guilshan’s comments place an impetus on understanding what photography evidence is and what role it plays when presenting photographic evidence to a court of law. Guilshan further discusses how
this perception may change because of digital imaging technology. Similarly Rose (2005) argues;

……another aspect of the photograph which we might be tempted to ascribe to its technology – its apparent truthfulness – has less to do with the technical capabilities of the camera and film and more to do with how photographs are understood. From its very invention, photography has been understood by some of its practitioners as a technology that simply records the way things really look. But also from the beginning, photographs have been seen as magical and strange. This debate should alert us to the fact that notions of ‘truthful’ photographic representation have been constructed. [Rose 2005, p19]

Rose is suggesting the concept of photographic truth is a construction made by the viewer or visual culture aspects, and does not reflect on the photograph or the technology used. When a critical examination of the forensic science application of photographs is considered, especially when used as evidence, distinct differences regarding the photograph’s purpose and function emerge. These differences have had little discussion in the forensic science literature and need some attention.

This chapter introduces taxonomic descriptors that outline the various modes of photographic evidence. It also uses the modes of inquiry described in the physical evidence model to scrutinise these differences. The purpose for developing a photographic evidence model is to develop a better understanding of the difference between evidential forms and how they relate to physical evidence and forensic photography.

4. 6 Developing Taxonomical Descriptors for Photographic Evidence

The previous discussion on what constitutes physical evidence introduces the concept of ‘mode of inquiry’. These modes of inquiry provide differences in how physical evidence outcomes are obtained and explained. They further suggest that photographic evidence should have a connection with the modes of inquiry used in physical evidence. There are four different modes of inquiry for photographic evidence and they are; i) document, ii) analyse, iii) describe and iv) witness. Table 4.1 lists the modes of inquiry established for physical and photography evidence;
The photographic evidence modes of inquiry are based on their function (methodology) and also explain how the evidential outcomes can be determined using those forms of inquiry. While different practices regarding various types of photography already exist, they have not previously been articulated as discrete modes of inquiry used for evidence. The reason why it is necessary to conceptualise different modes of forensic photography is to ultimately provide some discussion regarding the evidence principles (meaning the value of the evidence and its reliability).

The model suggests that all modes of photographic evidence are utilised under the proposed four modes of inquiry. The definitions and examples of these modes follow.

4.6.1 Photographic Evidence: Document

The previous chapter discussed aspects of visual culture in forensic science and may have appeared quite critical of the notion of representation of items and their implication of evidence. In fact, the simple representation of items and scenes is definitely a primary function of forensic photography. The position the previous chapter was arguing is the distinction between this form of evidence recording and other forms.

The mode of inquiry termed *document* suggests the simplistic recording of items, people and scenes using photography as a source of recording. An example of the *document* mode of inquiry may be described as an item of evidence such as a glove collected at the crime scene and taken to the forensic laboratory for DNA
examination. The item is swabbed for DNA and analysed. The glove is also photographed to provide a record or document that illustrates the existence of the glove and provide facts pertaining to the DNA evidence procedures. The photograph may also be used in court to illustrate the DNA evidence and assist in explaining where the DNA evidence was detected on the item. The photograph in this example becomes a document, record, or representation of an item of evidence. Document photographs do not undergo forensic analysis or interpretation, their function is to simply illustrate items of evidence.

4.6.2 Photographic Evidence: Describe (Visual Narrative)

The photographic evidence mode of inquiry called ‘describe’ consists of a visual narrative that utilises a sequential series of images that provide a narrative of the situation the photography is attempting to record. An example of a visual narrative is the recording of crime scenes, where the crime scene investigator moves through the scene and photographs aspects of interest that may be useful when reconstructing the event (the crime) and provide further evidence.

Crime scene photography often adopts filmic concepts that assist in the narration of the scene. Techniques such as the sequencing of shots that necessitate a succession of different viewpoints including; i) an establishing shot, ii) a mid-range shot and iii) a close-up, are film constructs rather than still photography (see Fig 4.8). These sequences provide a narrative that informs the viewer and provides a sense of orientation. Further sequencing concepts exist when a crime scene photography technique called ‘quartering rooms’ is applied. Quartering the room involves taking photographs from each corner of the room to provide several viewpoints of the same scene (see Fig 4.9). It allows the viewer of the photographs to examine the scene from various perspectives and it may provide some orientation regarding location of items.

Often this form of photography is used in conjunction with images taken for analysis. For example, close-up photographs of fingerprints used for identification only show the detail of the fingerprint. Further photographs are also taken at medium and long range to indicate, via a filmic narrative, where the fingerprints are located and other
Figure 4.8; Crime scene photographs of a fingermark sequenced to also show the location of the fingermark.
Figure 4.9; Series of four photographs that illustrate quartering the room of a arson fire scene.
important aspects such as significance. Significance may include indications that the
fingermark are positioned in a certain aspect to suggest they were made by someone
climbing through a window or found inside a safe where the suspect would not
generally have access.

Other crime scene information that may be recorded using the describe mode of
inquiry (using a visual narrative form) may include details of whether light switches
were on or off, possible points of entry and exit, location of evidence in relation to
other evidence and the location of the scene itself.

Sontag (2003) suggests the sequence of crime scene images are often considered as
evidence of the crime itself, rather than the after effects or consequence of criminal
activity. Visual narratives encourage viewers to make judgements regarding the
intent of the narrative. They promote aspects of interpretation, arouse curiosity and
entice participants to seek meaning from the narrative. Like most narrative modes,
interpretation is dependent on the viewer’s cultural experience and visual literacy
skills. Regulating methods for crime scene photography does provide some
consistencies when investigators attempt to extrapolate information sourced from
crime scene photographs.

Crime scene photographs are regularly used as a resource to enable the investigator
to review the scene, particularly when new information is presented to the case. The
photographs become a valuable resource for the ensuing investigation and provide a
visual narrative for the defence when preparing a case. Crime scene photographs may
also be used in court to provide evidence an offence actually did take place, which is
a principal onus of the prosecution.

A visual narrative of a crime scene may also be conducted using video cameras
[Goldstein 1985]. ‘Walk-through interviews’ of witnesses also provide the courts
with evidence that combines visual and oral narratives. This type of evidence is
usually conducted at the scene with a detective asking questions of the witness. The
witness then explains on camera what they saw and the imagery captured by the
video camera views any aspects of the scene described by the witness. This
technique is further used by police when interviewing persons charged with the
crime. These walk-through interviews provide an extremely powerful form of evidence when the visual and oral evidence is combined into a single narrative and the condition of intertextuality is enhanced.

4.6.3 Photographic Evidence: Analyse

Photographs that are used to extract forensic data to form opinions of origin, source or identification, form a mode of inquiry described as ‘analyse’. These photographs undergo forensic analysis or criminalistic examination and form the basis of physical evidence. A condition that is essential with this form of photographic evidence is the requirement to produce photographs free from image artefacts that may corrupt the visual data. These images must satisfy stringent forensic photography protocols that provide safeguards against the inclusion of inaccurate data. Some protocols are the inclusion of linear scales as a reference of size, the application of distortion aberration free lenses (macro lenses), set magnification ratios, appropriate lighting and set camera angles (free from rectilinear distortion) [Spring 2007]. Section 4.7 provides more detail regarding the specifics related to forensic photography procedures.

Another common objective of forensic photography is to improve the visualisation of the evidence in question. Visualisation of faint or latent evidence is often enhanced by increasing the contrast between the evidence and its surrounding background. Improving contrast is controlled by various techniques that include; lighting, optical enhancement and chemical enhancement of the evidence (e.g. bloodstains, fingermarks and footwear impressions). Visualisation by controlling contrast is a central aspect of forensic photography.

An example of the ‘analyse’ mode of inquiry is footwear impression evidence. Photographs of bloody footwear impressions may be chemically enhanced\(^{19}\) during the crime scene investigation and photographed. Figure 4.10 is a photograph of a bloody footwear impression that has been treated with amido black. Amido black is a blood reagent often used in crime scene investigation to produce stronger

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\(^{19}\) Various blood reagents are used to provide stronger contrast between the background and the blood impression.
visualisation by enhancing the contrast. The photograph taken of the impression is directly used in the comparative analysis between the ‘questioned impression’ of unknown origin (impression found at the crime scene) with an ‘exemplar impression’ of a known origin (taken from the suspect’s shoes).

This forensic examination is made directly from the photograph and does not include an examination of the impression when it was found at the scene. A footwear impression expert conducting the examination is likely to have never visited the crime scene where the impression was collected. Instead, the expert is relying directly on the visual data contained within the photographs to make the comparative analysis. The photograph in this instance becomes the primary source of data for the forensic examination. This is an important consideration regarding this type of inquiry and places a high degree of emphasis on the photograph’s accuracy. Other types of forensic photographs that are used in comparative analysis include bite mark impressions, fingerprints, toolmarks and tyre impressions.

Forensic photography practices that utilise an analyse mode of inquiry may include a range of scientific photography techniques including photomacrography, photomicrography, invisible radiation photography, fluorescent photography, polarisation photography and optical enhancement. These techniques offer a range of forensic photography techniques that form a forensic photographer’s milieu of skills and practices.

There are also other highly specialised forms of photography and imaging that utilise scientific instrumentation for the purpose of physical evidence examination. Several imaging techniques used in medical imaging have an application in forensic science and include: magnetic resonance imaging (MRI), x-ray, ultrasonic imaging and computerised axial tomography (CAT scan or CT scan) [Spring 2007].

Medical science is also a sub-discipline within forensic science (medico-legal) and the relationship between forensic pathology and medical imaging is an obvious one. A specific example of medical imaging in forensic pathology is the identification of victims with known orthopaedic reconstruction work. X-rays of the victim are compared (using comparative analysis) with previous x-rays taken of the victim
while seeking medical attention [Jablonski & Shum 1989]. The x-ray taken in the mortuary is compared with the victim’s medical records to determine identification. This technique is sometimes used when other more traditional forms of identification, like fingerprinting and DNA are not available or practical.

Image analysis software can also provide empirical analysis modes of physical evidence examination by considering visual images as data and performing various analyses including measuring, counting and statistical evaluation. Images used for analysis by image analysis software must satisfy certain criteria and be able to be calibrated with the software tools. This criteria is the same as the forensic photography previously described.

An example of empirical analysis using forensic photographs and image analysis is demonstrated in the experimental bloodstain photograph in Figure 4.11a. Low velocity bloodstains of various sizes were placed on a piece of card and photographed using techniques considered in accurate forensic photography. The two tables below (Table 4.2 and 4.3) present empirical results from the image analysis examination, which include an overall summary and details of each individual blood drop. A program called ImageJ™ was used in the example.

Analysis from ImageJ (version 1.42q) image analysis software included; a count of how many blood spatters, the size of each individual spatter, the mean size of all blood spatters, the roundness of each spatter and the position within the photograph using x and y coordinates. A threshold of >4 mm to infinity was used to eliminate any satellite spatters caused by the splash from each droplet when it was deposited onto the surface.

Figure 11b shows a screen grab with the blood spatters labelled by ImageJ™ during the image analysis. Table 4.3 provides details each spatter and the labels identify in Fig 4.11b relate to each item number. The summary in Table 4.2 indicates there were 36 droplets with a mean perimeter of 55.25 mm, a mean size of 104.12 mm² and the total area of 3,748.38 mm². A roundness value out of a score of 1 is also measured.
Figure 4.1; Footwear impression in blood on a ceramic tile and treated with amido black to enhance contrast.

Figure 4.11a; Various sized low velocity impact blood spatter.
Figure 4.11b: Low velocity impact spatter labelled during the ImageJ analysis.

Table 4.2: The summary of results from ImageJ image analysis. Threshold = >4mm to infinity.

<table>
<thead>
<tr>
<th>ImageJ Summary – Multi Size Blood Drops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of drops (count)</td>
</tr>
<tr>
<td>Total Area</td>
</tr>
<tr>
<td>Average Size</td>
</tr>
<tr>
<td>Area Fraction</td>
</tr>
<tr>
<td>Mean Perimeter</td>
</tr>
<tr>
<td>Mean Circularity</td>
</tr>
<tr>
<td>Itemised Blood Drop</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>1 139.74 mm²</td>
</tr>
<tr>
<td>2 217.41 mm²</td>
</tr>
<tr>
<td>3 132.09 mm²</td>
</tr>
<tr>
<td>4 207.22 mm²</td>
</tr>
<tr>
<td>5 168.65 mm²</td>
</tr>
<tr>
<td>6 198.71 mm²</td>
</tr>
<tr>
<td>7 95.16 mm²</td>
</tr>
<tr>
<td>8 41.97 mm²</td>
</tr>
<tr>
<td>9 100 mm²</td>
</tr>
<tr>
<td>10 105.36 mm²</td>
</tr>
<tr>
<td>11 43.32 mm²</td>
</tr>
<tr>
<td>12 40.75 mm²</td>
</tr>
<tr>
<td>13 26.03 mm²</td>
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<tr>
<td>14 102.1 mm²</td>
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<tr>
<td>15 184.98 mm²</td>
</tr>
<tr>
<td>16 48.87 mm²</td>
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<tr>
<td>17 166.49 mm²</td>
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<tr>
<td>18 174.18 mm²</td>
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<td>19 35.85 mm²</td>
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<td>20 35.42 mm²</td>
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<tr>
<td>21 101.29 mm²</td>
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<td>22 87.04 mm²</td>
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<td>23 155.26 mm²</td>
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<td>24 93.71 mm²</td>
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<td>25 35.66 mm²</td>
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<td>26 40.91 mm²</td>
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<tr>
<td>27 43.27 mm²</td>
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<tr>
<td>28 37.43 mm²</td>
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<tr>
<td>29 34.06 mm²</td>
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<tr>
<td>30 41.22 mm²</td>
</tr>
<tr>
<td>31 187.63 mm²</td>
</tr>
<tr>
<td>32 103.83 mm²</td>
</tr>
<tr>
<td>33 108.71 mm²</td>
</tr>
<tr>
<td>34 155.82 mm²</td>
</tr>
<tr>
<td>35 39.18 mm²</td>
</tr>
<tr>
<td>36 219.05 mm²</td>
</tr>
</tbody>
</table>

Table 4.3: Results from ImageJ image analysis examination. Threshold = >4mm to infinity.
4.6.4 Photographic Evidence: Witness

The fourth mode of inquiry described in this model is the condition of ‘witness’. These include photographs and images that are gained from CCTV cameras, mobile phones, video recordings by witnesses and photographs taken by suspects that are seized by police during search warrants.

In the case of CCTV images, the witness mode of inquiry establishes through the photointerpretation of the images an eyewitness account of the event. Reconstruction of the event may be developed using witness type images to provide forensic evidence and intelligence. Forensic intelligence provides information that may assist police investigations, while evidence provides proof (evidence) of criminal activity.

The identification of suspects from surveillance sources has recently become a widespread form of forensic and police investigation. Identification may be made from photographs using facial identification [Iscan 1993, Ferrario et al 1993, Vanezis 1996, Halberstein 2001, Bromby 2003, Yoshino 2004] and other individual markings such as paint stains on clothing [Creer 1984], creases in denim jeans [Vorder Bruegge 1999] or markings on suspects spectacles [Oz et al., 1999].

The quality of images obtained using source material, especially CCTV, can be a significant disadvantage for the forensic investigation and outside the control of the investigation. Defining the concept of ‘individuality’ when establishing identity through photographs is also an issue this study addresses in Chapter 8.

There are three different types of identification from surveillance photography sources that may be considered;

- Identification by a forensic expert.
- Identification by a lay person who witnessed the crime.
- Identification by a lay person who knows the suspect.

Surveillance photography is produced in several formats including CCTV, still photographs and video. Digital imaging now dominates more contemporary
surveillance modes of recording. This research considers all forms of surveillance capture as photography and forensic identification methods usually require still photographs captured from the moving images to enable a comparative analysis between ‘questioned’ and ‘exemplar’ images. There are, however, several distinctive sources of surveillance images including:

- surveillance images taken by a mobile surveillance operative (police or private investigator),
- images taken by a witness with a portable device (mobile phone, digital camera),
- surveillance images taken by a static CCTV camera (overt and covert) and
- surveillance images taken by a CCTV camera that may be operated by security personnel from a covert location (operative may have control over several photography aspects including; camera panning and tilt, angle of view, focus and zooming\(^{20}\)).

All surveillance photographs described above are considered as a witnessed condition of inquiry.

The consequence of surveillance photographs also differs for criminal and civil matters. Criminal investigations attempt to either record criminal activity or provide identification of suspects and victims [Jones 2005]. On the other hand, civil matters such as personal injury, attempt to establish certain conditions of sites and people [Vilensky 1990]. Internal surveillance of staff is also another application that has developed in the contemporary workplace as a result of technology development. Zonderman (1999) provides details of a survey carried out in 1997 by the American Management Association which found 34% of companies, from a survey population of 906 large companies, randomly watch employees from static security cameras [Zonderman 1999].

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\(^{20}\) Zooming is the changing of the lens focal length to increase or decrease image magnification.
Creer (1984) suggests photographs actually taken by the offenders themselves can provide evidence that may link a suspect with the product of crime (perhaps drugs and stolen goods). Police lawfully obtaining or seizing photographs during search warrants can produce photographs taken by the offenders. An example of how these images may be considered as evidence include; drug dealers photographed with the drugs, or the growth of a cannabis plantation at a specific location [Doyle 2003, Horswell 2004].

Doyle (2003) suggests the Australian Federal Police have also investigated sex crimes committed by Australians while visiting overseas location. Investigations including the seizing of suspect film from previous paedophilia offenders who travelled to locations that are known for child sex industries. Photographs showing the suspect engaging in illegal activities can provide a passive witness to these crimes and help identify any victims (particularly in child sex crimes). Creer further suggests that the physical structure on the edge of film rebates can be matched to the film gate of the camera that captured the image and provide further evidential links between the suspect, photographs and the suspect’s camera [Creer 1984]. Metadata in digital cameras can record the camera’s serial number to provide this link. Furthermore, the inclusion of GPS systems into cameras can provide a location using coordinates on the metadata.

The recent digital technology revolution has seen dramatic social changes due to the new technology embedding into our contemporary culture. Changes include the introduction of personal computers, the internet and, more recently, the exponential increase of surveillance in Western communities. Recent cases in Australia have seen youths posting criminal activities on social internet sites and have included video footage of them vandalising trains with graffiti [AAP 2009]. Posting visual footage of criminal activities onto internet sites by the perpetrators themselves provides a new type of photographic evidence and intelligence. Doyle (2003) suggests that when criminals video their criminal exploits, they are doing so for personal gratification [Doyle 2003]. When police take possession of the photographic material and identify the persons in the imagery, it may become evidence and require further forensic examination.
Law enforcement is also using these social technological changes to increase their ability to investigate crime. Kaufman (2007) describes a new online phenomenon called ‘crowdsourcing’ were police agencies publish CCTV images online and request public assistance to advance their investigation [Kaufman 2007]. The Victorian police have published CCTV images and computer generated identikit photographs in an attempt to source witnesses of crime or people who recognised suspects. This strategy has been previously used in other media sources such as television and newspapers.

Dutch police have posted on their internet website details of an unsolved 1995 murder case in an attempt to gain information and forensic intelligence from a wider community base. The initiative was developed by their cold case investigation unit who have included detailed case information including photographic evidence containing video of the crime scene, photographs of items found at the scene and the clothes the victim was wearing, and a diagram of the unusual wounds found on the deceased. This crowdsourcing strategy is asking the viewers if they recognise any elements of the case and even ask questions regarding interpretation of the wound patterns. The wound pattern has baffled the forensic pathologists across different countries and this strategy offers the forensic puzzle to a wider, albeit untrained community in a large scale brainstorming session of crowdsourcing. Kaufman argues;

...... In an attempt to solve a murder case from 1995 they put up details of the investigation online in the hope citizens will suggest new angles or ideas. The site allows anyone to examine photos of evidence for clues, study a map of the crime scene and even pore over illustrations of the victim’s wounds in order to work out what kind of weapon could have inflicted them. [Kaufman 2007, p8]

The concept of using a ‘critical mass’ to explore other investigation possibilities is an interesting development in forensic science. The combination of new technologies presents further applications of photography for the purpose of criminal investigation and physical evidence examination. It further suggests that crime scene photography may have an expanding application in the apprehension of persons committing crime using critical mass sources sometime in the future.
Witness forms of photography evidence may provide several physical evidence modes of inquiry. While they support a document evidence form of inquiry, other modes may also be used including comparative and interpretative analysis. This overlap of application needs careful consideration when used as forensic evidence. In comparative analysis of evidence as described by Creer (1984), Vorder Bruegge (1999) and Oz et al. (1999) the safeguards of more accurate photographic recording using forensic photography principles are not inherently available in witness forms of photography evidence such as surveillance images. While witness forms of photography appear as the most simplistic form of recording, they actually present the most complex form of forensic photography evidence when examined using comparative and interpretative methods of analysis. This is a critical point in relation to the reliability of physical evidence gained from these sources. Iscan (1993) suggested in the context of forensic identification;

Although it seems deceptively simple, the comparison of two or more photographs remains the one of the most difficult types of identification. As yet, no standard procedures have been developed for the analysis of photographs or video images [Iscan 1993, p58]

Despite Iscan’s comments, there are still no standard procedures for the identification of individuals using sourced photographs. This is most likely due to the difficulties this form of comparative analysis evidence presents. Recent case studies described in this research (R -v- Jung (2006) and R -v- Johnson (2007)) discuss the problems associated with this form of forensic evidence. Both cases demonstrate problems with the evidence presented in the case which relate to the photographic concepts inherent in the photographs used for comparison. The complexities associated with this form of photographic evidence are also investigated through experimentation in Chapter 6. Witness type photographs will, however, become increasingly more common in forensic investigations due to the diffusion of digital imaging technology, including CCTV, throughout the community. The level of surveillance within the community will also continue to rise.
4.6.5 Summary of Evidence Photography Applications using Taxonomic Descriptors

Table 4.4 lists various forensic photography evidence applications that can be categorised using the taxonomic descriptors modelled in this research. The table includes an additional sub-group of the analyse mode of inquiry. This sub-group includes modes of photography evidence that cannot be seen under standard human vision and utilise a range of scientific equipment such as microscopes, medical instrumentation, scanning electron microscopes, specialised cameras and lighting equipment.

<table>
<thead>
<tr>
<th>Document</th>
<th>Analyse</th>
<th>Analyse (Invisible Objects)</th>
<th>Describe (Photo Narratives)</th>
<th>Witness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Evidence</td>
<td>Fingerprints</td>
<td>Trace Evidence (photomicroscopy)</td>
<td>Crime Scenes</td>
<td>CCTV</td>
</tr>
<tr>
<td>Evidence in situ at crime scenes</td>
<td>Footwear Impression</td>
<td>Invisible radiation photography</td>
<td>Blood Spatter</td>
<td>Surveillance Images</td>
</tr>
<tr>
<td>Stolen Property</td>
<td>Physical Fits (paint/glass)</td>
<td>GSR</td>
<td>Forensic Pathology</td>
<td>Images captured by witnesses</td>
</tr>
<tr>
<td>Prohibited Substances (Drugs)</td>
<td>tyre Impressions</td>
<td>Bloodstains on dark objects</td>
<td>Motor Vehicle Accident Scenes</td>
<td>Photographs taken by suspects and seized by police</td>
</tr>
<tr>
<td>Items of Interest</td>
<td>Toolmarks</td>
<td>Latent Bruising and other injuries</td>
<td>Workplace Accident Scenes</td>
<td></td>
</tr>
<tr>
<td>Seized Items</td>
<td>Bite Marks</td>
<td>Latent Fingerprints</td>
<td>Scenes involving Explosions</td>
<td></td>
</tr>
<tr>
<td>Damage to Motor Vehicles and Equipment</td>
<td>Physical Fit Evidence</td>
<td>Medical Imaging (X-rays MRI, etc)</td>
<td>Fire Investigation</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4: Defining forensic photography types

4.7 The Reliability of Photographic Evidence

The question of the reliability of photographic evidence in forensic science is a poignant one that has had little discussion in the forensic science literature. Reliability of photographic evidence is characterised by the photographs representing facts, truth and accuracy. This work establishes that the determination of the reliability of photography evidence is based on; i) how the images relate to the physical evidence, ii) what questions are being proposed by the forensic evidence and iii) the images ability to answer those questions.
Reliability thresholds will vary depending upon the type of photography and its mode of inquiry. For example, forensic photographs consisting of footwear impressions for the purpose of comparative analysis are considered as ‘analyse’ type photographs, which require stringent technical considerations such as:

- the photograph must be taken with a lens free from curvilinear distortion (such as a macro lens) to ensure image dimensional integrity,
- the image must be highly resolved with fine detail to detect any ‘individual characteristics’ necessary for identification,
- a linear scale must be accurately used to calibrate the image size (for printing or image analysis software),
- the camera angle must be perpendicular with the subject to maintain the dimensional integrity of the subject and avoid rectilinear distortion,
- lighting must be even and provide the necessary definition for identification features,
- calibration of cameras settings must be correctly established to ensure accurate metadata embedded into the images (i.e. date, time, photographer),
- digital imaging treatment (i.e. Photoshop™ adjustments) must maintain the original integrity of the image and be recorded in contemporaneous notes.

These requirements are specific to forensic photography practice when using an analyse mode of inquiry and are not applied in other types of photography.

Understanding how images are used to produce forensic evidence is the first step towards understanding their level of reliability. This is a complex issue and requires a framework that can illustrate how the photographs are used within the physical evidence mechanisms. The relationship between physical evidence modes of inquiry and the images used in photographic evidence is a key element in this model. Another concept that is critical regarding this thinking is the position that not all photographs are considered to produce the same outcome. Forensic photography or sourced photographs may support various physical evidence modes of inquiry.
providing they are considered within the context of the forensic examination and the evidence produced is congruent with the physical and photographic evidence.

Figure 4.12 illustrates the relationship between photography and physical evidence modes of inquiry. The model further illustrates the potential outcomes and pathways used during the investigation. The previous example of footwear impression photographs would therefore use the analyse photography mode of inquiry, the comparative analysis mode of physical evidence and the potential outcome could be considered as expert evidence for court and/or forensic intelligence regarding the possible identity of the offender for the investigation.

![Diagram of evidence modes and outcomes]

*Figure 4.12; Modelling the relationship between physical evidence and photographic evidence.*
Evidence gained from CCTV images is considered as a witness form of photographic inquiry and is predominately used as an observation mode of physical evidence. This mode is traditionally used as witness evidence and provides forensic intelligence during the police investigation. Other physical evidence modes may be considered with CCTV images, however the photographic evidence must be carefully considered within the context of the physical evidence inquiry.

Furthermore, the fundamental considerations necessary when examining the reliability of photographic evidence must also be considered within the context of a legal framework and include;

- The evidence must be admissible (relevant, lawfully obtained, authenticated and not unfairly prejudicial).
- The visual data must be unambiguous and display an appropriate standard for testing the forensic hypothesis.
- The evidence must communicate aspects of truth and not distort reality.
- The evidence integrity must be maintained (provenance, chain of custody, no major alterations to image).
- The photographic evidence must be congruent with the physical evidence examination.

Unreliable photographic evidence would exist if images do not represent the facts and distort reality. Problems with photographic evidence reliability may arise when;

- The images are inadmissible.
- Unfair prejudicial aspects outweigh the probative value of the evidence.
- The photography evidence is misinterpreted by the forensic practitioner.
- The visual data is corrupted by image artefacts.
- The visual aspects of the evidence are presented in a way that does not reflect the facts (i.e. inappropriate inferences).
- Perceptions of lay witnesses, jurors and court officials are not consistent with the facts.
- Exemplar material created during the forensic analysis differs considerably from the sourced visual material (using comparative analysis).
• The photographs have been falsified or manipulated for deceptive and illegal purposes.

A danger regarding the inappropriate use of photographs as evidence is the degree of weighting that may be given to this evidence by the courts, especially when they may not represent the facts. Benjamin Madison III makes the following caution in his law review paper titled ‘Seeing Can Be Deceiving: Photographic Evidence In a Visual Age – How Much Weight Does It Deserve?’ [Madison 1984];

…… Impressed by advances in photography, courts generally favour photographic evidence, often according it substantial weight. Although photographic evidence is an asset to the adept trial lawyer, neither courts nor lawyers fully understand the capacity of photographic evidence for deception or improper influence. [Madison 1984, pp705-706]

4.8 Chapter Discussion

This chapter conceptualises forensic evidence derived by photographic sources. It establishes a conceptual framework that expresses the relationship between physical evidence and photographs used for forensic evidence. Its purpose is to engage with the complex issues associated with photographic evidence reliability and provide a foundation for further arguments that address the central research question.

In summary, this chapter has introduced the following concepts regarding photographic evidence;

• A paradigm that describes physical evidence which includes; i) process (the sequence of the investigation), ii) function (the methods used) and iii) principles (the value or significance of the evidence).
• The process component of the physical evidence paradigm consists of three phases; i) detection, collection and recording, ii) examination and iii) result analysis and reporting.
• The function component of the physical evidence model describes the methodology considerations used for the examination. There are four modes of inquiry described including; i) empirical analysis, ii) comparative analysis, iii) interpretative analysis and iv) observation.
• The principle component of the physical evidence paradigm describes how the evidentiary material can be considered as evidence.

• The introduction of a new holistic theoretical model for physical evidence that combines the four modes of inquiry with investigation outcomes.

• A discussion regarding photography as evidence.

• The development of taxonomic descriptors for various photographic evidence based on photographic evidence modes of inquiry. These taxonomic descriptors include; i) document, ii) analyse, iii) describe (visual narrative) and iv) witness.

• The relationship between photographic evidence and physical evidence based on centralised outcomes.

• A discussion regarding the concepts of what constitutes reliable and unreliable photographic evidence.

This study also examines how the magnitude of photographic evidence may significantly influence the court’s understanding of the facts. The framework developed in this chapter provide some basis to express photographic evidence and place some meaning and value on its level of reliability. It also assists in establishing some direction towards a more transparent use of photographic evidence including full disclosure of the methods used in the examination. The taxonomic descriptors become an important component for expressing the methods used during an examination and allow more consistency between forensic practitioners.

Photographic evidence is a highly valued and essential tool in forensic science. Understanding how it may be used during forensic examinations and how meaning is transferred and communicated is a critical issue for forensic photography practices and evidence. Understanding that not all photographic approaches produce the same forensic outcomes is an important concept to consider with this theoretical framework.

The following chapter examines how CCTV images are used to produce forensic evidence. It critically reviews the reliability of the evidence presented by the Crown’s expert witness and highlight the dangers when this form of evidence is not supported by forensic science and evidence principles.
Chapter 5

5.0 Case Study: Regina -v- Jung (Double Murder)

*The quality of the recording may often be so poor as to render the ‘evidence’ as worthless for the purpose of identification.*

Michael Bromby [Bromby 2003, p302]

The application of facial identification of persons of interest (POI) depicted in CCTV surveillance images has recently emerged in Australian courts. Novel forensic identification methods made directly from photographs have also recently been published in various forensic science journals [Iscan 1993, Porter & Doran 1998, Porter & Doran 2000, Halberstein 2001, Bromby 2003, Lynnerup *et al.*, 2003, Yoshino 2004, Brinkmann 2007, Cattaneo 2007]. With the exception of photographic representation of facial anatomy, identification made exclusively from photographs or CCTV images lacks any physical biology that is prevalent in other more established forms of forensic identification such as fingerprinting and DNA. Photographs of persons of interest are a *virtual* form of primary evidence when
compared with other physical biological forms such as blood, semen, fingermarks
and hair that may be left at the scene. This removal from the tangible form of
physical evidence into a virtual form has been recognised by some authors when
writing about novel identification methods. Yoshino (2004) provides a literature
survey of facial identification methods published in the forensic science literature.
This form of evidence has seen several issues relating to reliability arise and they
include;

- Identifications are highly reliant on aspects associated with the quality of
the photography
- Identification limitations need to be carefully considered due to the lack
of tangible physical evidence.
- The weighting of indirect evidence such as CCTV images should be
considered with caution as this form of circumstantial evidence is often
given inappropriate evidence weighting.
- The positioning and angle of installed CCTV cameras are most often not
considered for the benefit of facial identification.
- Concepts of individuality of facial features have not yet been established
in forensic science.
- Validation of facial identification methods has not occurred in forensic
science.

These issues are mostly interrelated and can significantly affect the potential
outcome of any forensic identification examination.

Edmond et al., (2009) suggests forensic identification experts have recently become
necessary for police and the prosecution when producing identification evidence
from CCTV as a result of an Australian High Court ruling\(^{22}\) in 2001 [Edmond et al.,
2009]. The Smith case involved the identification of Mundarra Smith by two police
officers from CCTV footage taken during a robbery of the National Australia Bank
in Caringbah [Biber 2002]. The police officers proffered identification evidence
during the trial based on their previous dealings with the accused and the High Court

\(^{21}\) Sometimes referred to in the media as ‘facial mapping’.
\(^{22}\) Smith -v- The Queen (2001) HCA 50
ruled that this form of identification was inadmissible. Neither police officer was a witness to the event and Justice Kirby explained that they did not have ‘specialised knowledge’ that would provide an exception to the opinion rule (s79) in *Evidence Act 1995*. Kirby J also added that the police officers were in no better position than the jury to form a majority view of the identity of the appellant [Edmond *et al.*, 2009].

Due to the *Smith* ruling in the High Court, it has become necessary for the prosecution to seek the assistance of forensic experts to conduct facial identification from CCTV images. No longer can police rely on using other police officers who may know the person being investigated. Edmond *et al.*, (2009) describe this recent necessity and argued;

> Until Smith, police officers and other investigators routinely made positive identifications from images based on their prior interactions with the accused or the limited familiarity gained through the course of an investigation. After Smith, investigators and prosecutors effectively had two options. First, they could endeavour to utilise the exceptions to irrelevance identified by the majority in the extract above. These exceptions enable investigators and police, in an ever-expanding range of circumstances, to proffer identification evidence linking a known individual to a suspect in a photograph or video associated with the criminal act. Second, police and prosecutors could seek the assistance of those with expertise – that is, pre-existing expertise – in disciplines such as anatomy, physical anthropology and photography. These experts, because of their ‘specialised knowledge’, would be able to give evidence about identity of persons in images in a way that would provide an admissible exception to the rule against opinion evidence........ [Edmond *et al.*, 2009, p345]

This case study examines CCTV identification evidence that was presented by the prosecution’s expert during the *Regina -v- Jung* (2006) trial in the aftermath of Smith.

Jung, a Korean national, was charged by police with double murder for the killing of brothers Duck Hwan Kim and Dok Su Kim in 1997 [Mercer 2007]. The case was prosecuted in the NSW Supreme Court before Justice Hall in 2006, almost a decade after the murders. Jung pleaded not guilty to the charges.

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23 Extract not included, however it suggests that the evidence may be included if some identifying feature is not apparent by observing the accused at the trial by the jury.
An aspect of reliability discussed in this chapter is how CCTV images are used in a comparative analysis using qualitative facial morphological methods. This case study examines the potential for misunderstanding how facial morphology may or may not be represented in photographs. Furthermore, the Crown presented a definitive identification result based on CCTV images that present several issues of reliability.

The expert called by the prosecution was Dr Meiya Sutisno who submitted two Expert Certificates dated 17 September 2005 and 6 June 2006 [Hall 2007a]. Sutisno describes herself in these reports as a ‘consultant forensic anatomist’. The focus of this case study is upon the evidence associated with the report dated 17 September 2005, which comprised of a facial comparison between a series of ATM\(^{24}\) CCTV images and photographs of Jung taken by the NSW Police. Sutisno’s report indicated that the person of interest depicted in the CCTV images is the person shown in the exemplar photographs.

The comparative analysis of photographs focussed on questioned CCTV images taken from a Westpac bank ATM in Queensland and exemplar photographs taken by the NSW Police. The first series of exemplar photographs were taken during an interview at the Kings Cross police station upon Jung’s arrest on 8 November 2004. The other photographs were taken on 11 April 2005 at a remand centre some months after his arrest. The remand centre photographs were taken by members of the crime scene unit for the specific purpose of forensic identification examination using forensic procedures. Both series of exemplar photographs were taken several years after the CCTV images.

The identification evidence from the CCTV images formed a critical component of the Crown’s case. There was no physical evidence linking Jung directly to the crime scene and Jung denied being in Australia at the time of the deaths. He also insisted he was not the person of interest depicted in the CCTV images. Establishing identity was a significant aspect of the Prosecution’s case [Mercer 2007].

\(^{24}\) Automated Teller Machine
The identification evidence presented in *Jung* became important from a jurisprudential perspective. The trial commenced a few weeks after the *Tang* judgement was released from the Court of Criminal Appeal (CCA). Spigelman CJ allowed the appeal in *Tang* and ordered a retrial. This judgement was also somewhat critical of Sutisno’s facial identification evidence. Spigelman CJ ruled that Sutisno’s opinions did not go beyond ‘*a bare ipse dixit*’ and that since her methods were not reported (due to some claims regarding intellectual property issues) her specialised knowledge could not be tested.

Jung’s defence counsel challenged Sutisno’s evidence in *voir dire*, which for the first time tested the legal position of expert identification using facial mapping evidence after the *Tang* appeal in the CCA. The defence called two forensic experts during the *voir dire*. The *voir dire* took several weeks to be heard and Hall J made two interim judgements regarding the admissibility of Dr Sutisno’s opinions and the exemplar photographs. These decisions are cited as:


Gary Edmond, a law scholar from the University of NSW, also used *Jung* as a case study into the admissibility of the specialised knowledge and the operation of the exclusionary rules under the *Evidence Act 1995*. Edmond’s study examined the failure of jurisprudence in relation to expert opinion evidence. He interpreted the facial identification evidence from *Jung* and Justice Hall’s decision in relation to the decision of the Court of Criminal Appeal in *Tang* and found several jurisprudence issues and inconsistencies with these judgements [Edmond 2008].

This chapter examines the reliability of the CCTV images associated with the facial identification evidence admitted at the *Jung* trial. It uses a range of material to

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26 *Ipse dixit* is a Latin term meaning ‘he himself said it’ and suggests the evidence is not proven only asserted by the expert witness.
27 A further judgment was also made in relation to the police record of interview.
analyse the application of the CCTV images when used for identification of persons of interest. The resources used for this case study include;

- Scholarly papers published in law review journals that relate to Jung and facial identification evidence.
- Media articles reporting on the case.
- The CCTV recording.
- The exemplar material produced by NSW police.
- Court transcripts from the trial.
- Expert Certificates and reports from the forensic experts.

This case study provides a useful framework to investigate problems associated with facial identification evidence from CCTV images in Australian courts. While this research is not focused on jurisprudential aspects of the evidence, reliability of the CCTV images and identification evidence is obviously relevant to admissibility in any rational system of justice. This chapter examines how the CCTV images were used to produce forensic identification evidence and critically reviews their reliability.

5.1 Case Background

Myoung Il Jung was arrested at Sydney airport in 2004 for the double murder of Duck Hwan Kim (aged 27) and Dok Su Kim (aged 31) in a Kings Cross lane on 30 January 1997 [Hall 2006a, Hall 2006b]. According to Mercer (2007) the Kim brothers were beaten to death over a dispute involving two rival Korean gangs involved in prostitution, drugs and loan-sharking. The trial was conducted almost a decade after the homicides.

The investigation into the Kim’s deaths saw several arrests by Task Force Arcadia\(^{28}\) within 24 hours of the murders in 1997. A named suspect, Myoung Il Jung, allegedly

\(^{28}\) NSW Police task force.
fled overseas before he could be apprehended by police. The accused entered Australia in 2004 using a passport in the name of Myoung Eii Chung. He was detained at Sydney Airport and taken to Kings Cross police station. The accused denied that he was Myoung Il Jung and that he had ever been in Australia before [Hall J 2006b, Mercer 2007]. The police investigation had to prove the accused’s identity to enable a prosecution. The onus of identity is one that falls among the Crown’s responsibilities.

No physical evidence left at the crime scene directly linked Jung or proved that Chung and Jung were one and the same person. Physical evidence such as fingerprints or DNA would have proven useful for the police investigation to establish identity however, no such evidence was available. Instead, the Crown had to rely on CCTV images taken in Queensland several days after the murders. Justice Hall made the following comment regarding the issue of identity and the Crown’s position;

*The issue at trial is one of identity. The accused denies that he was the offender responsible for the deaths of the deceased. He maintains that he was not present and that he is not the person of interest shown in certain CCTV images taken shortly after the deceased died. The Crown seeks to rely upon the CCTV footage taken in February 1997 and images taken from it for the purposes of an anthropological analysis conducted by a forensic anatomist, Dr. Sutisno. [Hall J 2006b, para 24]*

The Crown’s case against Jung was limited by the lack of physical evidence. Establishing Jung’s identity was paramount. The ATM CCTV images taken in 1997 were used by the prosecution to provide evidence that Jung and Chung was the same person, and that Jung was in Australia at the time of the homicides. The CCTV evidence was not related to the criminal activity *per se*, its purpose was to establish the identity of the accused.

### 5.2 Forensic Examination of ATM CCTV Images

A qualitative forensic examination was conducted of the CCTV images using a calibrated flat screen monitor (Samsung SyncMaster920n). Screen resolution was set at 1280x1024 pixels with highest (32 bit) colour quality. The CCTV recording was examined on the computer monitor using Cyberlink PowerDVD™ DVD player
software. The physical size of the viewing format was 220x165 mm which was viewed from a distance of approximately 500 mm. The screen resolution, calibration, image format/size and viewing distance were optimised to the best practical limits for image evaluation and facial identification. Ambient light in the room was decreased to avoid specular reflections on the monitor.

The CCTV footage was monochromatic and consisted of still images that alternated between two different viewpoints from two separate ATM’s. The camera angle was directly in front of the users of the ATM’s and was most likely located within the teller machines. Distinctive landmark features were observed on the CCTV footage, namely the veranda structure of the building (piers and bulkhead), variations in the tonal values of the paved footpath, an inspection grill located within the footpath, the street located near the building, and building structures on the opposite side of the street (although these structures were out of focus, due to depth of field). See Figure 5.11.

Data inscribed onto each separate image view included;

- ‘1-WBC SURF.PARADISE 034-216 ATM1’
- ‘1-WBC SURF PARADISE 034-216 ATM2’

The date stamp included on the screen begins at 02/02/97 12:18:30pm and ends at 02/02/97 12:24:57pm.

The person of interest in the CCTV footage is wearing a shirt consisting of large vertical stripes, light and dark in tone. The overall quality of the CCTV was poor. A qualitative evaluation of the CCTV quality identified the following image problems;

- Poor resolution
- Poor dynamic range and an inaccurate rendition of tonal values.
- Poor exposure of critical areas of interest including face.
- Images display high level of noise.
- Images suffering from acute lens distortion (curvilinear distortion).
• Images taken at close-range producing exaggerated image perspective and a distorted spacial representation.

The screen height (see Chapter 7) of the person of interest varies depending upon his location at the scene. The screen height ranges from approximately 50% to 200% and within the range of suitability for recording facial morphology (200%) [Cotterill 2008]. However, the inherent resolution is extremely poor, and in addition to other significant quality problems, the CCTV images do not record details required to distinguish identifying features of the person of interest (especially at the 50% range). Screen heights that range outside standing close to the ATM, notably decrease in resolution due to depth of field. There is significant curvilinear distortion observed in the images and this distorts the shape of the piers quite considerably. This distortion is more difficult to detect in the person of interest’s face, however it can be assumed that areas of the image other than the piers are also affected.

At the 200% screen height, qualitative assessment of the resolution indicates no visible detail in the person of interest’s hair and shirt buttons. Skin tone reproduction appears quite dark, possibly due to poor camera exposure, dynamic range problems and poor lighting on the person’s face. Figure 5.1 provides several images of the person of interest (wearing large vertical stripped shirt) positioned at different screen heights ranging from 50% to 200%. Other people in the images have had their faces pixelated.

5.3 NSW Police Photographs (Exemplar Material)

The NSW Police produced two series of photographs of the accused for the purpose of exemplar material and forensic examination. Photographs from both series have also appeared in the public domain by being tendered as evidence in the NSW Supreme Court and appearing in the media (both print and internet media). The exemplar photographs are also examined to determine their reliability in relation to the forensic evidence supplied in this case.
Figure 5.1: A series of ATM CCTV images illustrating the screen height range of the person of interest (approximately 50% to 200%). Pixelation has been added to the faces of other people depicted in the CCTV images.
5.3.1 Forensic Procedures on 08 November 2004

The first series of photographs were taken at Kings Cross police station during the record of interview and forensic procedures in accordance with the *Crimes (Forensic Procedures) Act 2000* when the accused was arrested on 08 November 2004. The photography procedure was also captured on video [Hall J 2006b]. A viewing of this video suggests the officer taking the photographs had some difficulty getting the camera to work. In particular, the electronic flash failed to fire and illuminate the subject. The resulting images are also suggestive of problems with the flash displaying poor and inconsistent lighting, in addition to subject movement caused by a slow shutter speed. The lighting direction is coming from directly above the accused and is most likely caused by the available incandescent or office fluorescent lighting situated in the rooms ceiling (see Fig 5.6, Photo C).

Lighting from directly above the subject often produces significant differences in the subject’s appearance [Petzold 1979]. It produces shadows in regions of the face including under the cheek, eye sockets, nose and neck. This type of lighting is often used for aesthetic applications by fashion and beauty photographers. Technically, it is known as ‘butterfly lighting’ [London *et al.*, 2005] and is designed to enhance the features or bone structure of the face and to enhance concepts of beauty from fashion models. The results of direct overhead lighting is an exaggeration of facial structure and should not be used for the purpose of exemplar photographs in facial identification. This form of lighting could produce unreliable visual effects not appropriate in forensic photography.

The photographs taken during this series were not taken by a forensic photographer [Hall J 2006b]. The overall quality is poor, with problems in exposure, lighting and overall sharpness. No specific details regarding the photographic procedure were submitted with the photographs for consideration, including the camera’s ‘u’ distance29 [Hall J 2006b]. The admissibility of these photographs taken on 08 November 2004 was challenged during the *voir dire* by the accused’s senior counsel and the photographs were tendered as evidence in *voir dire* (Exhibit J) [Hall J

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29 ‘u’ distance is the distance between the centre of the lens and subject.
The defence challenged the admissibility based on several legal arguments including the lack of qualifications and experience of the police officer who took the exemplar photographs during the forensic procedures. Justice Hall decided the exemplar images as admissible. Regarding the issue of photographic qualifications, Hall J made the following observation:

*Detective Senior Constable Noble did not have a professional qualifications or experience suitable for carrying out the taking of photographs ‘of a part of the body’. He had limited experience in taking photographs but not in relation to forensic photographs.* [Hall J 2006b, para 27]

The reliability of these exemplar images presents a problem with the identification evidence. The low image quality and exaggerated facial features caused by the lighting created less than ideal exemplar material for forensic analysis. His Honour made the following remark regarding the probative value of the exemplar photographs:

*The forensic photographs taken on 8 [November] 2004 produced images of the accused from a number of angles. They were not, however, taken in accordance with procedures that would be adopted by a forensic photographer. That renders them potentially, subject to deficiencies and that in turn can affect their reliability. However, I do not regard the photographs for that reason as either necessarily devoid of probative value or to have been distorted or corrupted by the lack of procedures having been adopted. Of course when the evidence is given at trial it may be that the probative value or weight of them is the subject of challenge in the light of the evidence given in the voir dire by Mr. Porter. The evidence is part of the foundational material required for morphological analysis and is potentially probative on ‘similarities’ relevant to identity.* [Hall J 2006b, para 41]

If his Honour were to find these exemplar photographs inadmissible, then the identification evidence (which uses the exemplar photographs) could also be inadmissible, thereby rendering the Prosecution’s identification evidence worthless. Since identity was critical to this case, the admissibility of these exemplar photographs was essential for the Prosecution. There appeared to be several aspects of the exemplar photographs that were non-compliant with sections of the *Crimes (Forensic Procedures) Act 2000* and Justice Hall used his discretion to admit the evidence.

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30 See decision for more detailed information; ‘The forensic photographic evidence is admissible’ Regina -v- Jung [2006] NSWSC 660.
31 The judgment actually uses the date ‘July’ however this is a typographical error. The corrected date has been included here.
The Forensic Procedures Act requires the exemplar photographs used in facial identification evidence to be taken by an appropriately qualified or experienced forensic photographer. Section 3 of the Crimes (Forensic Procedures) Act 2000 describes ‘appropriately qualified’ as:

appropriately qualified in relation to carrying out a forensic procedure, means:-
(a) having suitable professional qualification or experience to carry out the forensic procedure, or
(b) qualified under the regulations to carry out the forensic procedure.

The Act further defines;

forensic material means:-
(a) samples, or
(b) hand prints, finger prints, foot prints or toe prints, or
(c) photographs, or
(d) casts or impressions taken from or of a person’s body.

forensic procedure means:-
(a) an intimate forensic procedure, or
(b) a non-intimate forensic procedure, or
(c) the taking of a sample by buccal swab,
but does not include:-
(d) any intrusion into a person’s body cavities except the mouth, or
(e) the taking of any sample for the sole purpose of establishing the identity of the person from whom the sample is taken.

When investigating police take photographs of the accused without forensic services, the resulting exemplar material is not only more likely to be unsuitable for forensic examination due to technical deficiencies; it may also cause the entire identification evidence to effectively become inadmissible. The use of forensic photographers is an important consideration when examining the reliability of exemplar material to support forensic examinations of CCTV images for identification.

5.3.2 Forensic Procedures on 11 April 2005

The second series of exemplar photographs of Jung were taken on 11 April 2005 [Hall J 2006a] at a remand centre while the accused was held in custody. This series of photographs were taken by a crime scene officer for the specific purpose of obtaining exemplar photographs for comparison with the questioned CCTV images.

32 Quoted from [Hall J 2006b].
A video of the photography procedures was also taken for the purpose of the Crimes (Forensic Procedures) Act 2000. Some attempt to replicate different camera angles was achieved by taking several photographs with the accused turning slightly clockwise after each photograph. The resulting photographs were full-length poses (approximately 100% screen height).

Details regarding the forensic photography procedure were submitted with the photographs. This information contained the following [Griffin 2006];

- Camera: Nikon F90.
- Lens: Nikon 28-120 mm zoom lens.
- ‘u’ distance: approximately 3-4 metres.
- Focal length: Unknown (between 28-120 mm)

The actual lens focal length is unknown because a zoom lens (28-120 mm) was used during the photography. The photography was conducted using a film camera and no metadata was available which may have included details of focal length during each exposure. The photographer photographed the accused while standing on ground level and from a slightly elevated position (standing on a chair). A portable electronic flash was used to light the subject.

A qualitative evaluation of the photographs indicates the quality of these exemplar photographs is good with a high degree of resolution. The resolution is suitable to detect facial features including any identify features such as moles, scars and wrinkles [Porter & Doran 2000, Bromby 2003, Hall J 2006a]. The lighting techniques were also suitable for images used in forensic analysis (see Fig 5.6, Photo B).

It appears that these photographs were taken for the specific purpose of using them as exemplars during the morphological comparative analysis. Overall image quality was good and there was a range of camera angles captured. In comparative analysis methods for facial identification, the image perspective in both the questioned and exemplar photographs should be consistent; otherwise different photographic representation of facial morphology may occur. It would appear that image
perspective was not a consideration with either forensic procedure involving the recording of exemplar material for comparative analysis of facial anatomy.

### 5.4 Facial Identification Evidence from the CCTV Images

The Crown sought expert identification evidence from forensic anatomy consultant Dr Meiya Sutisno. Sutisno undertook a comparative analysis of morphological features using the questioned CCTV images and the exemplar photographs provided by the NSW Police. A further examination, which included an identity card, was also included. Two reports from Sutisno were tendered in the *voir dire*, dated 17 September 2005 (Exhibit K) and 06 June 2006 (Exhibit L) [Hall J 2006a]. Sutisno’s findings indicated the person of interest depicted in the CCTV images were the same person depicted in the exemplar images. Her examination was based on a comparative analysis between questioned and exemplar images and her findings consisted of morphological comparisons to identify similarities or dissimilarities.

Senior counsel for the accused challenged Sutisno’s evidence in *voir dire*. Justice Hall summarised the issues raised by the defence as follows:

> The principal issues examined in relation to Dr Sutisno’s analysis and evidence were as follows:
> (a) the quality, deficiencies and information related to the 1997 CCTV images and the use of still and computerised images derived from the CCTV material;
> (b) the photographs obtained by police of the accused (Exhibit J on the *voir dire*) on 8 November 2004 and the conditions under which they were taken;
> (c) the process employed by Dr Sutisno in utilising the photographic material referred to in (a) and (b);
> (d) the basis upon which the morphological analysis undertaken by Dr Sutisno was constructed.[Hall J 2006a, para 6]

Evidence in *voir dire* was heard for several days and included witnesses from the Crown and defence [Hall J 2006a]. Hall J produced a detailed written judgment on the *voir dire* (and is cited as; ‘Admissibility of Expert Opinion Evidence’ Regina -v- Jung [2006] NSWSC 658). Several cases were cited including the then recent *Tang*[^35].

[^33]: Issues raised by the defence counsel.
[^34]: As previously discussed.
decision from the Court of Criminal Appeal regarding Sutisno’s evidence in that case, and other prominent case law from Smith, Makita, Murdoch and others. Justice Hall determined that Sutisno’s evidence was admissible. However, he indicated that there were some concerns regarding the application of the photographic material and evidence deduced from those sources;

In the present matter, evidence is not evidence as to observation by a lay observer as to identity or similarity. The context in which the present matter is being considered is one in which there is a disputed question of expert opinion evidence in which there is likely to be a divergence of views on the expert analysis of morphological features. The question of reliability or credibility is to be evaluated in that context.

Accordingly, in undertaking the balance exercise required by s.137, it is not appropriate for the purposes of the present application, for a determination to be made as to the quality or reliability of the evidence as those are matters for jury determination.

The probative value of the opinion evidence of Dr Sutisno, if accepted, would be as relevant circumstantial evidence of similarities relevant to the question of identity. If the jury were to accept Dr Sutisno’s analysis and opinion based on it, then it would constitute important evidence in the Crown’s case. [Hall J 2006a, para 76-78]

His Honour’s position regarding the identification evidence from the CCTV images, is one that he considered necessary for the jury to make judgement regarding its level of reliability and appropriate weighting. This may be problematic in consideration of s.137 of the Evidence Act 1995 to which Hall J refers to in the extract above. Section 137 deals with evidence that may be ‘unfairly prejudicial’ because the evidence may be misused by the jury [Edmond 2008, Edmond et al., 2009]. Section 137 of the Evidence Act states;

Exclusion of prejudicial evidence in criminal proceedings

In a criminal proceeding, the court must refuse to admit evidence adduced by the prosecutor if it’s probative value is outweighed by the danger of unfair prejudice to the defendant.

Unfair prejudice means the danger that the jury may misunderstand or misuse the expert opinion evidence when it is presented to them in court. Some problems presented on this case consist of; the absence of any validation of the novel

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36 Smith v Queen [2001] 206 CLR 650
37 Makita (Australia) Pty Ltd v Sprowles [2001] 52 NSWLR 705
38 Regina v Murdoch (No. 4) [2005] NTSC 78
identification method used by the Crown’s expert, the poor quality of the CCTV images and the weighting of this evidence in relation to;

As far as it can be ascertained, no NSW Court – let alone a murder Trial – has accepted identification evidence in the form purported by Dr Sutisno based on morphological analysis alone. [Hall J 2006a, para 7, sec 6]

Obtaining a balance between ‘probative value’ and ‘unfair prejudice’ is a difficult process. Edmond (2008) argues;

In practice, the balancing exercise creates difficulties. For the trial judge is expected to balance incommensurables. [Edmond 2008, p14].

Edmond (2008) also suggests that s137 should be applied more aggressively to expert opinion evidence than lay evidence. He contends;

We can understand why judges might not want to unilaterally interfere with juror assessments of the credibility of lay witnesses or the reliability of their evidence. The same arguments do not, however, apply with equal force to opinions based on ‘specialised knowledge’. There would seem to be an obvious role for reliability when determining the probative value of inculpatory expert opinion evidence.

What we can say, on the basis of the foregoing review, is that taking expert opinion evidence ‘at its highest’ encourages the trial judge (and appellant courts) to assume that the techniques used and opinions presented by expert witnesses are reliable in preference to actually requiring the prosecution to persuade the trial judge that such an assumption is sound. It may make sense to adopt such a stance in response to the credibility of lay witnesses and the reliability of their evidence. This is because we have few dependable means of gauging credibility or the reliability of lay evidence. However, the same cannot be said about for forensic sciences. Almost all forensic scientific techniques can be assessed for validity and reliability. The question then becomes: why do judges not make a principled distinction where the reliability of techniques and the probative value of expert opinion evidence can be meaningfully determined? [Edmond 2008, p21]

This is a very interesting point and it is highly relevant in the context of this research question and case study. Rather than making a decision on the identification evidence reliability, Hall J relies on the jury’s insight to make a judgement on the expert evidence. If the Prosecutions identification evidence happens to be unreliable, the risk of unfair prejudice is significantly increased and the balance with probative value is overshadowed. Hall J appears to consider the balance of probative value, to

39 Referring to s79 Evidence Act 1995
which the evidence is a significant component of the Crown’s case, to the fact that the accused has the capacity to produce rebuttal experts. This thinking places the onus and the responsibility of preventing unfair prejudices on those forensic experts for the defence and, in turn, removes the responsibility of the Court. It shows some shift of responsibility and it is questionable whether this was the intention of s137. His Honour’s response to his unwillingness to exclude the evidence pursuant to s137 was;

The accused led evidence from two expert witnesses to whom I have already referred, namely, Mr Porter and Dr Doran. It is not irrelevant in the balancing exercise under s.137 in relation to the issue of unfair prejudice for some account to be taken of the fact that the accused has available to him such expert evidence which bears directly upon the analysis undertaken by Dr Sutisno.  

[Hall J 2006a, para 82]

This approach places the responsibility of demonstrating reliability upon forensic experts representing the defence and not the Crown. Edmond’s (2008) point is an important one in this context. Any expert presenting inculpatory forensic science evidence to a court should be burdened with the onus of validating its reliability by means of research, calculation of error rates or validation through scientific literature. These aspects are considered in Daubert in the United States. Justice Hall’s position here, however, appears to be placing this onus on the defence experts to disprove the Crown’s experts evidence and have the jurors decide who’s evidence is more feasible (not based on more reliable). This is not only inappropriate, it does by its very nature, introduce an unfair prejudice. That is, the accused is now responsible for disproving the reliability of novel scientific methods and the prosecution is effectively immune from this responsibility.

When the validation of photographic evidence is considered, it may become very difficult and highly complex for the defence experts to explain conditions of unreliability, as previously discussed in the visual culture in forensic science chapter. In relation to the Jung case, Edmond (2008) makes this statement about the decision to admit Sutisno’s evidence;

There is much to say about the admissibility determination in Jung. At no stage was Hall J concerned with the reliability of Dr Sutisno’s expert opinion

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evidence. The fact that her techniques could have been validated was not considered significant. Because facial mapping evidence is so epistemologically flimsy, the case provides a particularly useful illustration. The inability (or unwillingness) to exclude facial mapping evidence using sections 79 and 137 (and section 135) demonstrates the weakness of our current approach to expert opinion evidence adduced by the prosecution.

In addition to the concerns expressed by Porter and Dr Doran, there are many other serious issues which threaten the reliability and probative value of the facial mapping (or de facto identification) evidence. First, there are no large databases recording the distribution of anatomical features or the relationships between anatomical features. Even if we temporarily ignore the problems raised by focusing and distortion, angles and distances, lenses, lighting and depth of field, the conversion of three dimensional features to two dimensions – especially given the limited information recorded by many security cameras – we really cannot say much about apparent or purported similarities (and matches). The situation is analogous to early DNA results and population statistics. [Edmond 2008, p29].

The intention of this research and case study is to focus on the validity and reliability of the forensic evidence obtained from CCTV images. The legal arguments and forensic science principles are naturally interrelated and the discussion regarding the legal debate is an attempt to coalesce some issues surrounding reliability and admissibility from an interdisciplinary approach. Admissibility must also be a consideration of evidence reliability.

The issue of reliability exists from; i) technical aspects of the source examination material, ii) the preparation of the exemplar material, iii) law considerations (admissibility) and iv) identification and physical evidence principles. Justice Hall J summed up issues of reliability of this evidence during the voir dire as;

*It is apparent from what has been stated above that the principal attack made upon Dr Sutisno is that she has applied one particular form of analysis, the morphological analysis, being one which is essentially a qualitative or subjective one and which is based upon photographic materials that are affected by a range of deficiencies and defects. It was further put that the standards or criteria by which Dr Sutisno purported to match facial features was vague and did not permit her opinion to be tested. [Hall J 2006a, para 61]*

The following sections of this chapter examine issues relating to the reliability of this evidence and, in particular, the application of the photographic elements. Further concerns regarding the reliability of the CCTV identification evidence include;
• Validation of the morphological comparison method used and its principle regarding identification based on individuality.
• The misuse of the photographic material caused by lack of understanding and consideration of photographic science principles.
• The reliability of the photographic material used in the comparative analysis.

5.5 The Morphological Comparison Method

Facial identification methods have principally developed from techniques used to identify deceased persons by the superimposition of an image of a human skull with a known photograph of the possible victim. Identification is established by the matching of anatomical landmarks of the skull with soft tissue anatomical landmarks of the face. The dentition is also used to establish similarities of anatomical structure, hence smiling portraits are often used in this type of comparative analysis [Brown 1983, Dorion 1983, McKenna 1985, McKenna 1988, Maat 1989, Ubelaker & O’Donnell 1992, Yoshino et al., 1993, Seta & Yoshino 1993, De Angelis et al., 2007, Jackson & Jackson 2008]. This technique has been mostly replaced with DNA analysis, especially with bone fragments, although photo-superimposition techniques still have some use if the victim does not have a recorded DNA profile or any living maternal relatives (mtDNA) [Jackson & Jackson 2008].

The alignment of the two photographs (skull and facial portrait) is not an easy task and requires a good understanding of image geometry or image perspective concepts. To enable the registration of the two images, both images must match in image perspective and magnification or size. Maat (1989) makes the following comment regarding this notion;

For many years the technique of photographic superimposition of laboratory images of persons, living or dead, or the skulls on existing photographic portraits has been widely used for identification. But the proper depiction of size relationships between objects at different distances from the camera or observer is controlled by geometric perspective. Consequently, the relative sizes of the parts of a subject depend on their position (location) in relation to the camera and lens. At the same time the absolute size of the image depends on the focal length (or magnifying power) of the lens. [Maat 1989, p225]
Maat’s point is critical for the success of photo-superimpositions, otherwise the two images will not register\textsuperscript{41} even when comparing two images of the same person at the same magnification. Understanding this critical principle also allows the forensic examiner to better select the exemplar material and when photographing the skull. A technique that assists this critical requirement is using live video images of the skull [Brown 1983, McKenna 1988, Seta & Yoshino 1993b]. Adjustments to the image perspective (camera distance), image magnification (using lens focal length) and camera angle may be applied more precisely. The concepts described by Maat are not well understood outside forensic photography.

Consideration of the image geometric concepts would also be a critical aspect for facial identification methods when comparing questioned and exemplar photographs. This is particularly so if facial morphology (size, shape and form) is qualitatively described or photoanthropometric measurements are made from the anatomical representations shown on the photographs. In other words, each photograph used in the comparison should be of the same image perspective, magnification and camera angle. The concepts and importance of image geometric concepts do not appear to be considered by the Crown’s expert submitting the CCTV identification evidence in the Jung case.

Sutisno’s reports were submitted into court evidence during the voir dire (Exhibits K and L) [Hall J 2006a]. Her examination method consisted of a comparative analysis between the CCTV images from the ATM and exemplar images taken by the NSW Police. Her findings in the report dated 17 September 2005 were the following;

\textit{In conclusion, given the multiple numbers of matched features, which includes the most noticeable or recognisable features, distinguishing features or unique identifiers, habitual characteristics and racial traits, indicate the level of identification reached is ‘the same person’.} [Sutisno 2005, para 84]

Sutisno used the questioned and exemplar images to compare facial morphology for similarities or dissimilarities. This method is described in her report as ‘morphological analysis’ and consists of a series of qualitative assessments of certain listed facial features. The anatomical lists are arranged in headings such as; face,
supra-orbital region, cheekbones, nose, eyes, eyebrows, mouth, jaw, chin and others. Further sub-sections are then included within these headings. For example in the nose section, sub-sections include; nasion depression, nose length, nose breadth, bridge breadth and others. The results from each series of photographs are then compared.

The morphological analysis consists of taxonomic descriptors describing the attribute of each morphological feature being examined. Attributes are described in various forms or sizes and Sutisno’s descriptions appear to be similar to Allison’s (1976) ‘Portrait Parle’ descriptions described in his text. Taxonomic descriptions such as; small, medium, large, rounded, elliptical and average are used in the results of the analysis. These descriptions have no meaning without a standard or reference, particularly when describing size (small, medium or large) without some reference to scale. For example, what is represented by the description as ‘small’?

The ‘Portrait Parle’ or verbal portrait, was a concept developed by Alphonse Bertillon (1853-1914) in the nineteenth century [Bertillon 1896, Parry 2000]. Its purpose was for complex visual descriptions to be translated into a simplified language used by police to ‘describe’ a suspect [Alison 1976, Nickell 1994, Cole 2001]. Cole (2001) suggests these descriptions became a form of language that allowed visual identities to be coded and further transmitted through various communication forms including the telegraph. Bertillon’s method was used for descriptions of people from real subjects while Sutisno’s anatomical analysis is based on anatomy representations produced on photographs. Because of the lack of a size reference based on any empirical standard, the reliability of this form of examination is highly dependent on how the anatomical features are represented in the photographs. If the examination relies on using several different questioned and exemplar photographs, as in this case, then the comparison must be made from photographs that display similar anatomical representation, as indicated by Maat (1989).

The variations that may result from differing image perspectives can be seen in Figure 6.10. These images demonstrate differences in facial morphology when using different perspective. Examination of Figure 6.10 indicates that the nose in each
photograph can be described as large, medium or small, while the ear may also be described as large, medium or small. The size relationship between these anatomical features also differs. For example the sizes may be represented as; i) Photo A = larger nose, smaller ear or ii) Photo B = nose and ear are approximately the same size or iii) Photo C = smaller nose, larger ear. A critical question that arises when evaluating facial anatomical features from photographs is what are the differences between photographic representation and reality? As seen in Figure 6.10, size relationships may be represented differently in the same subjects using different perspective.

Maat (1989) suggests photo-superimposition methods used for identification require the matching of image geometric aspects of all photographs used in the examination. Comparative analysis methods such as morphological analysis described by Sutisno, must also consider this critical factor to ensure reliability of results. The affect of image perspective on facial morphology is tested using an empirical experiment and discussed in the next chapter. The following section attempts to explain basic image geometry concepts that relate to the current discussion.

Sutisno’s findings further suggest the examination findings were also determined by ‘…… distinguishing features of unique identifiers……’ [Sutisno 2005, para 84]. However, no unique identifiers as described by Porter and Doran (2000)42, Bromby (2003) or Yoshino (2004) are identified in Sutisno’s report. The resolution of the CCTV images were also found insufficient to record details such as moles, scars and wrinkles which would affect the level of reliability of the sourced material when used for the detection of distinctive or identifying features. Sutisno may be referring to the ‘unique’ aspects of her examination by the similarities of general morphology and/or the morphology of the ear. These features are similarities in morphology and are not considered as ‘distinguishing features’ or ‘unique identifiers’ as described in the previous literature [Porter & Doran 2000, Bromby 2003, Yoshino 2004, Edmond et al., 2009]. In Tang, Sutisno’s definition of unique identifiers is included in Spigelman CJ’s judgement and suggests [Spigelman CJ et al., 2006];

42 Porter and Doran refer to ‘unique identifiers’ as ‘individual characteristics’.
Unique Identifiers
These are features distinctive to an individual (the most recognisable features) such as deformities, blemishes, tattoos or habitual characteristics (for example, posture, limp or fidgeting) [Spigelman CJ et al., 2006, para 18].

The findings described in the Jung case do not appear to be consistent with the definitions described in Tang. The definition also considers habitual characteristics as unique identifiers. This is not supported in the literature and the notion would be difficult to sustain as an individualising quality of a person, not to mention the difficulties of detecting traits such as a ‘limp’ from still photographs or time lapsed CCTV recordings.

5.6 Basic Photographic Science Principles

This case study, and experiment in the proceeding chapter, relies on several basic photographic science principles and an explanation of these principles and definitions are necessary to explain the photographic concepts that underpin the identification evidence used in the Jung case. Table 5.1 provides some basic definitions necessary to understand certain aspects of this discussion. The optical properties of a simple lens are also be illustrated in the graphic representation found in Figure 5.2

Figure 5.2; diagram illustrating the lens conjugates whereas; u = ‘u’ distance, v = ‘v’ distance, f = lens focal length, o = object size and i = image size [adapted from Mitchell 1984].
**Optical Term** | **Definition**
--- | ---
Compound Lens | A lens design which consists of several lens elements that form optical principles specific to that combination of elements.
Nodal Points | The theoretical centre of a compound lens which may be described by two cardinal points; the front nodal point or rear nodal point. In general, the front nodal point is used to measure aspects of the lens which incorporates measurements made in the object space, while the rear nodal point is used for measurements involving the image space. The central axis of a compound lens is also described by its rear nodal point.
Focal Plane | The plane located where the light sensitive material (film or digital sensor) is positioned in the camera to record the image. Also known as film plane.
‘u’ Distance | The distance described between the subject and the front nodal point of the lens.
‘v’ Distance | The distance described between the lens rear nodal point and the film plane.
Focal Length | The theoretical distance between the lens rear nodal point and the film plane. Focal length describes the magnification ability of the lens.

Table 5.1: Photographic science and optical definitions.

The relationship between ‘u’ distance (u), ‘v’ distance (v) and lens focal length (f) may be expressed in the lens conjugate equation (below). Various derivations are also possible depending on the information required and lens design. This equation forms the basis for several concepts in photographic science.

\[
\frac{1}{u} + \frac{1}{v} = \frac{1}{f}
\]

Whereas; 
\[u = \text{‘u’ distance}\]
\[v = \text{‘v’ distance}\]
\[f = \text{focal length}\]

The production of a photograph involves capturing a three-dimensional scene or object with a camera and transforming it into a two-dimensional planar image. This transformation of spacial dimensions onto the photographic image is called
‘perspective’. Some confusion exists in terminology because the term perspective can also refer to other visual representations (e.g. aerial perspective, camera viewpoint or perspective). This research specifically deals with perspective that results from varying the object conjugate or ‘u’ distance and refers to this type of perspective as ‘image perspective’. Controlling aspects of image perspective in forensic photography is a critical function in several forensic applications. Jacobson et al., (2000) describe the relationship between focal length, object and image conjugates as;

By altering the lens to one of longer focal length, v is increased and the image enlarged; but it retains identical perspective. So a change of focal length for a given viewpoint does not alter perspective but only image size. By altering viewpoint by changing the object conjugate u, the perspective does change, the more obviously since a lens of large FOV (Field of View) may be used to include the same area of the subject from a closer viewpoint. [Jacobson et al., 2000, p58]

Jacobson et al., (2000) is arguing here that if the focal length is increased, this produces a longer ‘v’ distance and the result is an increase of image magnification. Furthermore, this increase of image size does not alter the image perspective. Jacobson et al., (2000) further suggest that perspective is changed by the ‘u’ distance only.

Understanding how image perspective is developed within the photographic image is a fundamental principle necessary for this type of forensic evidence. Maat (1989) refers to the critical nature of determining exact image perspectives for photo superimposition. This case study discusses these central aspects in its investigation of the reliability of forensic evidence gained by the comparative analysis of CCTV and exemplar photographs.

5.7 Magnification & Image Perspective

This research focuses on the reliability of evidence that has been established from CCTV images. Porter and Doran (2000) suggest that an essential aspect of facial identification evidence gained from photographs is the combination of two discrete forensic disciplines; namely forensic photography and forensic anatomy. This idea was put before Hall J and he explains;
It is clear that the analysis that has been undertaken by Dr Sutisno draws on material from two areas. The first is the area of photographic reproduction and related processes. The second is the area of forensic anatomy. [Hall J, 2006a, para 35]

Justice Hall also commented on Sutisno’s level of expertise regarding forensic photography, suggesting that;

Although she [Sutisno] has some skills in the use of photographic material, the evidence establishes that she has comparatively limited expertise in the field [referring to photography] …….. [Hall J. 2006a para 36].

Without the consideration of photographic science fundamentals during the forensic analysis of CCTV and exemplar photographs, identification from photographic comparison may produce significant errors, especially when using qualitative morphological comparison methods. As indicated in the early chapter on visual culture, photographs are not always simplistic representations of objects. Due to aspects of optical and image geometry, representation of facial morphology may differ in separate photographs because of image perspective. Sutisno refers to image perspective in her report and suggests her examination considered these issues. Sutisno reports;

To overcome issues of perspective and distance from the camera, the analysed digital images of similar perspectives were cropped and scaled to the same magnification using Adobe Photoshop 6.0 software on [a] PC desktop computer. Adjustments of brightness and contrast were made where necessary. [Sutisno 2005, para 17]

Sutisno’s (2005) reference to ‘similar perspectives’, refers to similar camera angles and not image perspective. She suggests that adjustments to the image magnification using image editing software such as Adobe Photoshop, may overcome any issues or variation caused by image perspective or ‘u’ distance (distance from the camera). This section examines aspects of magnification and discusses whether issues associated with image perspective as described by Maat (1989) can be corrected by increasing the image magnification as reported by Sutisno (2005). A detailed examination of this claim, will enhance the understanding of the reliability of the forensic evidence presented during this case.
5.7.1 Defining Image Perspective

Image perspective is principally the resulting visual effect when three-dimensional subjects are converted into two-dimensional planar photographs. The concept of the third dimension or visual space is represented by variations of object size. Image perspective may also be described by the ‘size relationship’ between objects appearing closer to the camera lens with those at a greater distance. This diminishment of object size creates the illusion of perspective (or z-axis). Furthermore, the size relationships from the same objects can become significantly different with images displaying different ‘image perspective’ (see Figure 1.4b).

Figure 5.3 provides an illustration of different image perspectives. In each photograph, the headstone situated in the foreground is approximately the same image size (some slight variation is observed). Photo A displays a deep perspective, which is characterised by the exaggerated space between the foreground object and the church in the background. The size differences between the headstone and the church are not realistic with the headstone appearing to be significantly larger in comparison with the size of the church. Photo D demonstrates the other extreme of image perspective. In this photograph, the size relationship between the headstone and the church building is more realistic, however, the space between these two objects is significantly decreased. Image perspective and its control, is a critical component of forensic photography practice as described in Chapter 4.

5.7.2 Defining Image Magnification

Magnification is expressed in photography as the size ratio between the actual size of the object to the size of the image captured in camera. Magnification can also be an expression of the print magnification, which is the ratio between the physical size of the image negative with the physical size of the print. Therefore, magnification can be a camera recording function at the image capture stage or the enlargement or reproduction ratio of the final print. Magnification may be expressed as a ratio, percentage, fraction or a factor and is calculated using the following formula;
Figure 5.3: Different image perspective is evident in each of these photographs. The size relationship between the foreground object (headstone) and the background (church) changes in each photograph. The apparent distance between these two objects also changes with each perspective.
Equation 5.2;  \[ m = \frac{i}{o} \text{ or } \frac{v}{u} \]

Whereas; \( m \) = magnification  
\( i \) = image size  
\( o \) = object size  
\( v \) = \text{‘}v\text{’} distance  
\( u \) = \text{‘}u\text{’} distance

Equation 5.2 demonstrates that magnification is the relationship between the physical size of the image and object or lens conjugates ‘\( u\)’ and ‘\( v\)’ distances (see Fig 5.2). Magnification may be altered by three different methods;

- Increasing or decreasing the focal length of the lens.
- Moving the camera closer or further away from the subject (changing the ‘\( u\)’ distance).
- Increasing or decreasing the reproduction ratio of the print or image physical size.

5.7.3 Changing Lens Focal Length

The focal length of a compound lens is described as the distance between the theoretical centre of the lens (or rear nodal point) to the focal plane when the lens is focussed at infinity [Zakia & Strobel 1993, Ray 1994]. The image size formed on a camera’s focal plane is directly influenced by lens focal length [Zakia & Strobel 1993, Salvaggio et al., 2009]. This means an increase in lens focal length will result in an increase of image size. Conversely, a decrease in lens focal length will result in a reduction of image size. Therefore, image size or magnification may be altered by the focal length of the lens when capturing the image in camera.

When lens focal length is altered on the camera, a change in image size or magnification occurs. This effect is evident when using a zoom lens and the lens is zoomed in and out (changing the focal length) causing the image size to increase or decrease. While focal length changes image magnification (size), it does not change image perspective as indicated by Jacobson et al., (2000). This suggests the size
representation and relationship between foreground and background objects depicted in the photograph do not alter. This is an important fact when considering the reliability of the forensic evidence in this case.

Image perspective is altered when a change of ‘u’ distance or camera distance is applied during image capture. When ‘u’ distance is decreased, image perspective is enhanced (deepened)\(^{43}\) and conversely it is diminished (flattened)\(^{44}\) when a greater camera distance is applied. While focal length has no affect on changing image perspective, it does have an indirect influence by controlling the camera distance due to the image magnification caused by the focal length. This concept is well established in general and forensic photography; however it is frequently not well understood by other forensic practitioners outside the forensic photography domain.

5.7.4 Altering ‘u’ Distance

As previously mentioned, magnification can be determined either during the photography of a subject and/or as an aspect of print reproduction. Logically, moving the camera closer to the subject will increase the image magnification, while moving the camera further away will diminish image magnification. Photographing objects at set magnifications is a common consideration when performing photographic tasks such as photomacrography (photography of small objects using specialised techniques).

Image perspective is controlled exclusively by changing the camera’s ‘u’ distance. The lens equation however, indicates there is a relationship between focal length, ‘v’ and ‘u’ distances (see equation 5.1). This relationship also affects magnification when applying photographic practices and in particular when photographing to set image magnifications. Table 5.3 illustrates this relationship when predetermined image magnifications are established. The ‘u’ and ‘v’ distance values in the table were calculated using the following two equations.

\(^{43}\) See Figure 5.3, Photo A
\(^{44}\) See Figure 5.3, Photo D
Table 5.2 maintains a constant focal length and demonstrates a relationship between magnification with ‘u’ and ‘v’ distances. When different magnifications are chosen, a change in image perspective also occurs due to the ‘u’ distance value changing. In this instance, magnification has an indirect affect on image perspective. As the magnification value increases, there is a decrease in camera distance (also see Fig 5.4).

<table>
<thead>
<tr>
<th>Magnification</th>
<th>X0.25</th>
<th>X0.50</th>
<th>X0.75</th>
<th>X1</th>
<th>X2</th>
<th>X4</th>
<th>X8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lens Focal Length</td>
<td>100mm</td>
<td>100mm</td>
<td>100mm</td>
<td>100mm</td>
<td>100mm</td>
<td>100mm</td>
<td>100mm</td>
</tr>
<tr>
<td>‘v’ Distance</td>
<td>125mm</td>
<td>150mm</td>
<td>175mm</td>
<td>200mm</td>
<td>300mm</td>
<td>500mm</td>
<td>900mm</td>
</tr>
<tr>
<td>‘u’ Distance</td>
<td>500mm</td>
<td>300mm</td>
<td>233mm</td>
<td>200mm</td>
<td>150mm</td>
<td>125mm</td>
<td>112.5mm</td>
</tr>
</tbody>
</table>

*Table 5.2: Calculation of camera ‘u’ distances required for specific image magnification. The ‘v’ distances are also shown to demonstrate the relationship between these two lens conjugates, while the focal length remains constant.*

Figure 5.4 is a plot determined from the results of Table 5.2 and illustrates the change in ‘u’ distance when different image magnification factors are used to capture the image. The smaller the magnification the longer the ‘u’ distance, while larger magnification factors have a shorter ‘u’ distance and deeper image perspective. Blaker (1989) suggests that as magnification is increased the ‘u’ distance\(^{45}\) becomes closer to the focal length value but will never theoretically reach this value. This concept is demonstrated in Figure 5.4 (below) with the lens focal length positioned on the x-axis. Hence, shorter focal length lenses are able to achieve shorter practical

\(^{45}\) Blaker (1989) refers to ‘u’ distance as ‘working distance’.
working distances (‘u’ distances) for equivalent image magnification and therefore influencing image perspective. However, as previously discussed, focal length is not an independent variable of image perspective.

![Image Magnification & 'u' Distance](image)

**Figure 5.4: The relationship between ‘u’ distance and image magnification. Results based on calculation using equation 5.3.**

5.7.5 Reproduction Size of Print or Image

Magnification of prints or images may be conducted using various methods. Traditional silver halide photography requires a print to be made from the film negative (or positive) and photographic enlargers can facilitate print magnification during the printing of the photographs. Digital imaging software may also enlarge or reduce the size of the image on the monitor and with the production of hardcopy prints using a digital printer.

Changing print or digital image magnification involves the overall enlargement or reduction of the image. Magnification is achieved uniformly across the whole image and no change in image perspective occurs. This type of change in magnification has no relationship with the camera’s ‘u’ distance at the time of capture, unlike the influence of magnification at the image capture stage. Print magnification maintains the size relationships between the foreground and distant objects. This means they remain in the same proportion and therefore no change in image perspective occurs.
Mitchell (1984) suggests that increasing the print size in the darkroom is the same as using a longer focal length lens on the camera [Mitchell 1984].

5.7.6 Critical Issues

The assumption made by Sutisno suggesting ‘issues of perspective and camera distance’ [Sutisno 2005, para 17] may be corrected by changing the image magnification using post-photography editing software is not consistent with photographic science theory. The change of print/image magnification changes the overall size in all aspects of the image and does not alter the inherent size relationships between different objects (image perspective). The table below illustrates the three methods of changing image magnification and indicates whether those methods are capable of changing image perspective. Image perspective may only be altered at the image capture and by changing the camera’s ‘u’ distance. Changes in focal length (without changing distance) or print/image magnification do not change image perspective.

<table>
<thead>
<tr>
<th>Method of Changing Magnification</th>
<th>Change of Image Perspective?</th>
</tr>
</thead>
<tbody>
<tr>
<td>In camera; change of focal length only (not distance)</td>
<td>NO</td>
</tr>
<tr>
<td>In camera; change ‘u’ distance</td>
<td>YES</td>
</tr>
<tr>
<td>Change print/image physical size</td>
<td>NO</td>
</tr>
</tbody>
</table>

*Table 5.3: Three methods of altering image magnification and their influence on changing image perspective.*

Photo editing software such as Adobe Photoshop does however have the capacity to correct for rectilinear perspective and lens curvilinear distortion [Evening 2007, Reis 2007]. These functions are limited in their application and require either the calibration of characteristics of the lens distortion aberration or distinct references such as parallel vertical or horizontal lines for correction. The correction of general image perspective, and particularly faces of people depicted with CCTV cameras, is beyond the scope of these digital editing applications.
Sutisno’s assumptions in this case, are primarily based on changing the image magnification to provide equivalent image sizes across all images used in the comparative analysis. This is a valuable attribute for comparative analysis methods to gain like-for-like specimens used during the analysis. However, a change in print/image magnification does not modify the image perspective nor control camera distance. This misunderstanding significantly affects the reliability of the forensic evidence used in the Jung case.

5.8 Determining Skin Tone from the CCTV and Exemplar Images

Another aspect of reliability with respect to the CCTV evidence presented in this case is the determination and comparison of the person of interest’s ‘skin tone’. Sutisno’s (2005) morphological comparison includes the characterisation of skin tone between the questioned and exemplar photographs. Sutisno’s report qualitatively determines the nature of the skin tone in four separate examinations, using different groupings of images from various camera viewpoints. The skin tone in each questioned CCTV image and each exemplar image was said to have matched and were described on each occasion as a ‘light tone’ [Sutisno 2005, pp14, 18, 20, 26].

It is well recognised within the forensic and general photography disciplines, that the correct rendering of skin tones is a difficult task for photographic and digital imaging processes. The accurate photographic rendering of skin tones is fraught with a number of reproduction and spectral variables [Jacobson et al., 2000]. Even under the strictest of laboratory and technical controls, the accurate reproduction of skin tones is difficult. In addition to the technical difficulties, a qualitative evaluation of skin tones is also highly subjective. Some variables that affect the rendition of skin tones in photographic prints and digital images include;

- The spectral distribution and colour temperature of the light source used to illuminate the subject.
- The spectral sensitivity of the capture mechanism (film or digital sensor).
- The film/camera white balance calibration or colour correction filters.
- Colour contamination of subject from objects within the scene (e.g. light reflecting from a coloured wall).
• Camera exposure (particularly in images suffering from under or over exposure).
• Lighting quality.
• Contrast.
• Colour and density variations in printing.
• Chemical processing variables in film and print processing.
• Computer colour management and monitor calibration.
• Imaging system dynamic range or colour gamut.
• Camera filtration.
• Digital imaging editing (Photoshop).
• Digital imaging colour space (i.e. Adobe RGB).
• The visual acuity of the examiner and viewing conditions.

The experimental photograph in Figure 5.5 provides examples of various skin tone results that may be achieved from a single image when reproduced as a photograph. This photograph was modified slightly to demonstrate the visual results achieved from a single source. Table 5.4 provides details of the variations illustrated in the photograph.

<table>
<thead>
<tr>
<th>Column</th>
<th>Type</th>
<th>Image Variant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Column (far left)</td>
<td>Colour</td>
<td>Colour variations</td>
</tr>
<tr>
<td>2nd Column</td>
<td>Colour</td>
<td>Print density variations (in 1 stop exposure increments)</td>
</tr>
<tr>
<td>3rd Column</td>
<td>Monochrome</td>
<td>Print density variations (in 1 stop exposure increments)</td>
</tr>
<tr>
<td>4th Column (far right)</td>
<td>Monochrome</td>
<td>Print density variation (same as 3rd column) plus image noise</td>
</tr>
</tbody>
</table>

*Table 5.4: Variations applied to single experiment photograph depicting variations of reproduced skin tones (see Figure 5.5).*

The image positioned in the second column and centre row (indicated with a blue border) is the standard image, meaning it is the image that represents indicated exposure and colour balance. Photography was conducted using electronic studio flash with softbox reflectors. Camera exposure was determined using a handheld light meter for accurate determination of camera exposure.
The first column of images shows variations from the standard in colour only and demonstrate the effect colour casts have on skin tone interpretation. The print colour casts may be seen in the neutral grey background (compare with standard image). Colour casts displayed in photographs alter the appearance of the subject’s complexion.

The second, third and fourth columns are variations of print density or exposure. The adjustments applied to each photograph are indicated on the right and represent:

- ‘N’ = indicated exposure.
- ‘N+1’ = indicated exposure plus 1 stop.
- ‘N+2’ = indicated exposure plus 2 stops.
- ‘N-1’ = indicated exposure minus 1 stop.
- ‘N-2’ = indicated exposure minus 2 stops.

The exposure variations in columns two to four clearly demonstrate that the determination of skin tone from photographs is fraught with problems and can be easily misinterpreted. Comparing the monochromatic images in column three, the description of skin tone may be described as fair, medium or dark complexion depending upon the photograph selected. Another important consideration with this type of subjective evaluation is the bias of interpreting the racial aspects of the subject and using the racial reference to interpret skin tone. Bias becomes a natural aspect of the interpretation due to the mechanisms of visual literacy and visual culture. That is, we rely on other external experiences when reading meaning from photographs. This bias is contrary to the notion of an objective scientific analysis as purported in the morphological analysis in this case study. The introduction of image noise and a reduction of image resolution in column four produces the same level of ambiguity as the previous columns.

The experimental images in Figure 5.5 provide evidence that the determination of skin tone from photographs is problematic and its reliability questionable. The level of ambiguity is further increased when analysing photographs that display image quality problems, and in particular, images suffering from poor exposure and lighting (like the CCTV images in this case). Issues of reliability become a problem when
forensic practitioners outside the forensic photography discipline do not consider or understand the technical limitations of the medium. Photographic reproductions do not always replicate the real as previously discussed in the visual culture chapter. The importance of combining forensic photography and forensic anatomy disciplines, as indicated by Porter and Doran (2000) and repeated by Hall J, is highlighted in this component of the case study. Determination of skin tone from CCTV and other photographic mediums should be considered with great caution and its reliability questionable.

An examination of the CCTV and exemplar images used in this case study (Figure 5.6) further support this notion of unreliability. Firstly, the questioned images sourced from the CCTV are monochromatic and not colour. Even though colour reproductions offer no more reliability as previously indicated in Figure 5.5, monochromatic representations are a distortion of reality. Monochromatic images reproduce skin tone as various shades of grey and this representation is dependent on aspects associated with exposure, lighting and subjective evaluations by the print maker or digital imaging editor.

The second aspect to directly observe from Figure 5.6 is the variation of skin tone depicted in the reproduction of images used in the Jung case. To suggest these three photographs ‘match’ in skin tone is an alarming statement to make and especially when the reproduction of skin tones is so visibly different in each reproduction. Comparing monochrome with colour images further adds to the questionability of this form of forensic evaluation.

To provide some objective insight into the variations seen in Figure 5.6, they were measured using Adobe Photoshop RGB pixel brightness values as a method of objectively comparing their inherent colour brightness or pixel values. RGB values are not absolute spectrophotometric measurements; they are values of brightness that are represented in a RGB digital image. In an 8-bit (2^8) RGB digital image, there are 256 different tone values per channel [Fraser et al., 2005, Robinson 2007]. An 8-bit per channel digital image is considered the minimum requirement for producing a

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46 Red, Green and Blue
Figure 5.5: Experimental photograph illustrating skin tone variation from a single image.
Figure 5.6: Photographs used in the comparative analysis facial identification. All images have been cropped to similar magnifications. Photo A: Questioned ATM CCTV image of person of interest, February 1997 (approximate 'u' distance = 0.4-0.8m) Photo B: Exemplar photograph taken by NSW Police, April 2005 (approximate 'u' distance = 3-4m) Photo C: Exemplar photograph taken by NSW Police, November 2004 ('u' distance unknown)
continuous tone reproduction. The combination of the RGB channels provides the synthesis of a full colour image and has 16,777,216 theoretical possibilities of colour tone [Fraser et al., 2005]. This colour reproduction possibility is calculated by multiply the potential value in each channel (e.g. 256x256x256).

The RGB values were measured from each image depicted in Figure 5.6 using Adobe Photoshop CS3 with a calibrated monitor. Each measurement was taken from a small spot on the pogonion region of the face (chin area). Table 5.5 provides the results of this examination with the mean values for each RGB channel and the mean total RGB value. The total RGB was calculated by multiplying the RGB values in each result.

<table>
<thead>
<tr>
<th>Image</th>
<th>Image Source</th>
<th>n</th>
<th>( \bar{X} ) (RGB Brightness Values)</th>
<th>SD</th>
<th>( \bar{X} ) (RGB Brightness Values)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo A</td>
<td>CCTV</td>
<td>31</td>
<td>R = 65</td>
<td>2.64</td>
<td>G = 65</td>
<td>2.64</td>
</tr>
<tr>
<td>Photo B</td>
<td>Exemplar (April 2005)</td>
<td>31</td>
<td>R = 242</td>
<td>4.18</td>
<td>G = 194</td>
<td>5.93</td>
</tr>
<tr>
<td>Photo C</td>
<td>Exemplar (November 2004)</td>
<td>31</td>
<td>R = 170</td>
<td>8.99</td>
<td>G = 105</td>
<td>6.65</td>
</tr>
</tbody>
</table>

Table 5.5: RGB values measured from the pogonion region of the face. The RGB brightness values were measured using Adobe Photoshop CS3. (see Figure 5.6).

The maximum RGB value is 256 per channel which represents the brightest value and the minimum is 0 (zero) which represent no tone. The total RGB value is an arbitrary measure used for a comparison of image values only. The maximum total RGB value is \( \approx 16.8 \) million. Graphs in Figures 5.7 and 5.8 provide a comparison of the measured RGB values from Photo A, B and C (Fig 5.6).

The results from the RGB value comparison do not support the notion that the skin tones depicted in each image (Fig 5.6) are the same, as represented in the photographs. Each photograph displays significant differences in each RGB channel and the total RGB values are also significantly different. These differences are to be
expected when using photographic media for the evaluation of skin tone and colour. Even though this method of evaluation was used as a component of the morphological analysis in the Jung case, evaluation from photographic sources cannot reliably support this type of analysis. The degree of unreliability can be seen when examining the results from the two exemplar photographs (Photo B and C). Even though the photographs depict the same known person, the RGB values are significantly different.

![Mean RGB Value Comparison](image1)

**Figure 5.7:** RGB values measured from the pogonion region of the face. The RGB values were measured using Adobe Photoshop CS3. From Figure 5.6 (n=31, standard error shown)

![Mean Total RGB Values](image2)

**Figure 5.8:** Total RGB values measured from the pogonion region of the face. The RGB values were measured using Adobe Photoshop CS3. from Figure 5.6
There is a counter argument to these findings that is often expressed when forensic anatomists are challenged on the validity of their qualitative morphological analysis methods. They claim they can see anatomical aspects depicted in photographs better than people without anatomical training. This chapter has shown from visual and objective positions, that the photographic representation of skin tone can produce significant levels of ambiguity and unreliability with or without training in anatomy.

As previously suggested, questioned and exemplar images should display similar properties that promote like-for-like comparative analysis methods. This requirement is very difficult to satisfy in the context of skin tone evaluation and consistent results are unachievable. This is especially true for poor quality images sourced from other means like CCTV. The three images used in Figure 5.6 were all sourced from different cameras, different media types (film and digital), monochrome and colour, and using different light sources and colour temperatures. Light sources used in images displayed in Figure 5.6 include;

- Photo A, CCTV image = reflected daylight.
- Photo B, Exemplar photograph (April 2005) = electronic flash
- Photo C, Exemplar photograph (November 2004) = incandescent or fluorescent lighting (room lighting – not confirmed).

These light sources are so significantly different and achieving comparable images for skin tone evaluation would be technically unlikely. Qualitative evaluation of skin tone from photographic sources, including CCTV, cannot be considered as a reliable scientific analytical method. Other qualitative evaluations of tone and colour are also evident in Sutisno’s morphological analysis and include; head hair colour and tone, eyebrow tone and iris (eye) tone [Sutisno 2005]. The same issues apply with these comparison topics.

Furthermore, there is no mention in Sutisno’s report to indicate that any photographic standard or references were used to ensure colour and tonal rendition of the images used in the comparison (i.e. inclusion of colour test standards). These inclusion are often not controllable from the sourced CCTV images, however references may be included in the exemplar material if required. Calibration of computer monitors were
also not mentioned in the report and this requirement is a basic to digital photography colour management and management of forensic imaging work stations, especially when colour and tonal aspects of the image are qualitatively evaluated.

5.8 Examination of the CCTV Crime Scene

A forensic examination of the secondary crime scene (ATM site) was conducted at Surfers Paradise in Queensland. The purpose of this examination was to establish the ‘u’ distances that were used in the questioned CCTV images. ‘u’ distances from the sourced questioned CCTV images were sought to evaluate the degree of similarity of image perspective between the questioned and exemplar photographs used in the comparative analysis. Aspects of reliability will depend on whether the image perspective in each image (questioned and exemplars) are similar. This is especially important when using a qualitative morphological comparison as is the situation in this case.

5.9.1 Reconstruction of CCTV Images

To enable the determination of ‘u’ distances used in the CCTV images, the images were used to ‘reconstruct’ the scene using critical landmarks visible in the images. This examination was not a photogrammetric examination, which would have also been a useful technique. Figure 5.11 is a CCTV image without any people in the scene. It was sourced directly from the supplied CCTV footage used in the Jung case. Despite the poor resolution and curvilinear distortion displayed in the image, distinctive landmark features are apparent in the image.

The crime scene examination took place in 2006, approximately nine years after the CCTV images were captured. It was reported that some landscaping of the streetscape had occurred in the intervening period and a coffee shop was built within the main structure of the Westpac building. The Westpac bank was still occupying the site and one ATM was moved to the Eastern side of the building (in 1997 the ATM’s were positioned next to each other). A crime scene sketch was made and measurements of the landmarks were recorded. Table 5.6 details the landmark measurements and Figures 5.9 and 5.10 are the crime scene sketches.
Figure 5.12 are photographs taken during the crime scene examination in 2006. The distinctive landmark features seen in the CCTV images taken in 1997 are also visible in these crime scene recording photographs.

<table>
<thead>
<tr>
<th>Identified Landmarks in Photographs</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM to concrete pier</td>
<td>1.54m</td>
</tr>
<tr>
<td>Concrete pier to kerb</td>
<td>≈ 8.0m</td>
</tr>
<tr>
<td>Wall near office doors to concrete pier</td>
<td>2.8m</td>
</tr>
<tr>
<td>ATM to metal grill on footpath</td>
<td>3.0m</td>
</tr>
<tr>
<td>Height of bulkhead (opp ATM)</td>
<td>2.6m</td>
</tr>
<tr>
<td>Width between concrete piers (opp ATM)</td>
<td>3.13m</td>
</tr>
<tr>
<td>Pier dimensions</td>
<td>450x450mm</td>
</tr>
<tr>
<td>Dimensions of pavers (under veranda)</td>
<td>400x400 mm</td>
</tr>
</tbody>
</table>

*Table 5.6: Measured distances and dimensions from identifiable landmarks at the ATM crime scene*

*Figure 5.9: Detailed sketch of ATM site at Cavill Road, Surfers Paradise, Queensland.*
## 5.9.2 Determining CCTV ‘u’ Distances

To determine ‘u’ distance estimations, a series of photoboards were constructed from the ATM CCTV footage (see Figs 5.13a and 5.13b). Several images were categorised based on the position of the person of interest. Each photoboard comprised of images where the person of interest was positioned at approximately the same distance from the ATM. Visible landmarks (piers, pavers etc) were used to indicate locations within the image. Interpretation of the CCTV images suggested the camera was located within the ATM machine itself. This was not confirmed, however it is a common location for this type of security camera and the images indicate the camera’s viewpoint was located within the ATM. The photoboards were used to assist in determining the location of the person of interest during the examination of the crime scene. Table 5.7 provides estimated ‘u’ distance ranges for each photoboard.
Figure 5.11: The ATM CCTV image displaying the visible landmarks at the scene.
Figure 5.12: Photographs of the ATM location in Surfers Paradise. Landmarks seen on the ATM CCTV images are seen at the location.
Figures 5.13a and 5.13b: 5.13a (overleaf) Photoboards ‘A’ to ‘D’ used in the reconstruction examination. 5.13b Photoboards ‘E’ to ‘G’. Pixelation artefact added to images.
<table>
<thead>
<tr>
<th>Photoboard</th>
<th>Distance Range</th>
<th>Median</th>
<th>Max Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photoboard A</td>
<td>≈ 1.4 to 1.7 m</td>
<td>1.55 m</td>
<td>1.7 m</td>
</tr>
<tr>
<td>Photoboard B</td>
<td>≈ 3.0 to 3.5 m</td>
<td>3.25 m</td>
<td>3.5 m</td>
</tr>
<tr>
<td>Photoboard C</td>
<td>≈ 0.5 to 1.1 m</td>
<td>0.8 m</td>
<td>1.1 m</td>
</tr>
<tr>
<td>Photoboard D</td>
<td>≈ 0.4 to 0.8 m</td>
<td>0.6 m</td>
<td>0.8 m</td>
</tr>
<tr>
<td>Photoboard E</td>
<td>≈ 0.4 to 0.8 m</td>
<td>0.6 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>Photoboard F</td>
<td>≈ 0.3 to 0.6 m</td>
<td>0.45 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>Photoboard G</td>
<td>≈ 0.6 to 1.5 m</td>
<td>1.05 m</td>
<td>1.5 m</td>
</tr>
</tbody>
</table>

Table 5.7: Estimated ‘u’ distances using the photoboard references. Refer to Figures 5.13a and 5.13b.

5.9.3 CCTV and Exemplar Image ‘u’ Distances

An examination of the CCTV ‘u’ distance range revealed that there are discrepancies between the questioned CCTV images and the exemplar images taken for comparative analysis. The median ‘u’ distance range for the CCTV images used in the morphological comparison was estimated to be between 400 mm and 1,100 mm. The range given by the crime scene officer for the exemplar photographs taken on 11 April 2005 was between 3,000 mm and 4,000 mm. This difference could produce considerable variation in image perspective and the representation of facial morphology. The ‘u’ distance for the exemplar material taken on 08 November 2004 was not determined or provided by the NSW Police. This distance remains unknown.

The next chapter investigates possible variations of facial morphology caused by differing image perspectives. Experimental work will further determine whether matching exemplar image perspective with the questioned photographs is a critical issue when conducting morphological comparisons illustrated in this case. Image perspective considerations could be an important consideration when determining the reliability of the exemplar material.

5.10 Chapter Discussion

This case study has highlighted several serious problems associated with the reliability of forensic evidence gained from the examination of CCTV images. The
predominant issues arise from the misuse of photographic material, or more specifically, the misunderstanding of photographic science principles associated with forensic photography. These misunderstandings are highlighted by assumptions that suggest skin tonality may be analysed qualitatively from images and image perspective may be corrected by an increase of magnification using Photoshop™.

The reliability of morphological analysis is also conditional on aspects associated with how morphology is represented in the photographs. Concepts of image perspective were not appropriately considered during the Crown’s evidence in the Jung case. The reliability of the morphological analysis is compromised due to differences in perspective and representation of morphology in the images when used in comparative analysis. These perspective differences are further examined in the following chapter.

The reliability of CCTV and exemplar images used as forensic evidence may be considered from five positions;

- Images and evidence must be admissible to a court of law. They must be lawful, relevant and not unfairly prejudicial.
- Images must comprise of the necessary information required for the forensic examination including technical and photographic science attributes (resolution, image perspective, scale etc).
- Image authentication and provenance must be established.
- The information and forensic evidence pertaining to the images must be accurate and based on reality.
- Details regarding the methodology used during the examination and photographic considerations of the evidence should be fully disclosed in reports proffered by the forensic experts.

Based on the criteria above, the Crown’s evidence in Jung did not effectively fulfil almost every criterion (image authentication is the only exception). This situation primarily developed because the Crown was unable to utilise a forensic photography specialist as a component of the forensic examination and in the preparation of the exemplar material.
The exemplar material used in the anatomical analysis presented several problems of reliability. The admissibility of the exemplar photographs taken on 08 November 2004 was challenged in *voir dire* by the defence based on application of the *Crimes (Forensic Procedures) Act 2000*. The Act requires the forensic procedures to be carried out by an appropriately qualified forensic practitioner suitable for the procedure. While the judge allowed the evidence using his discretion, the employment of a forensic photography specialist would have made the exemplar images comply with this aspect of the Act and may have prevented any challenge in court. If Hall J did not allow the exemplar evidence the entire forensic identification evidence would have been significantly affected by this decision. Considering the fact that there was little further evidence, this lack of procedure may have resulted in the case dismissal.

These exemplar photographs were also problematic due to their poor technical quality and unsuitability for comparative analysis. Both series of exemplar images (08 November 2004 and 11 April 2005) did not consider image perspective during the forensic procedures and this is a significant factor impinging on the reliability of the morphological analysis results. The deficiencies of forensic photography stem from the collection of exemplar material and further extend through to the forensic examination.

Furthermore, details regarding the application of the CCTV and exemplar images were not appropriately included in the supporting forensic reports. The application of images is a considerable component of the identification evidence presented by the Crown in this case. Detail describing how the images were captured, digitally modified and used throughout the comparative analysis is an essential requirement as in other forms of forensic examination. However, the treatment of the photographic content was not a consideration in the forensic reports. This raises the question of why do forensic practitioners often trivialise the provision of the forensic photography components of an examination and exclude these details in the reports.

This case provides a good example of this situation. The entire morphological analysis was conducted directly from photographs. The photographs, both CCTV and exemplar images, underwent certain processes for the purpose of the examination. To
test the reliability and accuracy of the morphological analysis, an examination of the photographic content is an obvious and considered area to investigate. Considering the photographs formed a critical component of the forensic examination method, the exclusion of detail in the reporting is inappropriate.

The requirement for reporting the application and treatment of forensic images used during a forensic examination is necessary for a variety of reasons. Firstly, under the *Makita* directive, forensic reports must include details of the forensic examination methods. If the examination involves the treatment, application and reliance of images, like the morphological analysis in this case, then full disclosure of how the images were used is essential.

Secondly, it is standard professional practice within the forensic sciences to document details of the forensic examination using contemporaneous notes. Contemporaneous notes record details of the examination and are an essential element in forensic science. If the procedures and applications cannot be tested or reviewed by the opposing side, then the evidence fails fundamental concepts associated with the adversarial legal system.

The inclusion of details regarding digital photography and any digital editing or image modifications are a basic requirement within forensic photography practices. Digital photography has the facility to record details of the camera settings used during the time of capture and store this information as metadata within the digital file. Information such as lens focal length (even with zoom lenses), exposure modes, aperture and shutter speed selection, white balance and film speed are basic inclusions with modern digital cameras (even inexpensive models). Image editing software such as Adobe Photoshop™ also has the capacity to log imaging editing procedures. This ‘history log’ may be attached to the contemporaneous notes as a hardcopy text file or embedded into the image as metadata, or both [Reis 2007, Evening 2007].

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47 *Makita* (Australia) Pty Ltd v- Sprowles [2001] 52 NSWLR 705
The reliability of the forensic evidence produced from CCTV images in *Jung* would have been enhanced if suitably qualified forensic photographers were employed during the preparation of the exemplar material and during the forensic examination.

When the identification evidence and its methodologies were challenged in the *voir dire*, his Honour’s decision to allow the evidence based on the fact the defence had expert witnesses, shifted the onus of validating the novel identification methods used by the Crown onto the defence experts. The inability to prove the reliability of the morphological analysis techniques used by the Crown’s expert does not automatically make this evidence inadmissible. However, the onus of establishing its reliability or validation must bear upon the party presenting the evidence or novel method, which in this instance was the Crown’s witness. Placing the responsibility of disproving the scientific reliability of the evidence methodology onto the defence, gives the Crown’s expert a type of immunity from validating their scientific methods used for determining the forensic evidence. This is a misguided and abusive application of the adversarial system.
Chapter 6

6.0 Experiment: Image Perspective and Facial Morphology

……. it’s well established that human memory features imagery to a very very large extent. At least 80% if not more of our memories of the past come to mind in the form of visual images. Indeed if you suffer brain damage such that you can no longer generate visual images, no damage to memory, just no longer generate visual images, you will become amnesic as a consequence…..

Martin Conway [Conway 2006]

During the examination of material used in Jung, it was found that photographs taken from different ‘u’ distances were used in components of the comparative analysis of facial morphology between the questioned and exemplar images. An experiment was designed to test whether discrepancies could occur in facial morphology when comparing photographs displaying different image perspective caused by differing ‘u’ distances. The function of this chapter is to examine those affects and attempt to quantify any discrepancies. The results will be further used to determine aspects of reliability when identifications are determined from CCTV images and to highlight
the importance of applying forensic photography principles when preparing exemplar material for forensic examination.

6.1 Experimental Design

The experimental design consisted of a controlled experiment using a polystyrene hair stylists model of a human head with known anatomical landmarks identified on the model using black pins. The model was photographed at different ‘u’ distances to produce photographs with differing image perspective. Facial features modelled from plasticine that represented different size facial morphology were added to the model. A series of photographs were taken of different facial features at various ‘u’ distances. Each photograph was printed using a laser printer and enlarged at approximately the same magnification using the linear scales incorporated into the photographs as a reference of size.

Physical anthropometric measurements were made directly from the model and modelled facial features as a reference standard of known values. The same photoanthropometric measurements were made directly from the photographs displaying the anatomical features. Several indices between two anatomical landmarks were calculated and these were employed in the analysis phase of the experiment. Indices were used to avoid any difficulties caused by magnification variance in the photographs and because the photographs were not 1:1 magnification or life size (as proposed by Halberstein 2001). A comparison between the indices made from the photographs was conducted to answer the following two questions;

- Does significant variance occur in facial morphology when using different image perspective?
- Is there an equilibrium point where changes in image perspective no longer alters facial morphology?

The indices calculated directly from the model were used as an experimental control and reference standard. The first question arises directly from the Jung case study when the Crown’s expert exclusively used facial morphology as a method of identification by using questioned and exemplar photographs of different image
perspectives. Testing these questions provide an evaluation of the reliability of the forensic evidence presented in the case.

The second question stems from an idea that fashion photographers control the mechanisms of image perspective in their photographs to deliberately maintain or heighten a sense of beauty. The concept of beauty has many definitions, however a primary notion is the prominence of ‘anatomical proportion’. Proportion as a construct of beauty suggests a person who projects a sense of beauty, possesses certain features in a proportion that is based on aesthetic notions [Atalay 2004, Field 2005].

When fashion photographers photograph beautiful models for fashion and beauty magazines, the concept of beauty is a critical visual element. Since the models already possess an inherent quality of beauty based on aesthetic qualities of proportion, the photographer’s task is to maintain and highlight this in the photographs. The fundamental goal, therefore, is for the photographic representation of the face to maintain the natural and realistic proportions of facial features. Fashion photographers use greater ‘u’ distances or a flatter image perspective as a tool to maintain the proportions of facial features and enhance the elements of beauty. Retail based portrait photographers also use the same concept to increase the sitter’s likeness by maintaining the correct facial proportion and avoid disproportional representation of facial features.

Therefore, based on contemporary professional photography practices, we can assume greater ‘u’ distances maintain the proportions of facial features more accurately than shorter ‘u’ distance. In other words, aspects of facial morphology are maintained more accurately using greater ‘u’ distances and shorter ‘u’ distances may result in a disproportional relationship between facial morphology. While this theory has some credibility anecdotally among professional photographers, the notion has not been quantitatively measured for forensic science applications. This is an important consideration regarding the reliability of the photographic material used in qualitative facial morphology analysis as seen in Jung.
The second question asks whether, at some particular ‘u’ distance, does facial proportions reach an equilibrium point where, once the correct proportions are reached, an increase of ‘u’ distance does not change the facial proportions or facial morphology. If this hypothesis proves correct and if the point of equilibrium can be measured, this would provide valuable information for facial identification. It would also provide information regarding the placement of CCTV cameras when facial identification may be of a greater importance (i.e. airports and banks).

6.2 Labelling the Anatomical Landmarks used in the Experiment

Anatomical landmarks were identified using black pins. The anatomical accuracy of the pin placement is considered less important than achieving consistency with the linear measurements over a range of specimens. The pins serve as reference markers to ensure consistency between each linear measurement. The following table lists the anatomical landmarks used and coded in the experimental work.

<table>
<thead>
<tr>
<th>Anatomical Landmark</th>
<th>Prefix</th>
<th>Anatomical Landmark</th>
<th>Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and Face</td>
<td>Left</td>
<td>(L)</td>
<td></td>
</tr>
<tr>
<td>Trichion</td>
<td>A</td>
<td>Right</td>
<td>(R)</td>
</tr>
<tr>
<td>Glabella</td>
<td>B</td>
<td>Ear</td>
<td></td>
</tr>
<tr>
<td>Nasion</td>
<td>C</td>
<td>Superaurale</td>
<td>I</td>
</tr>
<tr>
<td>Medial Canthus</td>
<td>D</td>
<td>Subaurale</td>
<td>J</td>
</tr>
<tr>
<td>Lateral Canthus</td>
<td>E</td>
<td>Nose</td>
<td></td>
</tr>
<tr>
<td>Cheilion</td>
<td>F</td>
<td>Midnasal</td>
<td>K</td>
</tr>
<tr>
<td>Menton</td>
<td>G</td>
<td>Pronasal</td>
<td>L</td>
</tr>
<tr>
<td>Tragion</td>
<td>H</td>
<td>Alare</td>
<td>M</td>
</tr>
</tbody>
</table>

Figures 6.2a and 6.2b illustrate the anatomical landmarks used on the head and face, while figures 6.3a and 6.3b indicate the anatomical landmarks on the ears and noses used in the experiment. The light blue ear (labelled ‘J’) was not used in the experiment because it was too heavy to attach to the foam model.

This research makes a distinction between the terms ‘anthropometry’ and ‘photoanthropometry’. Anthropometry is the measurement of anatomical features and landmarks made directly from a live specimen. While photoanthropometry is the
linear measurements made from the representation of anatomical features and landmarks presented in photographs.

### 6.3 Physical Anthropometric Measurements Directly from the Model

Physical anthropometric measurements were taken directly from the model to provide indices from key anatomical features that form a reference standard for comparison between measurements taken from the experimental photographs.

#### 6.3.1 Physical Anthropometric Measurement Protocols

The following protocols were used when conducting the linear measurements made directly from the model and from the experimental photographs. A set of Toolex™ digital vernier calipers were used for the linear measurements. The manufacturer reports the accuracy of the vernier calipers is within ±0.02 mm. Measurements were made on the lateral (outer) sides of the pins used as anatomical landmark references (see Figure 6.1). Five measurements from each anatomical landmark were taken to obtain a mean value. Standard deviations were also calculated.

![Figure 6.1: Diagram illustrating the measurement area of the outer edges of the reference pins.](image)

#### 6.3.2 Physical Anthropometric Measurements of Model

Tables 6.2, 6.3 and 6.4 list the physical anthropometric measurements made directly from the model. These measurements provide a known standard to compare the measurements made from the photographs at different image perspectives.
Figures 6.2a and 6.2b: Anatomical landmark references indicated by marker pins on the polystyrene hair stylist model used in the experiment: A Trichion, B Glabella, C Nasion, D Medial Canthus, E Lateral Canthus, F Cheilion, G Menton, H Tragion.

Figures 6.3a and 6.3b: Modelled facial features made from plasticine with anatomical landmark references: 1 Supraaurale, J Subaurale, K Midnasal, L Pronasal, M Alare. Please note; the light blue ear was not used in the experimentation because it was too heavy to position onto the model.
<table>
<thead>
<tr>
<th>Anthropometry: Face</th>
<th>Prefix</th>
<th>n</th>
<th>$\bar{x}$ (mm)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichion → Menton</td>
<td>A → G</td>
<td>5</td>
<td>165.03</td>
<td>0.15</td>
</tr>
<tr>
<td>Lateral Canthus (L) → Lateral Canthus (R)</td>
<td>E(L) → E(R)</td>
<td>5</td>
<td>114.84</td>
<td>0.14</td>
</tr>
<tr>
<td>Cheilion (L) → Cheilion (R)</td>
<td>F(L) → F(R)</td>
<td>5</td>
<td>41.96</td>
<td>0.14</td>
</tr>
<tr>
<td>Tragion → Nasion</td>
<td>H → C</td>
<td>5</td>
<td>126.34</td>
<td>0.10</td>
</tr>
<tr>
<td>Glabella → Menton</td>
<td>B → G</td>
<td>5</td>
<td>127.68</td>
<td>0.14</td>
</tr>
<tr>
<td>Medial Canthus (L) → Medial Canthus (R)</td>
<td>D(L) → D(R)</td>
<td>5</td>
<td>36.52</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 6.2; Physical anthropometric measurements of the face made directly from experimental model.

<table>
<thead>
<tr>
<th>Anthropometry: Noses</th>
<th>Prefix</th>
<th>n</th>
<th>$\bar{x}$ (mm)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black;</td>
<td>K → L</td>
<td>5</td>
<td>51.34</td>
<td>0.12</td>
</tr>
<tr>
<td>Alare (L) → Alare (R)</td>
<td>M(L) → M(R)</td>
<td>5</td>
<td>48.34</td>
<td>0.09</td>
</tr>
<tr>
<td>Pronasal → Tragion</td>
<td>L → H</td>
<td>5</td>
<td>156.74</td>
<td>0.47</td>
</tr>
<tr>
<td>Red;</td>
<td>K → L</td>
<td>5</td>
<td>42.08</td>
<td>0.10</td>
</tr>
<tr>
<td>Alare (L) → Alare (R)</td>
<td>M(L) → M(R)</td>
<td>5</td>
<td>34.53</td>
<td>0.12</td>
</tr>
<tr>
<td>Pronasal → Tragion</td>
<td>L → H</td>
<td>5</td>
<td>153.83</td>
<td>0.61</td>
</tr>
<tr>
<td>Orange;</td>
<td>K → L</td>
<td>5</td>
<td>49.96</td>
<td>0.05</td>
</tr>
<tr>
<td>Alare (L) → Alare (R)</td>
<td>M(L) → M(R)</td>
<td>5</td>
<td>36.27</td>
<td>0.10</td>
</tr>
<tr>
<td>Pronasal → Tragion</td>
<td>L → H</td>
<td>5</td>
<td>154.32</td>
<td>0.27</td>
</tr>
<tr>
<td>White;</td>
<td>K → L</td>
<td>5</td>
<td>58.46</td>
<td>0.12</td>
</tr>
<tr>
<td>Alare (L) → Alare (R)</td>
<td>M(L) → M(R)</td>
<td>5</td>
<td>42.41</td>
<td>0.08</td>
</tr>
<tr>
<td>Pronasal → Tragion</td>
<td>L → H</td>
<td>5</td>
<td>161.14</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Table 6.3; Physical anthropometric measurements of modelled noses made directly from experimental model.

<table>
<thead>
<tr>
<th>Anthropometry: Ears</th>
<th>Prefix</th>
<th>n</th>
<th>$\bar{x}$ (mm)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink: Superaurale → Subaurale</td>
<td>I → J</td>
<td>5</td>
<td>76.25</td>
<td>0.21</td>
</tr>
<tr>
<td>Blue: Superaurale → Subaurale</td>
<td>I → J</td>
<td>5</td>
<td>82.27</td>
<td>0.06</td>
</tr>
<tr>
<td>Green: Superaurale → Subaurale</td>
<td>I → J</td>
<td>5</td>
<td>76.29</td>
<td>0.04</td>
</tr>
<tr>
<td>Purple: Superaurale → Subaurale</td>
<td>I → J</td>
<td>5</td>
<td>63.55</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 6.4; Physical anthropometric measurements of modelled ears made directly from experimental model.

6.4 Photography of the Model

The photography of the model was conducted using a Canon™ 30D digital camera. Electronic flash units fitted with softbox reflectors were used to light the model using
a standard copy lighting\textsuperscript{48} set to produce an even soft quality illumination. Exposure was calculated using a Sekonic\textsuperscript{™} hand-held light meter set on incident exposure mode.

The camera was positioned directly in front of the model and at the same height to produce a norma frontalis viewpoint. The following technical specifications were observed and presented in the table below.

\begin{table}[h]
\centering
\begin{tabular}{|l|c|}
\hline
\textbf{Photography Specifications} & \\
\hline
Camera & Canon 30D Digital \\
Sensor & CMOS\textsuperscript{49} \\
Sensor size & 22.5 x 15.0 mm \\
File Format & JPEG – Highest Quality \\
Colour Space & sRGB \\
Exposure Calculation & Sekonic light meter \\
Exposure & f/ 16 @ 1/200\textsuperscript{th} sec \\
Lighting & Copy Lighting Style \\
Reflector & 1,000 x 1,000 mm softbox \\
Distance of Lighting & 1,550 mm from subject \\
\hline
\end{tabular}
\caption{Photography specifications of the photography to photograph the model.}
\end{table}

As indicated in the previous chapter, image perspective is altered in photographs by varying the distance between the lens and the subject, known as the ‘\textit{u}’ distance (see section 5.7.1). While image perspective is governed by optical laws [Jacobson \textit{et al.}, 2000] lens focal length is independent of image perspective and does not alter perspective. Lens focal length affects image magnification and field of view, however only ‘\textit{u}’ distance modifies image perspective. Lens focal length does to some degree influence the ‘\textit{u}’ distance due to the magnification ability of the lens, however ‘\textit{u}’ distance is an independent variable of perspective. The experimental design used varying ‘\textit{u}’ distances to produce different image perspectives with various combinations of modelled facial features (ears and noses). There are 12 different model configurations and 11 different ‘\textit{u}’ distances producing 132 different

\textsuperscript{48} Copy lighting uses two lights positioned either side of the subject at approximately 45\textdegree angle from the subject.

\textsuperscript{49} CMOS – Complimentary Metal-Oxide Semiconductor
anatomical/image perspective photographs. Figure 6.6 illustrates the 12 different model configurations that were photographed at 11 discrete ‘\(u\)’ distances. The first distance of 295 mm was the closest possible distance of the subject while maintaining the image composition of the model. Other distances were selected as a sequence of data and different focal length lenses were utilised to minimise the cropping of the image and maintain maximum image quality.

The photographic procedure comprised of taking photographs of all model combinations at the same ‘\(u\)’ distance, before repeating the process at a different distance. The following table lists the conditions used in the photography at different ‘\(u\)’ distances. Various lens focal lengths were used to control image magnification in camera to the best practical limitations. Focal length was increased with greater camera distance to maintain approximately the same image size throughout the experimental photographs. Images were further cropped using digital imaging editing software (Adobe Photoshop CS2™) to produce similar image magnification.

<table>
<thead>
<tr>
<th>‘(u)’ Distance</th>
<th>Lens</th>
<th>Actual Focal Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>295 mm</td>
<td>15 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>400 mm</td>
<td>16-35 mm zoom</td>
<td>20 mm</td>
</tr>
<tr>
<td>750 mm</td>
<td>16-35 mm zoom</td>
<td>35 mm</td>
</tr>
<tr>
<td>1,000 mm</td>
<td>50 mm</td>
<td>50 mm</td>
</tr>
<tr>
<td>1,500 mm</td>
<td>50 mm</td>
<td>50 mm</td>
</tr>
<tr>
<td>2,000 mm</td>
<td>100 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>2,500 mm</td>
<td>100 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>3,000 mm</td>
<td>100 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>4,000 mm</td>
<td>200 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>6,000 mm</td>
<td>200 mm</td>
<td>200 mm</td>
</tr>
<tr>
<td>8,000 mm</td>
<td>200 mm</td>
<td>200 mm</td>
</tr>
</tbody>
</table>

*Table 6.6; ‘\(u\)’ distances and focal lengths used in the experimental photographs.*

6.4.1 Protocol for Digital Editing of Photographs

All photographs underwent post-photography editing using Adobe Photoshop CS2™ (version 9.0) software. The principal function of editing was to produce all experimental photographs at the same image magnification to enable consistencies when conducting the photoanthropometric measurements made directly from the
photographs. While the lens focal length was changed at different ‘u’ distances, several distances did use the same focal length resulting in significant changes in image magnifications. Figure 6.4 demonstrates the variances in the original image captured at each ‘u’ distance and Figure 6.5 shows the same images adjusted to approximately the same magnification. Adjusting the image magnification does not alter the image perspective, only image magnification. Image magnification and image perspective are different image concepts (as previously discussed in section 5.7).

The procedure to standardise the magnification was accomplished by combining a standard sized image and overlaying it with the image to be edited. The opacity of this standard was reduced to produce a transparent image and to enable the visualisation of both images. The magnification of the edited image was then altered through the ‘transform; scale’ function and adjusted using the linear scale above the head of the model as a reference. The ‘shift’ key was held down during the dragging of the corner box when adjusting scale to maintain the dimensional proportions of the image.

Exposure adjustment was not necessary due to the accurate exposures obtained using a hand held light meter and consistencies with the large soft light source. A slight sharpening of the image, as standard with most digital images was applied. Text was added to the bottom centre of the image for identification purposes. Appendix B has contact sheets of the adjusted photographs used in the experiment. Each image file was given a new file reference. Tables found in Appendix C provide an index of the image files used in the data collection of the photoanthropometric measurements.

6.4.2 Printing Experimental Photographs

Adjusted digital images were printed using an office based monochrome laser printer at 600dpi on standard copy paper. The experiment did not require more expensive photographic paper and inks because the laser printer’s quality provided sufficient detail and resolution to conduct the photoanthropometric measurements.
Figure 6.4: A sequence of raw experimental photographs without magnification adjustment.
Figure 6.5: A sequence of adjusted experimental photographs with approximate magnification adjustment using the linear scale above the head as a reference.
Figure 6.6: Anatomical combinations used in the experimental photographs. All photographs represented in this figure were photographed at 1,000mm 'u' distance using a 50mm focal length lens.
6.5 Methods and Data Collection

Photoanthropometric measurements were made directly from the printed photographs of the model. The vernier calipers were used to measure the linear distances between the identified anatomical landmarks indicated by the reference pins. The measurements were made from the lateral edge of the pins to be consistent with the physical measurement method. The table below displays the anatomical features measured during the data collection from the photographs.

<table>
<thead>
<tr>
<th>Anatomical References</th>
<th>Prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superaurale → Subaurale</td>
<td>I → J</td>
</tr>
<tr>
<td>Alare (L) → Alare (R)</td>
<td>M(L) → M(R)</td>
</tr>
<tr>
<td>Lateral Canthus (L) → Lateral Canthus (R)</td>
<td>E(L) → E(R)</td>
</tr>
</tbody>
</table>

*Table 6.7: Anatomical references used when measuring the photoanthropometry from the photographs of the model.*

All measurements were recorded onto an Excel spreadsheet for calculation of photoanthropometric indices and to use in the analysis phase of the experiment.

6.5.1 Caliper Specifications and Operation Protocol

The Toolex™ 200 mm digital vernier calipers were used following the manufacturer’s instructions. The calipers were calibrated between each photograph measured using the calibration function of the instrument. The caliper specifications are include below and were operated within the recommended operating temperature.

<table>
<thead>
<tr>
<th>Digital Vernier Calipers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand</td>
</tr>
<tr>
<td>Span</td>
</tr>
<tr>
<td>Accuracy</td>
</tr>
<tr>
<td>Resolution</td>
</tr>
<tr>
<td>Repeatability</td>
</tr>
<tr>
<td>Operating Temp.</td>
</tr>
</tbody>
</table>

*Table 6.8: Digital vernier caliper specifications.*
6.5.2 Calibration of Print Magnification

A print magnification factor was calculated to determine the magnification consistency between experimental photographs. Although the application of photoanthropometric indices negates any variance in magnification, the factors were determined to maintain some consistency between each experimental photograph. The magnification factor was determined by using the modified ABFO\(^{50}\) No. 2 linear scale represented in the photograph which had a mean linear measurement of 105.34 mm \((n = 5, \ SD = 0.07 \text{ mm})\). The following formula was used to calculate each print magnification;

\[
\text{Equation 6.1;}
\]

\[
\text{Print Magnification Factor} = \frac{\text{Linear Measurement of Scale on Photograph}}{\text{Known Value of Linear Scale}}
\]

Magnification values >1 indicate the photographic image is larger than the physical size of the real object. Conversely, values <1 suggest the size represented in the photographs is less than the real object. The distribution of each magnification factor was calculated to examine the level of variance within the range of experimental photographs. The table below provides a summary statistic of the print magnification factor of all photographs used in collecting the experimental data.

<table>
<thead>
<tr>
<th>Summary Statistic for Experimental Photographs Magnification Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n)</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>Standard Deviation (SD)</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Variance ((s^2))</td>
</tr>
<tr>
<td>Lowest Value</td>
</tr>
<tr>
<td>Highest Value</td>
</tr>
<tr>
<td>Range</td>
</tr>
</tbody>
</table>

\(\text{Table 6.9; Summary statistics of print magnification factors used in the experimental photographs.}\)

\(^{50}\) ABFO - American Board of Forensic Odontologists. Modification to the scale comprised of cutting off one length of the right angled ‘L’ shaped scale.
The chart below plots the distribution of different magnification factors from all experimental photographs used to gain the photoanthropometric data. The analysis of the distribution of magnification indicates a normal distribution and is consistent throughout the 130 experimental photographs used to source the data.

6.5.3 Calculation of Anthropometric Indices

Linear measurements were made directly from each photograph using the specified anatomical landmarks identified in the experimental design. Indices were calculated to avoid any discrepancies caused by varying image magnifications presented in the experimental photographs [Catterick 1992, Halberstein 2001]. Indices were also used as a method of analysis. The application of indices is recognised as an anthropometric standard in the human anatomy and osteology field [Catterick 1992, Iscan 1993, Bass 1995, Schwartz 1995, Halberstein 2001, Byers 2008]. Iscan (1993) and Halberstein (2001) also suggest indices are a more reliable form of measurement when comparing facial features directly from photographs because they negate variations of image magnification rather than using absolute linear measurements.

There are some variations in the methods used to determine photoanthropometric indices within the scientific literature. Halberstein (2001) suggests the calculation of anatomical indices is gained by the following formula (equation 6.2);
Other workers within the anatomy and osteology discipline use an index that provides a percentage result. Iscan (1993, p66), Bass (1995, p70), Schwartz (1995, p324-326) and Byers (2008, p20) all employ the following formula when describing the size relationship of anatomical features;

\[
\text{Photoanthropometric Index} = \frac{\text{Largest Dimension}}{\text{Smallest Dimension}}
\]

The percentage formula (Equation 6.3) was used during this experiment to calculate indices using the raw data gained from the linear measurements made from the photographs. Both formulas were tested and it was found they produced similar results. However, the percentage formula was chosen because it provides consistency with other work described in the literature. The application of indices is further supported by Iscan (1993) who suggests the following regarding measurements taken directly from photographs;

More often than not, it is impossible to determine the actual dimensions of the face and its features. Therefore an index must function to eliminate the effects of absolute size differences between individuals or objects. An index is formed as follows: Small dimension x 100 / Large dimension. The result quantifies the proportion of the small dimension to the large dimension and thus the problem of scale is eliminated. As many indices as necessary can be generated. For linear dimensions, it is best to use the maximum dimension as a constant denominator. [Iscan 1993, p65-66]

The indices chosen for the analysis phase of this experiment were considered for their ability to describe the relationship of size between the modelled facial features (nose and ears) and a constant anatomical landmark. The set of indices should demonstrate any variance of facial morphology caused by the variable of image perspective. A common denominator, as described by Iscan (1993), was also considered to advance a level of consistency between the calculated indices from each individual facial feature. The distance between the left lateral canthus and the
right lateral canthus (E(L) → E(R)) was used as the denominator for all indices. This anatomical landmark was used because; i) it is central in the frame, ii) does not change size and iii) is a larger dimension than any other measurement made on the modelled facial features.

6.5.4 Indices of Known Values

To examine the effects of image perspective on facial morphology, the experimental design compares the indices measured directly from the photographs to the known values of the model. Indices were calculated from mean linear measurements described in section 6.3.2.

6.6 Analysis of Left and Right Lateral Canthus as a Common Denominator

The linear measurement between the left and right lateral canthus was considered as a common denominator for the calculation of the indices. Each lateral canthus is positioned on approximately the same plane as the modified ABFO No 2 linear scale used in the determination of the print magnification (see section 6.5.2). Therefore, the distance between each lateral canthus should be consistent throughout the series of experimental photographs due to the calibration of print magnification. Each left and right lateral canthus is positioned between the nose and ear on each model and is suitable as a neutral reference between those values.

The left and right lateral canthus distances on each experimental photograph were examined to ensure there was a level of consistency between their values and ensure the denominator was constant. The mean photoanthropometric lateral canthus values were also compared with the known mean value for comparison. The raw photoanthropometric values required an adjustment to consider the magnification factors of each photograph because the print size is less than life size. The following formula was used to calculate the adjustment and provide a value that may be compared with the known value.
Equation 6.4; 

\[ a = x \left( \frac{1}{m} \right) \]

Whereas; 
- \( a \) = adjusted value
- \( x \) = photoanthropometric value
- \( m \) = print magnification factor

The mean known anthropometric lateral canthus distance measured 114.84 mm while the mean adjusted photoanthropometric value measured 113.09 mm \((n = 130, \ SD = 1.35)\) which represents a negligible difference. The summary statistical results are listed below;

<table>
<thead>
<tr>
<th>Analysis of Denominator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Known</strong></td>
</tr>
<tr>
<td><strong>Mean Photo</strong></td>
</tr>
<tr>
<td><strong>( n )</strong></td>
</tr>
<tr>
<td><strong>SD</strong></td>
</tr>
<tr>
<td><strong>Min</strong></td>
</tr>
<tr>
<td><strong>Max</strong></td>
</tr>
<tr>
<td><strong>Range</strong></td>
</tr>
</tbody>
</table>

*Table 6.10: Summary statistics of the left and right lateral canthus distance from each photograph.*

The left and right lateral canthus distances appear, to be relatively consistent throughout the experimental photographs. No photo value exceeded the known value and this can be explained by the measurement method. It is easier to detect gaps between the reference pins when the calipers are oversized and more difficult when they are undersized. This suggests there is more of a tendency for the measurement error to be under the true value rather than over it. The scatter diagram in Figure 6.8 illustrates the distribution of each adjusted left to right lateral canthus photoanthropometric value measured from the experimental photographs. The solid line represents the mean known value measured directly from the model, while the two dashed lines represent -2\% and -5\% differentiation from the known value. The majority of photoanthropometric values form a cluster just below the mean known value and the -2\% discrepancy value.
The distribution of photoanthropometric lateral canthus values suggest; 76.92% of the values are between the known value (114.84 mm) and -2% (112.54 mm), 21.54% of values ranged between -2% (112.54 mm) and -5% (109.10 mm), while only 1.54% of values are outside these ranges. The results indicate 76.92% of adjusted lateral canthus values are less than 2% difference from the known value, while a total of 98.46% of photoanthropometric values are less than 5% difference from the known value. This result indicates the left and right lateral canthus photoanthropometric measurement may be considered as a constant value to be used in the indices calculations.
6.7 Results and Analysis

Two methods of analysis were conducted;

- Visual analysis of photographs printed at the same image magnification.
- The calculation of photoanthropometric indices plotted against the ‘u’ distance independent variable.

6.7.1. Visual Analysis Results

An examination of all printed experimental photographs indicate there are significant changes in facial morphology when comparing the relationship of size, shape and form of the facial features across various ‘u’ distances. The magnifications of all experimental photographs were calibrated to provided consistencies when examining the visual data represented in each photograph (see section 6.5.2). Figure 6.10 illustrates the range of photographs taken using the model’s red nose and green ear combination.

Observations indicate the size of the ear is smaller than the nose in ‘u’ distances 295 mm and 400 mm, however this reverses in the later photographs and the ear becomes larger than the nose. The physical measurements of the red nose (42.08 mm, SD 0.1) and the green ear (76.29 mm, SD 0.04) indicated the ear is, in real life, larger than the red nose. The visual results indicate it would be difficult to accurately describe the size of the nose and/or the ear when examining photographs with shorter ‘u’ distances. It also indicates the necessity to determine the ‘u’ distance from questioned photographs before any qualitative analysis of facial morphology is considered. This aspect appears not to have been considered in the Jung case.

No further changes in relative size between the nose and ear appear in the later photographs between the 3,000 mm and 8,000 mm ‘u’ distance. The size variances appear to stabilise at the longer distances as hypothesised during the experimental design phase. The longer ‘u’ distance photographs also produce a more natural looking proportion of facial features. Some curvilinear distortion is observed in the 295 mm photograph, which uses a 15 mm focal length lens.
Other differences are observed in the models neck and the region between the lateral canthus and the tragion (E→H) which change the shape of the face. These variances are explained by the image perspective in combination with different lens angle of view. Figure 6.10 provides a selective range of photographs from the red nose and green ear combination (‘u’ distances; 295 mm, 400 mm, and 2,500 mm). This series provides visual evidence relating to the size transition between ear and nose. The size relationship between the nose and the ear produce considerable differences in each photograph. The following may be observed;

- Photo A (295 mm ‘u’ distance) displays a large size nose with a small ear,
- Photo B (400 mm ‘u’ distance) display approximately the same size nose and ear, while
- Photo C (2,500 mm ‘u’ distance) displays a significantly larger ear and small nose.

This visual evidence raises serious questions regarding the qualitative facial morphology methods used by Sutisno in the Jung case (see Chapter 5). The shape of the face is also significantly different in each photograph. Taxonomic descriptors, such as round, elliptical, square, thin and broad, used to describe the shape of the face are also ambiguously represented in these photographs. Each photograph in figure 6.10 represents the face in a different form. The question here is ‘what image represents reality?’

The experimental photographs were taken using a norma frontalis viewpoint to minimise facial morphology variables caused by camera angles. When photographs are captured by CCTV cameras, they capture the subject at differing heights and camera angles in relation to the subject. This would produce further facial morphology inconsistencies.

6.7.2 Photoanthropometric Analysis

The left and right lateral canthus distance is used as a common denominator in the calculation of the photoanthropometric indices as described in Equation 6.3. It is a larger dimension and avoids indices problems with varying sized facial features.
Indices were calculated to describe the size relationship between the model’s ear and nose when photographed using differing image perspectives. Iscan (1993) suggests any indices may be used as a comparison of facial features. This experiment was designed to observe any variances between facial morphology, which is the size, shape and form of facial features caused by image perspective. The experiment used the following indices;

\[ \text{Photoanthropometric Index} = \frac{(\text{Alare (L)} \rightarrow \text{Alare (R)}) \times 100}{(\text{Lateral Canthus (L)} \rightarrow \text{Lateral Canthus (R)})} \]

\[ \text{Photoanthropometric Index} = \frac{(\text{Superaural } \rightarrow \text{Subaurale}) \times 100}{(\text{Lateral Canthus (L)} \rightarrow \text{Lateral Canthus (R)})} \]

The ear and nose features were chosen because of their position within the face. The nose is the closest feature to the camera lens while the ear is the furthestmost. Any variances in facial morphology should be detected by these extreme positions. Other facial features positioned within the same plane may be less able to detect variances.

### 6.7.3 Photoanthropometric Sampling Methods

All experimental photographs \( n = 130 \) were used to calculate mean. Indices were calculated for every experimental photograph and collected onto Excel spreadsheets. The table 6.11 illustrates the sample method used to obtain the mean indices.

<table>
<thead>
<tr>
<th>Photoanthropometric Indices Sampling Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of model combinations</td>
</tr>
<tr>
<td>Photoanthropometric measurements from each anatomical feature</td>
</tr>
<tr>
<td>Number of measurements used in each index</td>
</tr>
<tr>
<td>Total number of indices used for each mean nose index</td>
</tr>
<tr>
<td>Total number of indices used for each mean ear index</td>
</tr>
</tbody>
</table>

*Table 6.11 Sample methods used to determine photoanthropometric indices.*
Figure 6.10: Visual Analysis of three images used in the facial morphology experiment. Morphology variations are observed between the nose and ear in each image. Image ‘A’ displays a relationship between the nose and ear that suggests the nose is much larger than the ear. Image ‘B’ shows this relationship is approximately equal, while image ‘C’ suggests the nose is significantly smaller than the ear. The same ear and nose were photographed in each image.
6.7.4 Photoanthropometric Indices Results

Tables found in Appendix D provide the results for mean indices using the different anatomical facial features on the experimental model. The first series of tables are of the results gained from the photoanthropometric indices using each modelled nose. The final column presents the difference between the mean known index measured directly from the model and the mean photoanthropometric index measured from the experimental photographs. Any difference between these indices is a result of the image perspective and is caused by the independent variable; ‘u’ distance.

Graphic representations of results provide an informative method for the interpretation of results. Figure 6.11 plots the mean photoanthropometric indices of each modelled nose against the ‘u’ distance on the x axis. The y axis is the calculated mean percentage index. The solid lines in the graph signify the mean indices calculated from the experimental photographs, while the broken lines represent the mean known values measured directly from the physical specimens. There are four different noses represented on Figure 6.11 and each mean value has a sample size of approximately 33 indices.

![Morphological Changes Caused by Image Perspective](image.png)

*Figure 6.11; Graphic representation of mean photoanthropometric indices (nose) across a range of ‘u’ distance when compared with the know mean indices.*
Each photoanthropometric index forms a similar shaped curve when plotted on the graph. The different heights of each specimen on the graph are a result of the difference in physical size of the anatomical features used in experimental models used. The important aspect of these results is the relationship of each photoanthropometric value to its known value. A significant degree of data spread is observed between the indices derived from the photographs and the known values at the shorter ‘u’ distances. This indicates there are changes in the photographic representation of facial morphology when the ‘u’ distances are <1,000 mm.

Another graph was developed to examine the variation between each mean alare/lateral canthus index and their known values. Figure 6.12 provides a graphic representation of the differences between each photo and known indices. Each mean index is plotted across the range of ‘u’ distances with a common zero point positioned on the x axis base. Similarities between the results can be observed using this form of analysis.

The shape of each line is consistent with the previous diagram, as expected. Each mean index difference appears to demonstrate a level of correlation with each other. Slight variances could be contributed to inconsistencies in the measuring technique used to record the linear distances. The pattern indicates that the discrepancies between the photo and the real values are consistent with any combination of facial morphology. This is a significant concept in relation to the reliability of the forensic findings in Jung.

Both graphs provide an insight to how facial morphology is represented in photographs at various camera ‘u’ distances. As earlier hypothesised, facial morphology does reach an equilibrium point, where the proportions of facial features remain relatively constant after a certain camera ‘u’ distance is achieved. There is a significant degree of levelling of the plotted line once the ‘u’ distance exceeds 3,000 mm.
Figure 6.13 plots the effects of camera ‘\(u\)’ distance on facial morphology using the size of the ear (superaurale → subaurale) and the lateral canthus distance. The opposing direction of the plot is a notable difference to the previous graphic representations. The difference is caused by the position of each numerator used in the equation and in relation to the denominator. As previously discussed, the denominator in both indices analysis uses the left and right lateral canthus distance due to its neutrality and is considered to be a constant value throughout the experimental photographs. The position of each numerator however varies. The nose (left alare → right alare) is positioned anteriorly to the lateral canthus while the ear (superaurale → subaurale) is positioned posteriorly to the lateral canthus. The relationship of these positions changes the direction of the result values. For example, as the ‘\(u\)’ distance increases the size of the nose decreases, in relation to the lateral canthus value.
Morphological Changes Caused by Image Perspective
(Superaurale - Subaurale)/(Lateral Canthus (L) - Lateral Canthus (R))
Mean Values

% Index (I-J)/(E(L)-E(R))

Mean Green Ear
Known Green Ear
Mean Purple Ear
Known Purple Ear
Mean Pink Ear
Known Pink Ear

Variance Between Mean Photo and Known Indices
(Superaurale - Subaurale)/(Lateral Canthus (L) - Lateral Canthus (R))

Mean Difference

Figure 6.13; Graphic representation of mean photoanthropometric indices (ear) across a range of 'u' distance and compared with the known mean indices.

Figure 6.14; Graph displaying the index difference of each ear values.
Figure 6.14 displays a consist shape of each plotted line and is consistent with the previous graph (Fig 6.12) except for the inversion caused by the change in relative location of the facial features. The known values of the green and pink ears are very similar and obscure each other slightly.

The variance graph in Figure 6.14 also demonstrates consistencies with the previous results. There is also a degree of consistency between each ear value plotted on the graph. The overall correlation of results suggests this method of analysis provides evidence that camera ‘u’ distance, therefore image perspective, does have a significant influence on the facial morphology represented in photographs.

### 6.8 Chapter Discussion

This experiment was designed to answer two questions; i) does significant variance occur in facial morphology when using different image perspectives and ii) is there an equilibrium point where changes in image perspective no longer alter facial morphology?

The findings of the experiment found that facial morphology is significantly influenced when camera ‘u’ distances are <1,000 mm. There are moderate changes between 1,000 mm to 3,000 mm and very little change when distances are >3,000 mm.

The important implication of these findings is that when making a comparison between two different photographs, the representational aspects of facial morphology presented on each photograph could be significantly different if the photographs have different image perspectives. The findings suggest a high degree of caution should be taken when forensic practitioners use photographs as a source of identification. It also highlights the importance of ‘matching’ the image perspective of the questioned photographs with the controlled exemplar material. A ‘like-for-like’ condition often expressed with other comparative analysis methods should be considered.

Previous workers have indicated the need to replicate the camera angle when preparing exemplar photographs for facial identification using comparative analysis.
methods [Ruifrok et al 2003, Introna et al 2007, Cattaneo 2007]. The results indicated in this chapter further highlight the need to include matching of the image perspective in addition to matching camera angle and height.

Including critical aspects of image perspective into the methodology of exemplar preparation adds a high degree of complexity to the process. Image perspective is not well understood by forensic practitioners outside the forensic photography discipline. Establishing the image perspective and ‘u’ distance of the sourced questioned photographs or images is a difficult task and in many cases is not possible. However, as seen in Jung, ‘u’ distances from static cameras like CCTV may sometimes be obtainable by using image reconstruction techniques.

The reconstruction of the image to determine ‘u’ distance ranges is an important requirement to improve the level of reliability of identification of individuals from sourced surveillance photographs. The reconstruction provides essential data for the replication of photographic conditions found within the questioned photograph and allows these factors to be incorporated into the exemplar material. The following forensic investigation aspects are considered critical when conducting a reconstruction of the questioned image/s is examined to provide more reliable forensic evidence;

- The site of the image must be considered as a crime scene.
- Image reconstruction must be conducted by an expert in forensic photography with the qualifications, experience and training in photographic science.
- The sourced image must clearly demonstrate landmarks to enable scene reconstruction or, alternatively, perspective grid photogrammetry [Hyzer 1982, Robinson 2007] may be applied.
- The image must be taken from a static camera (i.e. CCTV without zoom, pan and tilt capabilities).

Considering the site as a crime scene is an important aspect of the process of obtaining forensic evidence during the image reconstruction. It demands that certain procedures occur that ensures the information obtained is lawful and contains quality data as expected in all crime scene investigations. Lawful access to the site is
imperative otherwise the evidence gained from the examination will be inadmissible. This point may require a warrant to gain access to the location or permission from the owners. Establishing the site as a crime scene also enables police to secure the area and prevent access by the public. Working on busy public thoroughfares becomes difficult and the integrity of the site may be compromised if the site is not secured.

Problems arising from identifications based on facial morphology were witnessed in *Jung*. The Crown’s expert witness presented identification evidence based solely on facial morphological analysis that suggested a definitive positive identification of the accused. The Crown’s evidence used sourced questioned images gained from an ATM CCTV camera and two sources of exemplar photographs. The exemplar photographs were taken by the interviewing police officer on the day of the arrest, while further controlled exemplar photographs were taken by crime scene officers at the remand centre where the accused was held. The exemplar photographs were not taken by a forensic photographer, nor were forensic photography experts consulted during the identification process by the prosecution. It appears the facial morphological analysis was conducted without any consideration of image perspective for both the sourced and exemplar photographs. The finding of the research described in this chapter is that facial morphology can be significantly affected by image perspective.

In the *Jung* case study, a reconstruction of the ATM site (refer to Chapter 5) was conducted to gain estimates of the ‘*u*’ distances used by the ATM CCTV camera. The reconstruction found that the ATM images used in the facial morphology analysis were photographed at a ‘*u*’ distance range between 400 mm and 1,000 mm. Further information gained from a police statement and forensic procedure video, suggested the crime scene officer’s exemplar photographs were taken at a ‘*u*’ distance range between 3,000 mm to 4,000 mm. The camera distance used by the interviewing police officer was not provided. Image reconstruction using the forensic procedures video and an examination of the police interview room, may have provided this information.
In summary the *Jung* case photographs used for the morphological analysis consisted of the following ‘*u*’ distances found in Table 6.12.

<table>
<thead>
<tr>
<th>Photograph Source</th>
<th>Taken By</th>
<th>‘<em>u</em>’ Distance Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM CCTV – questioned images</td>
<td>CCTV</td>
<td>400-1,000 mm</td>
</tr>
<tr>
<td>Exemplar photographs (8 Nov 04)</td>
<td>Police Officer</td>
<td>Unknown</td>
</tr>
<tr>
<td>Exemplar photographs (11 Apr 05)</td>
<td>Crime Scene Officer</td>
<td>3,000-4,000 mm</td>
</tr>
</tbody>
</table>

*Table 6.12: ‘*u*’ distances for questioned and exemplar images used in the morphological analysis*

The difficulties that arise from the Crown’s evidence in *Jung* are that the two known image perspectives used in the morphological analysis where significantly different, yet the Crown’s findings suggested a definitive positive identification using facial morphology exclusively as the analysis method. This does not suggest the Crown’s expert was incorrect; however, it does raise serious concerns with the scientific methods applied to the facial morphology identification methods without the consideration of image perspective. The absence of any supportive evidence from a forensic photography expert by the Crown is also a concern. It appears no consideration was given to the technical and photographic science conditions of the photographic material used in the identification analysis by the Crown.

Figure 6.15, is the same as Figure 6.11 previously used in this chapter and is not data gained from the *Jung* case. The area indicated by the dashed lines represents the two known ‘*u*’ distance ranges used during the forensic analysis by the Crown’s expert in *Jung*. The indicated area situated to the left is the ‘*u*’ distance range (400 mm – 1,000 mm) established during the reconstruction of the ATM site by the defence. The other indicated area on the right, is the ‘*u*’ distance range (3,000 mm – 4,000 mm) indicated by the crime scene officer in his police statement.

The experiment described in this chapter, provides evidence that suggests the differing image perspectives used within these two different ranges, produces significantly different facial morphology on the resultant photographs.
Catterick (1992), Iscan (1993), Halberstein (2001) and Kleinberg et al., (2007) all suggest that the application of photoanthropometric indices could avoid any errors caused by different image magnifications. While this holds true regarding the magnification of the image, image perspective is a separate and different optical condition that needs to be considered when determining the reliability of photoanthropometric indices. Image perspective is a more complex visual concept than image magnification and is inherent in all photographs. It is a visual element that affects the relationship of size between various objects within the frame and spacial representations when images are produced by the transformation of three-dimensional objects into two-dimensional planar photographs. Image perspective is generally not well understood by forensic scientists outside the forensic photography discipline. It appears image perspective was not considered by Iscan (1993), Halberstein (2001) and Kleinberg et al., (2007) which devalues their arguments about facial identification methodologies.

Figure 6.15 Graph indicating the results of the experimental work with the ‘u’ distance found with the question and exemplar photographs used in the Jung (2006) case.
Iscan (1993) is an experienced anthropologist with extensive forensic casework experience. In his chapter titled ‘Introduction of Techniques for Photographic Comparison: Potential and Problems’ found in Iscan and Helmer (Eds) (1993) ‘Forensic Analysis of the Skull: Craniofacial Analysis, Reconstruction and Identification’ Iscan further suggests he observed in a previous study with Charney, regarding the comparison between two-dimensional and three-dimensional facial reconstructions, changes in facial morphology. He suggests;

\[\ldots\ldots\text{the two forms of facial reconstruction produces dimensional similarities but very different morphological features}\] [Iscan 1993, p57].

This difference is most likely caused by the affect of image perspective. Other than his observation of differing facial morphology, Iscan does not mention image perspective as a potential problem in the chapter [Iscan 1993].

The condition of image perspective is more noticeably experienced in forensic anthropology when conducting photographic superimposition identification methods. This identification technique uses a photograph of a known person superimposed onto a photograph of an unknown human skull [Maat 1989, Yoshino et al., 1995, Jayaprakash et al., 2001, Eliasova & Krsek 2007]. Identifications are established by the level of correspondence of anatomical features and particularly the dentition. The application of video editing suites has also been used as a method of superimposing images. The misalignment of facial features becomes quite obvious with this identification method. Maat (1989) argues that when selecting photographs of the known person, consideration regarding the distance from which the sourced photographs were taken (‘u’ distance) is important. Photographs that were taken at camera distances greater than 1,500 mm provide more accurate alignment of images. Maat (1989) suggests the image perspective of photographs taken at a greater distance is more reliable than photographs that were taken at close range.

Little research regarding image perspective and facial morphology has been published in the scientific literature. Maat (1989) however, discusses the value of understanding the type of image perspective (referred to as ‘geometric perspective’) that is inherent in the known photographic sources and argues that it is important to
ensure they were taken at a ‘safe distance’ greater than 1,500 mm. Maat (1989) also suggests that sourcing professional portraits for the superimposition examination provides a greater chance of a safe distance than amateur snapshots. This condition is because of the photography practices used by professional portrait photographers who use image perspective as a method of enhancing the likeness of the sitter as previously discussed. While Maat does not offer any quantitative evidence supporting the claim of a safe distance, it is an astute observation and one that is supportive of the findings of this experiment. This experiment supports a safe distance of >3,000 mm not >1,500 mm.

6.8.1 Summary of Experiment Findings

The image perspective and facial morphology experiment has highlighted several critical aspects that require consideration when examining the reliability of photographs used for identification of individuals from surveillance images. These considerations include;

- The exemplar photographs must replicate the image perspective of the questioned images (like-for-like comparison).
- Facial morphology is significantly affected by image perspective when using shorter ‘u’ distances.
- Photoanthropometric measurements including indices are also significantly affected by image perspective.
- Forensic photographers should be used to evaluate the photographic conditions of the sourced surveillances images and report on the possible image perspective presented in the image/s. This information is used to prepare the exemplar material for like-to-like comparison.
- The exemplar material should be prepared by suitably trained forensic photographers who understand the conditions and controls associated with image perspective.
- The possible inclusion of visible landmarks within the frame of CCTV cameras will support obtaining ‘u’ distance ranges when reconstruction investigation by forensic photographers is conducted.
• Reconstruction of the scenes using ‘grid perspective photogrammetry’ [Hyzer 1982, Robinson 2007] and digital overlays may also assist scene reconstruction.

• When installing CCTV cameras in places that require critical facial identification (e.g. banks, airports etc) ‘u’ distances >3,000 mm should be considered to provide images that maintain a more accurate representation of facial morphology. Longer focal length lenses may also be incorporated into the camera systems to improve the image magnification and resolution at these greater distances.

The following chapter examines another case study involving the identification of the person of interest depicted on CCTV images. The identification in this case was conducted by an anatomist and two lay witnesses.
Chapter 7

7.0 Case Study: Regina -v- Johnson (Double Murder)

Our culture revels in technological extensions to our everyday human faculties. From the first hesitant productions of 19th-century photography – its daguerreotypes, callotypes and ambrotypes – machines have increasingly assisted us in the art of remembering. In the 1920’s the camera became a tool of detection, a machine for rational observation, a police forensic recorder.

Caleb Williams [Doyle & Williams 2006, p16]

The previous case study and experiment examined the reliability of evidence derived from CCTV from a forensic science perspective. This chapter will examine another case heard before the NSW Supreme Court in 2007. It approaches the reliability of the CCTV evidence from a range of disciplinary perspectives including forensic science, psychology and visual culture. This chapter critically examines how the CCTV evidence was presented to a court during criminal proceedings. It discusses several issues associated with the evidence and what influence the interpretation of CCTV images has on their ability to manifest unambiguous facts.
This case study consists of CCTV images used as evidence to convict Peter James Johnson for the double murder of Ian and Anna Hughes in 2005. The trial was heard in the NSW Supreme Court in 2007 and is cited as ‘Regina -v- Johnson [2007] NSWSC 274’. The investigating police sought the identity of a person of interest (POI) depicted on a bank CCTV camera who was withdrawing funds from the victims’ bank accounts shortly after their deaths. Police sought, on separate occasions, the opinions of two anatomists for the purpose of providing expert identification evidence of the person of interest.

The CCTV footage show a person withdrawing funds from the deceased’s bank accounts at an ATM in Windsor, New South Wales. This withdrawal occurred close to the victim’s house, where they were killed, on the day of the homicides. Further footage was obtained two days after the killings at the same location depicting the person of interest withdrawing further funds from the deceased’s account. The identification of the person of interest depicted at the ATM would provide an evidential link to the homicides and was considered to be significant circumstantial evidence.

Dr Sutisno supplied an Expert Certificate regarding her preliminary examination in May 2006. She describes her occupation in the report as a ‘consultant forensic anatomist’ [Sutisno 2006]. Sutisno’s report does not proffer an opinion regarding the identification, it does however advise that the initial assessment determined that the supplied CCTV images were clear and sufficient to warrant a comparative analysis to determine identification. It appears that Sutisno did not conduct a further examination and the investigating police instead sought an expert opinion from another anatomist Professor Henneberg.

Henneberg provided an Expert Certificate regarding the identification of the person of interest depicted in the CCTV images dated October 2006. Henneberg describes his occupation as ‘Professor of Anatomy’ from the University of Adelaide. His report suggests there is a ‘most likely’ probability the person of interest is the accused and further indicated that there was not enough anatomical detail to reach certainty due to the quality of the images. Henneberg’s Expert Certificate was included in the
Crown’s brief of evidence, however it was not presented as evidence-in-chief during the trial.

The Crown instead relied on the evidence given by two lay witnesses who knew the accused. Both witnesses provided positive identification of the accused made directly from the CCTV images. The defence challenged the CCTV identification evidence on the *voir dire* and Whealy J, provided his admissibility decision after hearing further evidence from two lay witnesses and the defence expert during the *voir dire* [Whealy J 2007a].

This chapter examines the CCTV identification evidence provided to the court and the reliability of CCTV images as evidence. This case study is significantly different to the *Jung* case because it uses lay witnesses for the purpose of identification rather than relying on forensic experts. The case study investigates the attributes presented during the case to examine the application of CCTV images and the issues that may arise when lay witnesses provide evidence of identification when viewing CCTV recordings. This chapter discusses the issues of reliability surrounding this case and investigates various items and resources used during the case, including:

- Newspaper articles reporting on the case.
- The CCTV recordings.
- The exemplar material used in the forensic examinations.
- Court transcripts from the trial in the NSW Supreme Court.
- Expert Certificates and reports from forensic experts.
- Published articles on facial recognition and CCTV evidence.
- Standards Australia for CCTV [AS 4806.2 - 2006].

This chapter provides a critical analysis on how images from CCTV are used to recognise or identify persons of interest by lay witnesses. The analysis focuses on the central research question in relation to the reliability of CCTV images when used for identification and how the CCTV evidence was presented before the court. The
examination of the two case studies used in this research combine to provide an analysis based on real life experience of how this form of evidence is used in contemporary Australian courts of law.

7.1 Case Background

The murder of Ian Hughes (aged 60) and Anna Hughes (aged 57) occurred in South Maroota, New South Wales (NSW) on the 23 September 2005. The victims were a married couple and were strangled to death in their home [Hamilton 2005a, Hamilton 2005c, AAP 2006, Cowan 2007, King 2007, Whealy J 2007b] with silk scarfs and men’s dress ties [Lawrence 2007a, Whealy 2007b]. It was further alleged by police, that the killer then stole a total of $12,400 from the victims’ bank accounts shortly after their deaths by using their bankcard at various ATM sites [AAP 2006, ABC 2006, Cowan 2007, King 2007, Lawrence 2007a, Whealy J 2007b].

The accused was arrested in Hoyleton, South Australia (SA) [Hamilton 2005c, Berrett 2005] and charged with various offences including the double murder in September 2005. Peter James Johnson was extradited to Sydney to face trial [Hamilton 2005c, Berrett 2005] and strenuously denied the charges and police allegations [Whealy J 2007b]. The police investigation relied on a range of evidence including CCTV surveillance images recorded on 23 September 2005, the same day as the homicides and again on 25 September 2005 at an ATM at Windsor NSW. Two lay witnesses known to the accused also provided evidence that they could recognise him in the CCTV recordings.

An anatomical comparison of the ATM CCTV images and known video footage taken by the SA Police was undertaken by Henneberg for the Crown. The questioned CCTV images were supplied by the NSW Police and sourced from the ATM CCTV camera while the video footage was conducted by the SA Police when executing the arrest warrant on the accused. The Crown’s expert indicated in his ‘Expert Certificate’ dated 30 October 2006, that the person of interest depicted on the ATM CCTV images is ‘most likely’ Peter James Johnson. Expert identification evidence was not heard in the Crown’s evidence-in-chief. The Crown did however, use lay
witnesses who gave evidence during the trial and claimed they recognised Johnson in the CCTV recordings.

This case study examines the opinions made by the Crown’s expert and both lay witnesses, in order to determine whether the visual data represented in the evidence is reliable. The objective of this qualitative examination is first to determine whether the questioned and known material are of forensic value and are sufficiently reliable to form an opinion regarding the identity of the person depicted in the questioned images. The second component of the case study examines how both forms of evidence; the lay witness oral evidence and the CCTV footage itself, relate to each other and whether the collective presentation of both forms of evidence may be considered as reliable or whether dangerous evidential inferences are introduced. The examination also contrasts the probative value of the evidence with any unfair prejudice to the accused.

The case against Johnson relied heavily on circumstantial evidence. Justice Whealy, in his findings, suggested that despite any direct evidence there was ‘a good deal of circumstantial evidence’ [Whealy J 2007b, para 9] which also included DNA evidence found on the ligatures [Whealy J 2007b]. Johnson maintained his innocence and claimed he was at his girlfriend’s home for much of the day, particularly around the time of the murders. He also claimed that he was there all evening and until the next morning when the funds were taken from the deceased’s accounts [Whealy J 2007b]. In relation to the CCTV evidence, his Honour findings included;

On the evening of 23 September, at about 10.25pm, the offender\(^\text{52}\) went to the ATM machine at Windsor ANZ and withdrew $200 from Ian Hughes Credit account with the ANZ bank. This was the account he had unsuccessfully attempted to use in the day. There was CCTV footage of the person who used the ATM on this occasion. There was also CCTV footage of the person who used the same ATM on 25 September 2005 at 5.12am. None of the witnesses was able to identify the offender in relation to the footage taken on these two occasions. Both the offender’s ex-wife and a friend, Mr Mott, gave evidence that the offender had an unusual way of walking, and holding himself when walking. I am satisfied that the person shown in the footage is the offender. Although the footage is unclear and imprecise in certain areas, there is a strong resemblance between the person shown in the footage and the offender. In particular the person in the footage has the very characteristics referred to by the offender’s

\(^{52}\) His Honour Whealy J, makes an earlier reference in his findings, that his references to ‘the offender’ is Peter James Johnson.
ex-wife and Mr Mott. The offender denied that he was the person shown in the footage but I reject this evidence. I am satisfied beyond reasonable doubt that it was he who used the ATM machine on each of these occasions [Whealy J 2007b, para 16]

In March 2007, Peter James Johnson was found guilty and sentenced to two life terms [Davies 2007, Horton 2007, Whealy J 2007b]. This chapter focuses on the identification evidence sourced from the CCTV images. It does not discuss details of the circumstantial evidence nor any other evidence outside the purview of this research question using a disinterested and neutral position, the guilt or innocence of the accused is not considered during the examination of the CCTV evidence. The reliability of the identification evidence from the CCTV images is exclusively examined during this case study.

7.2 ANZ Bank CCTV Recording; 23 & 25 September 2005

Investigating police obtained CCTV recordings of a person of interest withdrawing funds at the ANZ bank in Windsor. The theft of the funds was made from the deceased’s accounts on the 23 and 25 September 2005. These withdrawals took place before the bodies had being discovered [Whealy J 2007b]. The CCTV recordings were used in the following circumstances during this case;

- Police showed the CCTV recordings to people familiar with the accused for identification purposes.
- The CCTV recordings were tendered and shown as evidence during the trial.
- The CCTV evidence was shown in court in support of the two lay witness’s evidence.
- The CCTV recordings were used by two experts for the Crown and an expert for the Defence (not used at the trial).
Figure 7.1: ‘Camera 04: 23/09/2005 22:27:54’ depicting the POI approaching the ATM and taken an item from the left pocket.

Figure 7.2: ‘Camera 04: 23/09/2005 23:27:56’ depicting the POI approaching the ATM and taken an item from the left pocket.
Figure 7.3; ‘Camera 04: 23/09/2005 22:28:07’ POI obscuring his/her face using what appears to be a white cloth or handkerchief.

Figure 7.4; ‘Camera 04: 23/09/2005 23:29:17’ POI obscuring his/her face using what appears to be a white cloth or handkerchief.
Figure 7.5; ‘Camera 04: 25/09/2005 05:15:05’ POI obscuring his/her face using what appears to be a white cloth or handkerchief.

Figure 7.6; ‘Camera 04: 25/09/2005 05:15:06’ POI obscuring his/her face using what appears to be a white cloth or handkerchief.
7.3 Forensic Examination of the CCTV Recording

A qualitative assessment of the CCTV recordings was conducted for the purpose of the case and this research. The examination was conducted using a calibrated computer monitor (Samsung SyncMaster 920N™). Screen calibration was achieved using ColorVision Spyder2express™ monitor calibration software. Screen resolution was set at 1280x1024 pixels with Highest (32 bit) colour quality. The CCTV recordings were examined on the computer monitor using the proprietary player software (Video CD Player) included on the CD containing the CCTV recordings. The physical size of the viewing format was 200x123 mm and viewed from a distance of approximately 500 mm. The screen resolution, calibration, image format/size and viewing distance were optimised to the best practical limits for accurate image evaluation and facial identification. Ambient light in the room was decreased to avoid specular reflections on the monitor.

7.3.1 CCTV Recording and Metadata

The digital CCTV recordings were stored on two separate CD’s. The first CD label ‘1’ contained a recording dated 23 September 2005. The second CD labelled ‘2’ contained two recordings dated 23 September 2005 and 25 September 2005. The recording dated 23 September 2005 found on the second CD was the same recording contained in the first CD. In effect, there were two digital CCTV recordings and the metadata from these files are listed below;

- **CD Labelled: 1**
  Containing the following metadata;

  Details from CD - DS2(24627).
  Unit ID Number: 00D0D9044DE6

  CD contains 1 image sequences.

  Cam 4 - CAMER_04
CD Labelled: 2

 containing the following metadata;

Details from CD - DS2(12313).
Details recorded from DS2 at 15:18:08 28/10/2005.
Unit ID Number: 00D0D9044DE6

CD contains 2 image sequences.

Cam 3 - CAMERA_03
Cam 4 - CAMERA_04

Sequence 2 from 05:05:24 25/09/2005 to 05:17:23 25/09/2005 contains:
Cam 3 - CAMERA_03
Cam 4 - CAMERA_04

The CCTV recordings depict a person of interest using the ATM on two separate occasions. According to the metadata included on the file, the dates of these activities were; 23 September 2005 and 25 September 2005 and filmed on a camera identified as ‘Camera 4’. The CCTV camera viewpoint appeared to be positioned from a high advantage point situated some distance to the left and facing the ATM. The CCTV camera depicted the person of interest at a range of approximately 50% of the screen height [Cohen et al., 2006, Australian Standard 2006b, Cotterill 2008]. The footage provided by ‘Camera 3’ was very dark with no useable information.

7.3.2 General Observations

The CCTV recording shows the person of interest approaching the ATM, using the teller machine and then leaving the area. The following points of interest were observed during the examination of the recordings;

- On the first occasion, the POI walks through the scene appearing from the bottom of the screen and exiting from the screen top (23/09/05: 22:26:21 - 22:26:30).
- The POI reappears from the top of the screen and approaches the ATM (23/09/05: 22:27:45 - 22:27:57). He/she appears to be searching for some

- On both occasions (23/09/05 and 25/09/05) the POI appears to be making efforts to mask his/her face from any CCTV cameras with the left hand. The POI is also using, what appears to be a white cloth, possibly a handkerchief, to obscure his/her face from the CCTV camera positioned in the awning and any possible camera position within the ATM itself. Refer to Figures 7.3 and 7.4.

- On the second occasion, the POI approaches the ATM from the top of the screen (25/09/05: 05:15:00). On this occasion the POI is holding with his/her left hand, a white cloth (?) in front of his/her face, while holding another item in the right hand (most likely an ATM card). At one stage during the operation of the ATM, the POI appears to look at the CCTV camera located in the bank’s awning (25/09/05: 05:15:09). The POI appears to be aware of the camera and is taking evasive action throughout the ATM operation. The POI leaves the scene from the top of the screen (25/09/05: 05:16:12). Refer to Figures 7.5 and 7.6.

7.3.3 CCTV Frame Rate

The CCTV recordings appear to be a sequence of still images that are played consecutively by the supplied propriety player to give the appearance of a video recording. To conserve storage space, CCTV cameras can be set at different frame rates [Matchett 2003, Cohen et al., 2006]. Adjustments to frame rates on CCTV camera systems mean the camera will capture the information in time-lapse. The frame rate determines how many images are captured every second and are called frames per second (fps).

The idea of capturing motion was first realised by English photographer Eadweard Muybridge in 1878 with his experimental work with the gait of a galloping horse [Happé 1975]. Motion pictures and video footage also consists of a sequence of still images played at a frame rate that exceeds our persistence of vision [Happé 1975]. This vision phenomenon creates the illusion of movement. To produce the
appearance of natural motion, the film rate on motion picture film cameras is 24 fps [Happé 1975] and general broadcast video between 25-30 fps [Cohen et al., 2006].

Due to the nature of CCTV surveillance, images are captured 24 hours per day, 7 days per week. This amounts to exceedingly high levels of data when images are captured at a natural motion frame rate of approximately 25 fps. Digital CCTV systems also have the facility to compress each digital image to save storage space using various codecs. Codecs are compression and decompression algorithms, which also affect the level of image resolution depending on the degree of compression. Common codecs applications include JPEG, MPEG and MP3 [Cohen et al., 2006]. To further save storage space on digital or video CCTV systems, the frame rate may be adjusted to capture fewer frames per second [Matchett 2003, Damjanovski 2005, Cohen et al., 2006]. General digital CCTV systems use a frame rate between 5-6 fps [Matchett 2003, Cohen et al., 2006] although frame rates as low as 1 fps are sometimes used [Cohen et al., 2006].

Access to the actual CCTV camera system used to capture the supplied CCTV recordings was not available. However, visual examination of the recordings was able to approximate the low frame rate used by reference to the time stamp included on the CCTV images. The frame rate used in the supplied CCTV recordings was consistent with approximately 1-2 fps. This frame rate is considerably less than the required frame rate to produce the visualisation of natural motion (≈ 25 -30 fps) and results in an unnatural motion of any subjects moving through the image space.

7.3.4 Image Quality

The general image quality of the CCTV recordings from Camera 04 is very poor and contains several image artefacts. The following problems affecting facial identification were observed;

- Extremely low resolution (this aspect will be discussed in the next section).

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53 High frame rates cannot be estimated by visual examination.
• Image highly pixelated and displays a significant level of image noise artefact.
• Poor colour rendition.
• Lighting does not illuminate the subject/s appropriately to support methods of identification. The lighting displays harsh shadows and lens flare.
• Poor camera exposure and poor dynamic range.
• Significant lens flare appearing from top of the screen and affected most of the image area.

7.3.5 Resolution Standards for Identification

Recent research [Cotterill 2008] at the University of Western Sydney, investigated minimum CCTV resolution standards required to resolve facial morphology (ear morphology) for the purpose of facial identification. Forensic identification methodologies further require the ability to determine facial features that may be considered as ‘unique identifiers’ or ‘individual characteristics’ such as scars, wrinkles, moles and freckles etc [Porter & Doran 2000, Bromby 2003, Yoshino 2004, Iscan & Loth 2004]. Some morphological features are widely considered as individual such as ear morphology [Bertillon & McClaughry 1896, Rhodes 1956, Iannarelli 1964, Purkait & Singh 2008, Wilkinson & Evans 2009]. However, the concept of individualisation is often based on an assumption rather than scientific research and may present problems with positive identifications [Iscan & Helmer 1993, Liu et al., 2003, Saks & Koehler 2008]. Chapter 8 further discusses the ideas regarding individuality. Iscan, in his chapter titled ‘Techniques for Photographic Comparison’, suggests the following in relation to identifications made from morphological analysis. This thinking remains consistent today;

What makes one individual different from all others is a complexity of variation possible with many features. Interpretations and conclusions must be made with caution because certain characteristics may be common to a specific racial or ethnic group [Iscan & Helmers 1993, p68].

The comparison of images obtained from CCTV cameras and exemplar images taken of suspects is a highly complex forensic task. Identification based on the comparison of images may appear deceptively simple, yet it remains highly complex to many
forensic experts, let alone lay witnesses. Iscan and Loth (2004) make the following comment regarding identification from the comparison of images;

*Although it seems deceptively simple, this kind of comparison is one of the most difficult to make.* [Iscan & Loth 2004, p796].

Forensic identification from CCTV images, require the imaging system to record at a minimum resolution standard. This standard is also dependent on the field of view of the camera and how large the subject appears in the camera frame [Brooks 2004, Standards Australia 2006b, Cohen et al., 2006, Cotterill 2008]. The field of view is described as the cameras range and is expressed by the percentage of the subject in relation to the screen height. Refer to figure 7.7 which is sourced from the Australian Standard AS 4806.2;

![Figure 7.7: Illustration showing the camera range based on the percentage of the subject with the screen height](sourced from Standards Australia (2006b) p20).

The range of the person of interest from the CCTV recordings indicates approximately 50% screen height range. Cotterill’s (2008) research advocates minimum resolution requirements to resolve the morphological detail necessary for facial identification methods described by Iscan & Helmer (1993), Halberstein (2001), Yoshino (2004) and Wilkinson and Evans (2009). These minimum resolution requirements are described at different ranges and expressed in MTF50 (Modulation Transfer Function) values. Modulation Transfer Function (MTF) is an empirical
method of determining the resolution of an imaging system. Cotterill’s research defines the MTF using a slant edge test from digital images. It does not define the resolution of CCTV monitors, but the digital image obtained by the optical system. Her research suggests there were no resolution limits detected for a range of 50% of screen height. This means the research found that morphology of the ear is not visible at the 50% screen height due to the small size of the feature at this camera range even with highly resolved images.

A 50% screen height was also determined for the CCTV images used in the Johnson case. The poor resolution of these images further exacerbates the difficulties regarding the capacity to provide identification evidence using facial morphology.

Examinations of the CCTV recording confer with Cotterill’s results. No visible detail regarding facial morphology can be detected in either of the CCTV recordings. Qualitative assessment suggests the resolution is very low and unsuitable for identification purposes. No unique identifiers (or individual characteristics) [Bromby 2003, Yoshino 2004] are detected because of the poorly resolved nature of the CCTV recordings and the image artefacts also presented in the images and at the same screen height rate (refer to Figures 7.1 to 7.6).

![Figure 7.8: Minimum resolution values from Cotterill’s experiment. The lower values represent less resolution required to resolve ear morphology. The 100% and 50% range did not record a MTF50 value at these ranges. The CCTV images used in this case are at a 50% screen height range [chart sourced from Cotterill 2008].](image)
The Australian Standards (2006b) and guidelines from the UK’s Home Office [Cohen et al., 2006] make the distinction between ‘identification’ and ‘recognition’. However, this distinction is largely dependent on image resolution. As Cotterill’s (2008) research indicated, facial morphology (facial features) are not clearly defined at any minimum resolution at a 50% screen height range. If facial features cannot be determined, then recognition could be unreliable.

7.4 South Australian Police Arrest Video (Exemplar Material)

An examination of the exemplar video footage was also conducted. This material was recorded by the SA Police during the arrest of the accused. Four DVD’s were examined, labelled ‘Tape A’, ‘Tape B’, ‘Tape C’ and ‘Tape D’. The examination was conducted using a calibrated computer screen used to view the CCTV recordings.

General observations of the video recording indicated;

- The filming appeared to be hand held except for periods within the vehicle.
- The lighting quality varies throughout the filming due to the use of available lighting. No additional lighting was detected.
- Image quality is reasonable for video recording standards (but it is not highly resolved).
- Unique identifiers such as skin creases on the accused are detected in the footage.
- The filming appears to be a record of the arrest procedures and was not carried out for the purpose of forensic analysis.
- Most of the filming displays a three-quarter or close-up view of the accused. No angles or image perspective replicating the questioned material (CCTV images) were observed.

The ‘exemplar’ material displays considerable differences to the CCTV material, including;
Figure 7.9: Exemplar still images taken from the arrest video used by the Crown’s expert during the analysis. The Crown’s expert did not indicate he used still photographs during the examination method. Note the difference in camera angle and image perspective between the exemplar images and the sourced CCTV images (the faces of the police officers have been pixelated).
• No consistency with the pose of the subjects (i.e. full-length seen in the questioned imaging, while mostly three-quarter and close-up poses seen in the exemplar footage).
• Exemplar material does not appear to be produced for the specific purpose of the forensic identification examination, but for other purposes (i.e. to document the police arrest and search procedures).
• The exemplar material does not match any aspect of the questioned material (resolution, camera angle, image perspective).
• The suitability of the exemplar material is further problematic if it was not conducted by a person with forensic photography skills with knowledge, particularly regarding concepts of image perspective, lens choice, camera angles and resolution requirements needed for identification examinations, as set out in the ACPO (Association of Chief Police Officers of England, Wales and Northern Ireland) guidelines [ACPO 2003].

7.5 Expert Identification Evidence

Henneberg’s Expert Certificate, as set out in section 177 of the Evidence Act 1995, provides his opinion that the images depicted in the CCTV images were ‘most likely’, with 95% accuracy, that of the accused [Henneberg 2006]. The identification results were based on a comparison between the person of interest depicted in the CCTV images (questioned) and the SA Police video (exemplar). The accused’s identity was known and confirmed in the SA Police video. Henneberg (2006) suggested his ‘most likely’ positive identification was based on the following observations made during his comparative analysis between the CCTV recordings and the exemplar material;

• He has a slim body build.
• He has rounded shoulders.
• His posture – head held forward and hips thrust forward when standing on both legs.
• He is right handed.
• He is a cigarette smoker.
• His cheeks have vertical hollows.
Henneberg conceded that his observations were limited by the quality of the CCTV images. The methodologies described in the report were also quite limited, however it was suggested the anatomical examination (from the footage) examined aspects of individual characteristics of the body and face of the person of interest. Henneberg’s report does not state whether or not he examined the questioned and exemplar material side-by-side or at different times on a single monitor.

The expert evidence was not presented as part of the Crown’s case during the trial. Just before the commencement of the trial, the Crown informed the defence that they had decided not to use the expert identification evidence. The reasons for this decision are unknown.

Henneberg’s findings are based on some general descriptive notions of body shape and some character idiosyncrasies and habits. There is no indication that the identification is based on any concepts of individuality that would warrant identification. Henneberg’s methods are less than ideal and there are significant photographic differences between the questioned and exemplar material. These photographic differences are highly problematic for reasons discussed in the earlier Jung case study. Considering the lack of morphological detail presented in the face of the CCTV recordings, any suggestion of a positive identification would be highly unsuitable.

The preliminary findings from Sutisno, suggesting the CCTV was of suitable quality for identification purposes, is also problematic and in stark contrast with the findings of this research. While the CCTV camera used to record the person of interest could not be quantitatively tested using optical testing methods (MTF), qualitatively no facial morphological features were visible. Minimum resolution standards must be considered when determining the suitability of CCTV images for expert identification, a factor often not considered by forensic practitioners.

7.6 Forensic Examination of Crime Scene (ANZ Bank, Windsor)

For the present research an examination of the ATM site was conducted to confirm details presented in the CCTV images and to enhance the background information
provided for the forensic examination of the images. The secondary crime scene was examined at approximately 21:36 hrs on 28 January 2007. The time considered for the inspection was to replicate the quality and quantity of available lighting that was available in the scene during the CCTV capture. The examination indicated the location of the ATM, which was positioned in the front window in the CCTV images, had been moved to the left and into the building entry. Other structural features of the building appeared to be consistent with the building depicted in the CCTV images. The following observations were made during the examination of the crime scene location:

- No CCTV camera was visible in the ceiling of the front awning. However, a hole was detected in the fabricated metal ceiling that is consistent with the height and angle depicted in the images (It appears that the CCTV camera had been removed from its original position).
- Tiles on the front wall situated below the window were observed to be consistent with the CCTV images. Tiles measured 220 x 110 mm in size and were grouted with black grout, displaying reasonable contrast.
- Pathway was on a decline, heading down towards the southern end of the road.
- The pavement appeared to be constructed with a course bitumen material.
- Concrete gutter on the kerb appeared to be straight and not curved as indicated in the CCTV images.
- ATM was positioned within the recessed entry of the bank.
- A CCTV camera was located opposite the ATM camera and was covered with a spherical glass or plastic dome.
- Street lighting was extremely low and situated on the opposite side of the street. No lighting was present within the front awnings ceiling.
- Six lights were located in the ceiling of the entry recess.

The lighting presented at the scene appeared to be consistent with the lighting depicted in the CCTV images; a low level of illumination and quality. The white tiles in the buildings construction were present and could be used as a possible reference for size and rectilinear distortion.
7.7 Lay Witness Evidence from CCTV Recording

During the investigation, police approached possible witnesses who knew the accused and requested they examine the CCTV footage in an attempt to obtain an identification from the visual evidence. This type of identification is significantly different to a comparative analysis examination from a forensic expert. It relies on the witness’s ability to recognise the person of interest because of their experience as an eyewitness to the crime or, as in this case, because they are familiar with the suspect. This type of identification is considered as ‘lay witness’ identification and is discussed as ‘observation’ evidence in Chapter 4.

Two witnesses made a statement to police indicating that they could identify the accused when they examined the CCTV recording. The witnesses were Mrs Gail Susan Johnson, the accused’s ex-wife and Mr Richard Michael Mott, a friend of the accused and a former police officer with the NSW Police Force. Each witness had known the accused for more than twenty years and gave evidence during the trial. Their familiarity with the accused was never in any doubt.

During their oral evidence at the trial, both witnesses made concessions with respect to identification difficulties caused by the poor quality of the CCTV footage. This case study examines their evidence and also in the context of previous recognition accuracy research. During the court proceedings, the CCTV footage was admitted as court exhibits (Exhibit GG and Exhibit FF). The CCTV footage was played to the court (including the jury) at times throughout the witness’s testimony. In essence, the identification evidence presented by the Crown was the combination of the oral testimony of Johnson and Mott with the CCTV vision. This combined presentation is an important aspect of the critique of this case study and is further discussed later in the chapter. An examination of Johnson and Mott’s evidence was conducted using court transcripts. Sections of their testimony have been included to provide some perspective regarding the level of confidence the witnesses provided regarding the identification of the accused on the CCTV footage. It also shows the sequence of evidence presented to the court, which is an important aspect of reliability.

54 ‘Exhibit GG’ was the CCTV footage captured on 23 September 2005 and ‘Exhibit FF’ contained both CCTV recordings captured on 23 and 25 September 2005.
On 13 February 2007, Gail Johnson gave evidence to the court. Her evidence included details regarding her relationship with the accused and other contextual information. This examination only considers her evidence in relation to the identification from the CCTV footage. Some way through her evidence, the Crown Prosecutor asked Johnson several questions regarding the accused’s appearance. The CCTV exhibits were then played in court and she was asked a series of questions. The exchange reproduced below was sourced from court transcripts. It is not the full oral evidence presented by witnesses and some details not relating to the CCTV evidence have been omitted.

Evidence-In-Chief

CROWN PROSECUTOR: Did you on 15 November 2005 view some video footage of a male person apparently using an ATM machine?
JOHNSON: Yes.

CROWN PROSECUTOR: I want to ask you some questions before I ask you to look at that again, but first of all, can I ask you do you know whether the accused was right- or left-handed?
JOHNSON: Right-handed.

CROWN PROSECUTOR: Could you describe his hands?
JOHNSON: Big hands, and very fat fingers.

CROWN PROSECUTOR: Could you describe his posture, if you like?
JOHNSON: Always round shouldered, bent over.

CROWN PROSECUTOR: What about his build in 2005?
JOHNSON: Stocky, solid build.

CROWN PROSECUTOR: Shoulders?
JOHNSON: Rounded.

CROWN PROSECUTOR: His height?
JOHNSON: 5-foot-10 or just under.

CROWN PROSECUTOR: His approximate weight?
JOHNSON: Fluctuated between 12 to 13 stone. Sorry to say ‘stone’.

CROWN PROSECUTOR: Did he smoke?
JOHNSON: He did.

CROWN PROSECUTOR: Do you remember what brand he smoked?
JOHNSON: Benson & Hedges Special Filter, now Classic it is known.

CROWN PROSECUTOR: Sorry?
JOHNSON: It is known as Classic.
CROWN PROSECUTOR: In relation to the way he smoked, can you ever recall the cigarette being left in his mouth when he was doing something else?
JOHNSON: Oh, yes, if he was using both his hands he could leave the cigarette in his mouth, yes.

CROWN PROSECUTOR: What about the way he walked?
JOHNSON: He always walked slightly bent, his head facing the ground and his shoulders rolled forward.

CROWN PROSECUTOR: Is it convenient to show her that now, your Honour?

HIS HONOUR: Yes, Exhibit GG, that is the extended version.

CROWN PROSECUTOR: I will ask you to look at these two footages of CCTV and probably after lunch I will ask you a few more questions.

EXHIBIT GG PLAYED.

CROWN PROSECUTOR: We will show the footage of the 25th on this one, your Honour because the other part is a repeat.

EXHIBIT FF PLAYED.

(an adjournment for lunch followed and Johnson’s evidence continued after lunch)

CROWN PROSECUTOR: Mrs Johnson, after looked (looking) at the CCTV were you able to observe anything about any of the images shown in terms of similarity to anyone?
JOHNSON: Yes, I could, yes.

CROWN PROSECUTOR: First of all, what feature or features were you able to observe and who do you say, if anyone, they were similar to?
JOHNSON: They are similar to Peter Johnson, the back view of him.

CROWN PROSECUTOR: In Exhibit GG, that is one of the CCTV shots you saw, there was a back view of a person walking, so you see that person’s back as they are walking?
JOHNSON: Yes, yes.

CROWN PROSECUTOR: What do you say about that in terms of similarity?
JOHNSON: The similarities in the way that he walks bent forward with his head looking to the ground and his shoulders rolled forward.

CROWN PROSECUTOR: In both of the CCTV's there are images of a person at the ATM machine. Are you able to say anything at all in term of similarities there to anyone? It may not be as strong as the walking but …….
JOHNSON: The only similarity really is that he is smoking but probably the more I view the footage probably the more similarities I can see because I have now watched it a few times and I am seeing more similarities the more I watch it.

CROWN PROSECUTOR: Are you able to actually describe what the similarities are between the person depicted at the ATM machine and the accused?
JOHNSON: More so with the shoulders than anything else. The way his shoulders are forward is what stands out to me.

CROWN PROSECUTOR: Did you notice what hand the man, the person, at the ATM was using to punch in the numbers?
JOHNSON: Yes, I did.

CROWN PROSECUTOR: What was that?
JOHNSON: His right hand.

CROWN PROSECUTOR: What about the position of the head of the person at the ATM machine, the position of his head?
JOHNSON: No, the position of the head didn’t do anything, no.

CROWN PROSECUTOR: Any other aspects?
JOHNSON: No, just with what he was wearing, the shirt was the same.

CROWN PROSECUTOR: What do you mean?
JOHNSON: The same colour shirt or jacket when he was walking away and standing at the ATM machine.

CROWN PROSECUTOR: It is important we don’t confuse necessarily between the person walking away and the person at the ATM. What I am asking at the moment is similarities of the person at the ATM with the accused as you know him to be. Do you understand the difference?
JOHNSON: Yes.

CROWN PROSECUTOR: Do you or not?
JOHNSON: No, not really.

CROWN PROSECUTOR: All I am really asking, I am not asking you to compare the image of the person walking with the image of the person standing at the ATM at this stage. I am not asking you to compare. All I am asking you to do is to, and I think you have said this, that there are similarities between the person at the ATM and the accused?
JOHNSON: Yes.

CROWN PROSECUTOR: All I am asking is what are they?
JOHNSON: Yes.

CROWN PROSECUTOR: And you have said the shoulders?
JOHNSON: Yes, mainly the shoulders and the fact that he is smoking a cigarette in his hand.

CROWN PROSECUTOR: Are you able to say anything about the build?
JOHNSON: The build looks very similar in that it is a solid build. It is not a small-framed person, it is the same solid build.

Cross-Examination

DEFENCE COUNSEL: In relation to the person that you saw on the CCTV using the ATM machine, I think you said that similarity was the forward shoulders?
JOHNSON: Yes.
DEFENCE COUNSEL: Did you observe that person in the footage using the ATM machine?
JOHNSON: Did I?

DEFENCE COUNSEL: Did you see a person in the ......
JOHNSON: Yes, I did.

DEFENCE COUNSEL: In order to do that, they were bending over to punch numbers on the machine?
JOHNSON: Yes.

DEFENCE COUNSEL: And the numbers were obviously down around or approximately waist height or thereabouts?
JOHNSON: Yes.

DEFENCE COUNSEL: In order to reach the numbers you saw the person bend over?
JOHNSON: Yes, bend slightly forward, yes.

DEFENCE COUNSEL: Is it fair to suggest that your matrimonial separation with Mr Johnson was a bitter one?
JOHNSON: Yes, absolutely.

DEFENCE COUNSEL: You said things to him like ‘You’ll live to regret this day’
JOHNSON: I may have.

DEFENCE COUNSEL: ‘I have never hated anyone in my life but I hate you so much I despise you’?
JOHNSON: Yes.

DEFENCE COUNSEL: Is that still the case today?
JOHNSON: Yes.

DEFENCE COUNSEL: Throughout your marriage did your husband ever wear a beanie?
JOHNSON: Not to my knowledge.

DEFENCE COUNSEL: You see the clothes on that CCTV footage that the person is wearing on the video?
JOHNSON: Yes, I did see.

DEFENCE COUNSEL: Your husband doesn’t have any clothes that resemble that, would you agree?
JOHNSON: I agree but then the footage was not all that clear.

(the defence counsel asked further questions that did not relate to the CCTV evidence)

Re-Examination by Crown Prosecutor

(several questions were asked by the Crown during the re-examination, however only the last question related to the CCTV evidence)
CROWN PROSECUTOR: You said you despised him and still do. Has that in any way influenced the evidence you gave about the viewing of the CCTV?
JOHNSON: No, no, no.

This was the witness’s second time giving this evidence due to the Defence challenge in voir dire, which is discussed after the evidence-in-chief. When the identification evidence is considered in this testimony, it offers very little positive identification. The descriptions made by the witness were vague, confusing and with a considerable degree of uncertainty. She has recognised the accused based on poor quality CCTV footage and vagueness of the identifying features. On its own, this oral evidence regarding the identification would most likely have had little effect on the jury. However, the evidence given must be considered as a combination of the visual evidence shown before the questions regarding her recognition evidence and her oral testimony. The significance of combining the two forms of evidence, the CCTV material and oral evidence, is its degree of support Johnson’s evidence gives to the visual narrative offered by the CCTV evidence.

The following day, Richard Mott gave evidence before the court. The following is an extract of his evidence relevant to the CCTV identification;

Evidence-in-chief

CROWN PROSECUTOR: Well, just as to him and what you know of him physically if you like, his appearance or the way – his stature or his build?
MOTT: Yeah, Peter has a sort of distinctive walk that’s – he’s sort of got stooped shoulders and when he walks he sort of shuffles his head from side to side (indicated) and his feet – I don’t know how to explain it, but it’s sort of different to other people’s walk.

CROWN PROSECUTOR: What about the shoulders?
MOTT: They’re normally stooped (indicated).

CROWN PROSECUTOR: Is that only walking or is it when he’s still as well, can you say?
MOTT: Oh, I think it’s more noticeable when he’s walking.

CROWN PROSECUTOR: What about the position of his head?
MOTT: Well, it’s normally – he normally sort of – I don’t know, it’s hard to explain, but his head’s normally like that (indicated).

CROWN PROSECUTOR: When you say ‘like that’....
MOTT: Sort of down, yeah (indicated)

CROWN PROSECUTOR: Sort of .....
MOTT: Looking downwards.

CROWN PROSECUTOR: Now, did you know what his height was or not? If you don’t know precisely just say so?
MOTT: No, I don’t think he’d be six foot. He’s a bit under six foot I’d say.

CROWN PROSECUTOR: What about his build in 2005?
MOTT: His build, he was fairly solid build, bulky.

CROWN PROSECUTOR: Sorry, the last word?
MOTT: Bulky.

CROWN PROSECUTOR: And he smoke?
MOTT: Yes, he was a heavy smoker.

CROWN PROSECUTOR: And did you observe him smoking on a number of occasions?
MOTT: Yes, I did, yeah, I did.

CROWN PROSECUTOR: Did you observe anything particular about the way he smoked a cigarette?
MOTT: Yeah, he always used to sort of have a distinctive way of smoking. He’d sort of draw very heavily on a cigarette (indicated).

CROWN PROSECUTOR: When you did that you put your hand up to your face (indicated)?
MOTT: Yeah, that’s how he’d sort of smoke.

CROWN PROSECUTOR: So you indicated to describe it you put your right hand up with the index and middle finger very close to your lips (indicated)?
MOTT: Yeah, sort of like that (indicated).

CROWN PROSECUTOR: Almost touching?
MOTT: Almost touching, yeah (indicated).

CROWN PROSECUTOR: On 10 November 2005 were you shown some CCTV footage of a man – apparently of a person using an ATM machine?
MOTT: I was, yeah.

CROWN PROSECUTOR: Do you remember the police officer who showed you that?
MOTT: Yes, I do.

CROWN PROSECUTOR: Who was that?
MOTT: Detective Gilbert.

CROWN PROSECUTOR: And at the time he showed you that, can you remember what he said, if anything, what he said or what he asked you to do, or can you remember the words that he used or, if not, as best you can what he said?
MOTT: Yeah, he wanted me to view the video and see if I could identify who the person was that used the ATM.

CROWN PROSECUTOR: All right. Now, you viewed it then, correct?
MOTT: Sorry?
CROWN PROSECUTOR: You viewed it?
MOTT: Yes, I did.

CROWN PROSECUTOR: And as a result of viewing it, could you see any aspects or characteristics of a person shown approaching and using the ATM that were of significance to you?
MOTT: Yes, I saw – you know, to me it could have been Peter. It appeared to have the mannerisms of what appeared, from what I saw of the video, that it was Peter.

CROWN PROSECUTOR: That it could have been?
MOTT: Could have been, sorry, could have been Peter.

CROWN PROSECUTOR: You’d agree that the quality of the CCTV is not great?
MOTT: Yeah – no, it’s not.

CROWN PROSECUTOR: So that’s as high as you would put it that it could have been?
MOTT: Yeah.

CROWN PROSECUTOR: What were the characteristics that you noticed that made you say that – would make you say that?
MOTT: Well, the walking, distinctive walking and the smoking at the time using the ATM, yeah.

CROWN PROSECUTOR: What about ……
MOTT: And his actual posture.

CROWN PROSECUTOR: His posture?
MOTT: Yeah.

CROWN PROSECUTOR: What about the build of the person?
MOTT: Yeah, well, his build and – yeah.

CROWN PROSECUTOR: Was that consistent……
MOTT: It was consistent to what I would say that I remember Peter as.

CROWN PROSECUTOR: Had you seen him in casual clothes?
MOTT: Yes.

CROWN PROSECUTOR: Might the witness be shown exhibit FF?

CROWN PROSECUTOR: I just want you to look at this to confirm whether this was the CCTV that you viewed and then I’ll just ask you a couple of questions after that.

EXHIBIT FF PLAYED.

CROWN PROSECUTOR: That is the 23rd. Now the 25th.

EXHIBIT FF CONTINUED TO BE PLAYED.
CROWN PROSECUTOR: I just wanted to play part of the other exhibit GG, your Honour.

EXHIBIT GG PLAYED

CROWN PROSECUTOR: I’ll stop it there, your Honour.

CROWN PROSECUTOR: Mr Mott, just having a look at those, first of all, are they the CCTV’s that you looked at in November of 2005?
MOTT: I believe so.

CROWN PROSECUTOR: And just looking at them again – I’ve already asked you about features that you saw – is there anything other that you want to add in terms of characteristics to what you’ve already said?
MOTT: No.

CROWN PROSECUTOR: That is the examination.

The extracts from each witness’s testimony exclude information that is not relevant to the CCTV evidence. The length of the transcription material included in this chapter is necessary to gain an understanding of how the CCTV evidence was embedded into the oral evidence from each witness. The combination of both forms of evidence is an important aspect. Both witnesses expressed difficulties identifying any facial features due to the poor quality of the recording.

It should also be noted, that any criticism of the lay witnesses evidence is not a challenge on their integrity and honesty. They have clearly answered questions openly and honestly to their best knowledge. Any criticism of their reliability as a witness is solely based on how they perceived the visual evidence.

Prior to this evidence being heard by the jury, the lay witness evidence and the CCTV footage were challenged by the defence in a voir dire. During the voir dire, the Judge heard evidence from the two lay witnesses, a defence expert and the CCTV footage was viewed without the jury present. His Honour published his voir dire decision on 13 February 2007 and is quoted below;

His Honour: The view I expressed in my earlier decision remains essentially the same. It still seems to me, this is a tentative view having heard the evidence, it seems to me there is a degree of probative value as to what came from both Mr Mott and Mrs Johnson. In light of the evidence of Mr Porter, not necessarily because of his evidence, because I think that one does not have to be an expert to form a conclusion on the point, I consider it would be quite risky to try and
identify the person in the CCTV solely from the way in which the person is walking, that is, from the length of his stride or the manner in which his feet are moving. This is because of the time lapse in movement of the photographic frames. To describe the person as shuffling, for example, and draw some resemblance between that person and the accused on that account, would be rather a risky enterprise, in my view.

On the other hand, it does seem to me that the evidence of Mrs Johnson and Mr Mott, notwithstanding anything Mr Porter has said, does suggest that there is a resemblance in certain of the frames between the person in the CCTV and the accused; in particular, the height and stature of the person, the position of the head and shoulders both when walking, and perhaps standing still; and the method of smoking a cigarette. Once again, however, it does seem to me that it could not reasonably be suggested that either of the witnesses has purported to identify the person in the CCTV as the accused. The evidence of the accused’s rather unusual way of walking does have probative value and in my view, it should go before the jury. Similarity, the evidence of the accused’s general physical characteristics as at 2005.

I still consider that directions or warnings should be said to the jury however. I do not know what counsel think about these suggestions, but the points that need to be stressed seem to be the following:

1. The evidence is not identification by either witness, and the jury should not regard it as such.

2. The jury will be entitled to examine the images in the CCTV themselves and do so armed with or assisted by, assuming it is of some assistance, the evidence of Mr Mott and Mrs Gail Johnson and consider for themselves whether the person in the CCTV does or does not resemble the accused. I think that the jury should be warned, however, that they may not be able to identify the person in the CCTV; and that in assessing the images they should take into account first that the picture is of poor quality. Secondly, it appears to be a series of still images. Thirdly, the jury must allow for some distortion arising from the position of the camera. All three of those matters need to be taken into account with the consequences that the images should be scrutinised carefully if the jury are attempting to ask themselves whether there is a resemblance between the person in the CCTV and the accused.

Finally, there will be a need to remind the jury perhaps that the Crown does not rely on this evidence as identification evidence. It is simply part of the Crown’s overall circumstantial case, but one point of that case, to be given such weight as the jury thinks it should have and no more [Whealy J 2007a].

The balance between any unfair prejudices and probative value was an issue during the voir dire. His Honour’s decision clearly makes the point, that the witness’s evidence should not be considered as identification evidence. If this is the case, then what probative value does their evidence offer? In relation to recognition evidence and his Honour’s suggestion that the witness’s testimony may be considered as
circumstantial evidence, these aspects are further examined in the following chapter sections.

7.8 Facial Recognition Research

Research into the reliability of facial recognition from images by witnesses can be considered as an interdisciplinary area of research that resides within the psychology and visual culture domains. How, what and why people recognise faces in images is an interesting psychological consideration. Characteristics inherent in images provide the visual information to invoke meaning and recognition. They are considered to have a visual culture function. The two disciplines provide a nexus of ideas that provide an interesting interdisciplinary area of study.

There have been several published papers over the last decade regarding the accuracy of lay witnesses to recognise people from various visual sources including; images on credit cards, CCTV, photo arrays, artist’s drawings and photographs made from skull reconstructions. Some researchers include; Schiff et al., 1986, Rhodes and Wooding 1989, Kemp et al., 1997, Bruce et al., 1999, Burton et al., 1999, Bruce et al., 2001, Henderson et al., 2001, Stephan and Arthur 2006, Stephan and Henneberg 2006, Megreysa and Burton 2007, Wilkinson and Evans 2009. Researchers include psychologists and forensic practitioners.

Studies that have examined the accuracy of facial recognition by lay witnesses primarily fall into two distinctive categories; studies based on ‘unfamiliar’ and ‘familiar’ faces. Research generally suggests there is a low degree of accuracy, when people attempt to compare photographs of unfamiliar faces with other image sources (CCTV recordings, ID photographs or from photo arrays). This also includes results gained from testing police officers trained in identification [Burton et al., 1999]. The findings also suggested that matching of unfamiliar faces produced poor results, even when high quality images were used [Burton et al., 1999]. Most research is predominantly based on identifying faces and is not based on gait or body shape.

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55 Photo arrays consist of a grouping of facial photographs.
Burton et al., (1999) and Bruce et al., (2001) compared results from both types of facial recognition; familiar and unfamiliar faces. Results from the unfamiliar groups corresponded to other research indicating a high degree of error. Burton et al., (1999) suggests this error is in order of 30%. However, both papers suggest a high degree of accuracy when the faces shown are highly familiar to the observer [Burton et al., 1999, Bruce et al., 2001].

Central to this case study however, is the findings from Burton et al., (1999). Burton and his colleagues tested observers who were familiar and unfamiliar with the test subject. The experiments not only compared the results of the two groups, they also tested groups using poor quality CCTV recordings. The findings of this work remained consistent; it found people unfamiliar with the test subjects produced a high degree of error, while people who were familiar with the test target produced accurate results even with poor quality CCTV recordings. However, Burton’s et al., (1999) experiment also tested the conditions in which the familiar group made their accurate identifications and this component of the work is most relevant to the Johnson case.

Using poor quality CCTV recordings, Burton et al., (1999) tested different parameters in which the familiar group examined the CCTV images to make their assessments. Their first experiment consisted of showing the CCTV footage and the results was a high level of accuracy in the familiar test group and low accuracy in the unfamiliar test group. The second experiment further tested the familiar group’s ability to recognise the targets from various isolated visual cues. The experimental design isolated visual aspects by; i) obscuring the body (by placing a black box over the body area), ii) obscuring the gait (by using a time lapsed sequence of the footage, rather than natural motion) and iii) obscuring the face (by placing a black box over the face region) [Burton et al., 1999]. The results of Burton et al., (1999) study indicated that familiar groups produced a high degree of accuracy when determining recognition by facial features. However, the results also show high error rates when recognition was determined exclusively by gait or body shape. Discussing the results, Burton et al., argues;
The data from this experiment strongly suggest that subjects were using information from the face to identify people in these videos. There was a small (but reliable) reduction in accuracy when a person’s gait or body was concealed. It is evident from Figure 4 (not included) that the face obscured condition produced much worse performance than all the others. This is even more apparent in Figure 5, (not included) which shows that when these images were seen for the first time, people were extremely inaccurate at recognizing them. It was in this condition that subjects had to rely on body shape, gait, and knowledge of the people’s clothes. However, it seems that they were unable to make good use of these cues to identify the target people. [Burton et al., 1999, p246 and 247].

It seems intuitively reasonable to suppose that observers do use gait and body-shape information to discriminate among people, but this intuition is not supported in the data. [Burton et al., 1999, p248].

Burton’s et al., (1999) findings suggest that the familiar group identifications made from either the person’s gait or body shape are highly inaccurate, while identifications made from this group made by facial features were highly accurate. These findings are especially relevant to this case.

7.9 Reliability of the Lay Witness’s Evidence

Evidence given at the trial by both lay witnesses suggested they could recognise the accused in the CCTV recordings by the way he walked and by his body shape rather than from his face. The forensic examination of the CCTV recordings indicated that;

- Natural motion was not present in the recordings and that the recording consisted of a sequence of time-lapsed images (similar method to Burton’s et al., 1999 experiment to obscure the gait).
- The body position of the POI also appeared to be strongly influenced by several factors including; the POI reaching into his left shirt pocket by evasive methods to avoid detection (head down to hide his/her face and placement of obstacle over face), and the physical operation of the ATM could also cause some bending forward.
- The POI’s face was obscured by lack of resolution, the evasive methods employed by the POI, and poor lighting.
Combining the findings of the forensic examination of the CCTV recordings and the concessions made by both witnesses - that they could not see the person of interest’s face clearly and their determination was based on the person of interest’s gait and body shape - Burton’s et al., (1999) research suggest that this type of evidence could produce unreliable results.

An important distinction between Burton’s et al., (1999) experiment and the evidence supplied by the lay witnesses, is the degree of unintentional bias placed on the observers. Burton’s experimental groups were not asked to make an identification of a named person, however in the Johnson investigation, both witnesses went to the police station with the purpose of seeing whether they could identify the accused in the CCTV recordings. The extent of this unintentional bias is unknown, however it may be of significance when attempting to make an identification to assist police.

Doyle (2005) discusses several issues regarding the number of misidentifications and their causes when suspects are identified by eyewitnesses including victims of crime. Doyle (2005) also discusses the potential of ‘unconscious transference’ by the eyewitness, which is a psychological effect that impedes the witness’s memory through contamination by ‘post-event’ information [Doyle 2005]. Doyle suggests this situation may be seen when police first show witnesses photographs or mug shots of the suspect during the investigation and then subsequently ask the witness to identify the suspect in a line-up. Doyle discusses problems of identification caused by unconscious transference:

…they rushed into the laboratories. There, they generated a body of experimental findings that led to another extraordinary consensus: 95% of the experts agreed that a witness who have seen a mug shot of a defendant in a photo-array was more likely to identify the same man in a subsequent ‘live’ lineup, whether the initial photographic identification was right or wrong ????????????? The police routine of showing mugshots to witnesses, in other words, provided post-event information of unusual salience. A photo-array process that had been regarded as a routine preliminary screening turned out to be the last genuine chance to retrieve uncontaminated memory. By the time the in-person lineup came around, the witness would be remembering the face the witness had seen in the mugshot. [Doyle 2005, p105]

While this case presents a different situation to that described by Doyle, it does present the same dangers which lead to a level of unreliability when witnesses are
attempting to make an identification with the influence of post-event information. In this case, the witnesses specifically went to the police station to view the CCTV recordings for the purpose of identifying the accused who was known to them. Due to the lack of any detail of facial features in the CCTV footage, the interpretation and any identification, could be significantly influenced by unintentional biases based on the witness’s willingness to assist police as good citizens and their pre-event knowledge or memory of the accused’s appearance. Inaccuracy in identification caused by unintentional bias is a strong possibility especially when the condition of the images is considered. In other words, when viewing images that do not show facial features clearly the witnesses could in fact begin subconsciously to see similarities based on their memory and willingness to help with the investigation. This is an important consideration when evaluating the reliability of their evidence.

The critical questions that arise from the Johnson case study are about the prospective reliability of the witnesses and what weighting should be given to their oral evidence when combined with the visual evidence (CCTV footage). Madison (1984) suggests,

Jurors are more likely to believe physical evidence than oral testimony. The potential prejudice of photographic evidence, therefore, is enhanced. [Madison 1984, p726-727].

Madison’s comment is applicable in the context of this case although the oral evidence given by the witnesses adds to the influence of the visual evidence (CCTV).

Previous research [Loftus 1979, Kemp et al., 1997, Wells et al., 1998, Burton et al., 1999, Bruce et al., 1999, Wells et al., 2000, Bruce et al., 2001, Doyle 2005] into the reliability of lay witnesses to recognise unfamiliar people is considered as unreliable. However, results with familiar faces suggest the level of reliability is significantly improved [Bruce et al., 2001].

The two lay witnesses in Johnson however, were unable to make any identification based on the facial features due to the poor resolution of the footage and because the person of interest employed evasive actions and obscured his/her face from being recorded on CCTV (see Figures 7.3, 7.4, 7.5 and 7.6). Both witnesses claimed they
could recognise the accused, albeit conceding some difficulties, and their claims were based not on facial features but how the subject walked and by the body shape.

The examination of the CCTV recording also proved that the detection of facial features was not possible and that the time lapsed images were not suitable for movement analysis or to form any opinion on how the subject was walking. Furthermore, Burton’s et al., (1999) research demonstrates that the reliability of lay witnesses familiar with the person of interest could not be determined without the visualisation of facial features. The research also indicates that recognition using gait or body shape produced a high degree of error [Burton et al., 1999].

There was obviously some doubt regarding the witnesses’ evidence and a possibility that the recognition evidence was potentially unreliable. As a way of promoting a balanced view regarding this evidence, Whealy J, gave instructions to the jury on unreliable recognition evidence:

Members of the jury, I wanted to say something to you, which I will repeat to you in my final summing-up, but while it is fresh in your mind I want to say something to you about the evidence of Mr Mott and Mrs Gail Johnson. Each of those witnesses gave some evidence about the physical characteristics of the accused based on their long knowledge of him. There is no need for me to say anything about that, it is a matter for you as to whether you accept that evidence and what weight you give it.

I am more concerned, however, with the evidence of both Mr Mott and Mrs Gail Johnson in relation to their viewing of the CCTV footage and the comments they had to make about whether or not the person in that footage resembled in some respect the accused. That is the evidence I am focussing on. In relation to that evidence, it is necessary for me to point out to you and direct you that neither Mr Mott nor Mrs Johnson positively identified the accused. There is no suggestion, therefore, that that evidence is to be regarded by you as an identification, and the Crown, of course, does not rely on the evidence as identification evidence. It is simply part of the Crown’s overall circumstantial case, and it is a matter for you as to whether you accept that evidence and what weight you give it. It is entirely a matter for you. But it may occur to you, members of the jury, that you might want to look at the CCTV and armed with or assisted by the evidence of Mr Mott and Mrs Gail Johnson as to physical characteristics of the accused consider for yourselves whether the person in the CCTV does or does not resemble the accused. It is legitimate for you to do so.

I simply want to add a word of warning, as it were, to say to you that in the end you may not be able to identify the person in the CCTV footage and, in particular, these matters seem to me to be important to point out to you, that the picture is of poor quality. Secondly, it appears to be a series of still images which jump forward rather than an exact portrait of someone moving in a
natural way. Thirdly, you obviously would have to allow for some distortion arising from the position of the camera. And fourthly, you would need to take into account that the person in the CCTV footage may have been, probably was, attempting to hide his features. That may have affected his posture and method of movement. They are matters I draw to your attention and ask you, if you are scrutinising the video yourself and if you are asking yourself whether there is a resemblance between the person in the CCTV and the accused, that you should take those matters into account and scrutinise the video footage carefully before coming to a conclusion about it.

The final matter I wanted to raise with you is to give you a warning. The experience of the courts is that even the most honest of witnesses in identifying somebody, particularly from photographs, can get it wrong. As I say, the most honest of people can simply make a mistake and the experience of the courts are that there have been occasions when somebody has mistakenly identified as a person committing a crime. Here we are not dealing with identification evidence, as I have said to you already, but nevertheless, I think it is important that I should warn you that it is possible that Mr Mott and Mrs Gail Johnson may have had an expectation that the person in the CCTV footage might be or possibly resemble the accused in some respects. For that reason, the evidence might be unreliable.

I am not saying anything at all about the honesty of the evidence or the honest endeavour of the witnesses to present their evidence truthfully, but the evidence, as I say, may be unreliable for that reason. I am not suggesting that it is unreliable. It is a matter for you entirely, and you may find it to be quite reliable. I need to warn you that it might be unreliable for the reason I expressed, and you should bear in mind, therefore, the warning I give you; namely, that you need to be cautious in accepting the evidence, and you need to exercise caution in the weight that you give to the evidence for that reason. [Whealy J., 2007 sourced from court transcript Regina -v- Johnson NSWSC 274, p601-602]

Justice Whealy’s instructions to the jury clearly refer to the potential unreliability of this evidence, made in good faith, by the lay witnesses. Whealy J specifically advises the jury that the evidence is not identification evidence, it should not be considered as identification evidence and that the resemblance considered by the witnesses could be unreliable. Various forms of eyewitness identification are frequently criticised as being unreliable. Elizabeth Loftus, a pioneer of eyewitness identification research, suggests;

Jurors have been known to accept eyewitness testimony pointing to guilt even when it is far outweighed by evidence of innocence. [Loftus 1979, p9].

The emphasis placed in the quote is Loftus’s emphasis [Loftus 1979]. While the lay witness’s evidence in this case is not eyewitness evidence per se, when the combination of the witness oral evidence is incorporated with the vision of the
CCTV recording, the evidence becomes a passive form of witnessing the crime. This is an important aspect to consider.

Whealy J’s suggestion to the jury to examine the CCTV footage themselves to determine whether there are resemblances to the accused is also problematic. As recognition research has indicated, people who are unfamiliar with the person of interest produce significantly poor recognition results. Assuming the jury consisted of members who are unknown to the accused, this direction becomes somewhat inappropriate. The jury should have rather been instructed not to make their own identification judgements by examining the CCTV because of the known error associated with recognition of unfamiliar faces.

The degree of inaccuracy by juries to match video images with the defendant in the dock during a trial is further supported by Davis and Valentine (2009). Their experimental research examined how reliable potential jurors would be when asked to make this comparison in court. Davies and Valentine indicate;

……conclusions from the experiments reported here suggest that inviting juries to compare a defendant with CCTV images as the only form of identification evidence would appear to be a risky policy, and on the basis of current research should be avoided, even if the footage is of the highest quality. [Davis & Valentine 2009, p503]

Justice Whealy’s notion for the jury to compare the footage with the accused may be a misdirected request when compared to the research regarding recognition [Loftus 1979, Kemp et al., 1997, Bruce et al., 1999, Burton et al., 1999, Bruce et al., 2001, Doyle 2005, Davies & Valentine 2009]. This body of research all suggest some caution due to the high degree of inaccurate recognition by lay people who are unfamiliar with the accused. This perception is a critical issue associated with the reliability of evidence derived from CCTV.

7.10 Chapter Discussion

Four critical questions arise from the evidence presented in the Johnson case and its application in the trial and how the court perceived the reliability of the evidence. Firstly, if the court considered the identification evidence to be possibly unreliable,
and the instructions from the judge were for the jury not to consider the evidence as identification evidence, then what purpose does it serve? The probative value of the evidence is somewhat diminished if identification evidence cannot be considered as such. This type of evidence becomes a de facto form of identification evidence and what does that mean? Either the person of interest can or cannot be identified – hence it must be established as identification evidence.

Whealy J referred in his voir dire decision to the fact that the CCTV footage and the oral evidence of the lay witnesses could be considered as circumstantial evidence. How can visual evidence be considered as having some probative value if the person depicted on the CCTV footage cannot be identified by any form including facial features due to the poor quality of the recording? It would also be equally unfairly prejudicial if the inability to eliminate the accused was considered as supporting circumstantial evidence.

Justice Whealy made a reasonable attempt to allow this evidence to be heard and seen by the jury, while providing some recognition of the possibility of misidentification. However, the evidence must balance the probative value with any unfair prejudice, as indicated in s137, otherwise the risk of an injustice is enhanced. As previously mentioned, his Honour’s instructions to the jury encouraged them to examine the CCTV footage themselves and make a judgement based on resemblance to the accused. This direction is problematic when considering the known unreliability of unfamiliar people making those judgements.

The second critical question relates to how the oral evidence of the lay witnesses and the visual evidence or CCTV footage were successively presented to the jury. The visual narrative offered by the CCTV footage is also an important component of the overall circumstantial evidence. That is, it provides evidence that illustrates the action of the killer after causing the deaths of the victims. The visual evidence conveys the killer’s intent and motivation for the victim’s torture and eventual demise was for the purpose of gaining unauthorised access to their bank accounts in order to steal money. The Crown’s circumstantial case against the accused relied heavily upon his desperate financial situation and to the fact that he gained a similar value of funds at around the time of the homicides without a reasonable explanation.
[Whealy J 2007b]. The visual narrative of the CCTV footage, including further external contextual information such as the time, location and data from the ATM itself, combines in the narrative to confirm the sinister nature of the actions. The CCTV footage became a central component of the facts presented by the Crown. Therefore, was the visual narrative of the CCTV footage the primary reason for its inclusion, or was it used to support an inference linking the accused to the ATM? There was no evidence to support the notion that the person depicted in the CCTV was the accused other than the lay witness’s claims.

The concern with this evidence is when the visual narrative provided by the CCTV evidence is combined with the de facto identification evidence offered by the lay witnesses. Despite the instructions made to the jury by Whealy J, it becomes difficult to separate the specifics objectively when visual evidence is incorporated with the oral evidence. This is particularly the case when the visual evidence is as compelling as the CCTV images offered in this case and especially when considering the visual evidence was captured only hours after the deaths of the victims. The CCTV footage (photographic evidence) suggests that funds were withdrawn from the victims’ account by the person depicted in the images who is most likely the murderer. If that person appeared to resemble the accused then an inference of guilt is strongly enhanced. Combined with the oral evidence that identifies the accused by people who have known him for a long period, the association between the event depicted on the CCTV evidence and the accused is a significant influence.

The inference of guilt surrounding the combination of the oral and CCTV evidence helps to create certain perceptions which are based on fact and which may imply meaning from the CCTV evidence when examined by the court. Cognitive scientist Donald Hoffman’s (2000) work examines aspects of ‘visual intelligence’. He studied the connection between vision and the determination of meaning or understanding from the visual stimulus. Hoffman suggests that the cognitive processes of vision appear to be effortless and dependable. In reality, however, Hoffman argues that the process is highly active and our visual intelligence, controlled by our previous knowledge and experiences, ‘drives our rational and emotional intelligence’ [Hoffman 2000, pXI-XII]. The development of a strong connection between the
accused and the CCTV footage by the Crown is a method to develop or enhance perceptions rather than for the establishment of facts. Hoffman (2000) further argues;

*Vision is not merely a matter of passive perception, it is an intelligent process of active construction. What you see is, invariably, what your visual intelligence constructs. Just as scientists intelligently construct useful theories based on experimental evidence, so your visual system intelligently constructs useful visual worlds based on images at the eyes. The main difference is that the constructions of scientists are done consciously, but those of your visual intelligence are done, for the most part, unconsciously. [Hoffman 2000, pXII]*

Developing persuasive inferences that connect the accused with the CCTV vision aids the construct of guilt by association with the visual narrative. Hoffman (2000) further suggests that the process of visual intelligence occurs more subconsciously and the results seem to emerge from a dependable source. There are some dangers here when inferences are enhanced and take precedence over fact. Or more accurately, when the facts are not known or inappropriately determined. When examining the CCTV evidence in this context, the prejudicial affect appears to outweigh the probative value, as previously discussed in s137 in the *Jung* case. This condition of evidence reliability may also be examined from a visual culture perspective and there are overlaps with Hoffman’s visual intelligence views.

The sequencing and combining of the two forms of evidence (oral and CCTV) form a different evidence construct than if they were independent items. The sequence of how this evidence was presented to the jury is illustrated in Figure 7.10. The diagram shows, in a simplistic form, how the CCTV evidence and the recognition evidence by the lay witnesses were connected to produce a single narrative incorporating the visual and oral evidence. It is well recognised in the visual culture domain, that the succession of visual information (and when including an oral narrative) strongly influences the interpretation by the audience. That is, the information is intertwined to form a new interpretation or meaning [Doyle 2003]. This interchange of consecutive information is described in visual culture as ‘intertextuality’ and the product is mutually constitutive [Doyle 2003].
The sequence illustrated in Figure 7.10 suggests; i) oral evidence describing the accused, ii) the CCTV footage and iii) the oral recognition evidence. The sequence was then immediately repeated by another witness. The intertextuality of the two evidence forms (oral and visual) produces a strong Gestalt that further enhances the meaning of this constructed narrative and its powerful influence. Gestalt psychology theory was developed in 1912 by Max Wertheimer (1880-1943), a Czech born psychologist working in Germany. Zakia (2002) describes the principles of Gestalt psychology as;

*The main principle of Gestalt psychology supports this; the way in which an object is perceived is determined by the total context or field in which it exists* [Zakia 2002, p28].
Objects as understood by Zakia (2002) can include various forms when related to Gestalt psychology. These objects may include photographs, video footage, CCTV images, typeface, written and oral text and even group interactions or dynamics. The sequencing of the oral and visual evidence in the Johnson case provides a strong Gestalt and the textual aspects of the narrative produce a condition of intertextuality. In other words, they become one or whole. Concepts of visual intelligence, Gestalt psychology and intertextuality are interrelated. Doyle (2003) also suggests that the effect of intertextuality significantly enhances the narrative and meaning. The outcome of this evidence is succinctly described by Doyle:

*Together they make a whole that is more than the sum of its parts.* [Doyle 2003, p53]

The intertextuality links the accused to the CCTV vision without any tangible or real evidence. It is implied or inferred by the condition of intertextuality (and Gestalt psychology). This intertextuality of the identification evidence with the visual narrative presented in the CCTV footage produces a prejudicial form of evidence when the facts regarding the reliability of the identification evidence are considered. If the visual narrative provided by the CCTV footage is accepted as a representation of fact and the jury believe that the lay witnesses could identify the accused, a linkage between the crime and the accused is established. Justice Whealy’s instructions, asking the jury to ignore aspects of the evidence that are mutually constitutive, may have little or no influence on the overall clarification of the evidence. The two evidence forms produce a highly powerful suggestion of guilt when the accused becomes associated with the visual narrative of the CCTV evidence because of intertextuality, which is a consequence of the constructed sequencing of the evidence.

Furthermore, in relation to the dependence on the judge’s instructions to the jury, Edmond (2008) suggests there is a body of evidence that advocates judicial instructions by presiding judges are often confusing and may be ineffective. The effectiveness of instructions in the context of how the oral and CCTV evidence was presented, remains questionable. Edmond (2008) argues:
Without wanting to devote too much space to directions and warnings, what we can say by way of summary is that almost all of the available research suggests that judicial instructions are difficult to follow and probably ineffective. Continuing confidence in directions and warnings seems to be misguided. Trial and appellate judges concerned with securing formally fair trials have a tendency to exaggerate the value of instructions, directions and warnings. [Edmond 2008, p41]

The third critical question is what weighting did the jury give to the CCTV evidence based on the combination of the visual evidence narratives and oral evidence given by the witnesses? The weighting given to the CCTV evidence is known only to the jury and its reliability is strongly linked to how they perceived and used the evidence. Madison (1984) discusses how weighting from photographic evidence can inappropriately influence decisions made by the jury. Madison makes the following caution;

*Impressed by advances in photography, courts generally favour photographic evidence, often according it substantial weight. Although photographic evidence is an asset to the adept trial lawyer, neither courts nor lawyers fully understand the capacity of photographic evidence for deception or improper influence.* [Madison 1984, p705-706]

Justice Whealy provided some instruction to the jury regarding the consideration of weighting of the identification evidence offered by the lay witnesses and its reliability, but not the visual evidence. In fact, his Honour encouraged the jurors to consider the identification evidence in combination with the CCTV evidence. He also did not indicate any potential weighting for consideration that may arise from the combination of the visual evidence narrative with the identification evidence. The compelling visual narrative offered by the CCTV footage could strongly influence the weighting of the identification evidence and, by incorporation, could have a significant impact on the jury’s decision. Madison (1984) further suggests;

*The current practice of allowing the jury unbridled discretion to determine the weight given to photographic evidence is unsound. The potential of photographic evidence to deceive or influenced the jury improperly, combined with the increasing reliance on photographic evidence, requires courts to exercise greater control over the reliability and weight accorded photographic evidence…* [Madison 1984, p741-742]

Madison’s (1984) comments were made some time ago, however they remain relevant to this case. A lack of appreciation of visual culture concepts and its influences remain in the contemporary legal environment (see Chapter 3). The
complexities of CCTV evidence are not fully understood and the problem is compounded by simplistic approaches to representation. Suggestions that the jury can examine the evidence objectively and make a decision about identification based on the oral evidence by the witnesses, the examination of the CCTV footage, and their own evaluation as to whether there is a resemblance to the accused, is problematic and provides an unreliable foundation. This is not a judgement on the sophistication of the jury members, but a challenge to the reliability of images as evidence.

The fourth critical question relates to the issue of the disparate power afforded to the Crown when they presented the CCTV evidence and whether this advantage is unfairly prejudicial. Doyle (2003) argues from a perspective that relates to the use of visual evidence in the context of television footage, however it is also relevant in this case. Doyle (2003) suggests;

One key form of power is the ability to define a situation so that others act on that definition as reality. The definition of these criminal justice situations is not self-evident, even if they are recorded directly by cameras. Instead their meaning is negotiated between the key players: television journalists, police, criminal suspects, and TV audiences. This is an interaction in which power relations are usually unequal. [Doyle 2003, p135]

There are several key points made by Doyle (2003) that relate directly to the Johnson case. The Crown has, by manipulating the intertextuality of the CCTV evidence, redefined the reality by linking the accused with the CCTV vision without any substantial or demonstrably reliable evidence. Doyle (2003) further suggests these new definitions of truth are not ‘self-evident’ and can appear reasonable, even when they do not represent reality. The meaning of the CCTV evidence in this case relates to the accused, even though no evidence supports this notion. As Doyle (2003) suggests, the meaning is negotiable between the key players who are in this instance the jury, the prosecution (Crown and police), witnesses, the accused and his defence counsel. The power in this instance was on the side of the prosecution whose case is supported by the inferences. The defence had relatively little power to rebut or redefine these interpretations. As previously indicated in Chapter 3, the power of persuasion is often with the beholder of the images and the Prosecution took full advantage of their position.
From a sociological perspective, the level of authority afforded to CCTV evidence is comparable to notions of panoptic surveillance. French philosopher Michel Foucault (1926-1984) first used Jeremy Bentham’s (1748-1832) prison surveillance design as a metaphor for the power of a modern state to control the behaviour of its citizens [Banks 2007]. Bentham’s Panopticon design of British prisons⁵⁶, provided surveillance from a single advantage point, which could provide a condition of surveillance of several cells while the inmates were isolated [Lyon 1994, Norris & Armstrong 1999, Banks 2007]. The power stems from the concept that inmate behaviour can be modified because they do not know whether they are being watched or not. There is a conscious suggestion of constant surveillance even though there is not in reality. The power is given solely to the prison authority while eliminating entirely any power from the person being watched [Norris & Armstrong 1999].

The CCTV evidence and the methods employed in this case to create and enhance the narrative shifted power to a single party. The inference that established a link between the accused and the CCTV footage was not proven reliable and was based on suggestions rather than known facts. Somewhat like panoptic surveillance notions, the power shifted significantly to the authority with the surveillance mechanisms or in this case, the CCTV evidence. The accused’s position was effectively helpless without methods of refuting the linkage due to his disempowerment. Power had been given entirely to the surveillance possessor, the Crown. This situation is a highly dangerous condition.

Questions of reliability regarding CCTV evidence stem from how it was presented to the court collectively, the constructed intertextuality and the inequitable condition of the evidence. The perplexing aspect of this evidence is whether the CCTV evidence supported the oral recognition evidence by the witnesses who knew the accused, or whether the recognition evidence supported the visual evidence of the CCTV footage. If the visual evidence was made admissible on the basis of communicating the facts concerning the motive and circumstantial aspects relating to the crime, then the evidence from the lay witnesses provide nothing further to the facts except a

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⁵⁶ The panoptic prison design was also adopted by other countries outside Britain.
highly persuasive and potentially inaccurate inference against the accused that could create the possibility of a miscarriage of justice.
Chapter 8

8.0 CCTV Evidence: Identification

Bertillon had abstracted human identity, transforming it from a representation, if not necessarily accurate or complete, visual image, such as the photograph, into an alphanumeric expression. But for all the linguistic tricks of Bertillonage, identification, in all three phases of Bertillon’s tripartite system, remained a visual act, dependent on the perceptions of human operatives.

Simon Cole [Cole 2001, p167]

The identification of persons of interest depicted on CCTV while engaging in criminal activities, has certainly developed some impetus in contemporary law enforcement and criminal investigation practices. The increasing application of CCTV within public and private spaces will further increase the need for identification from these surveillance sources. In Jung and Johnson, both cases used forensic experts to determine the identity of the person of interest depicted in the CCTV images. The Johnson case also used lay witnesses who were familiar with the
accused. These cases present three issues that specifically relate to the identification methods used during the forensic examination.

Firstly, the identification evidence is reliant on the reliability of the images used in the forensic examination (both questioned and exemplar images). The application of forensic photography and photographic science concepts is also a critical prerequisite when determining identity directly from photographs. Secondly, the forensic identification methods require a methodology that can be validated. Thirdly, the identifications were not based on any distinguishing features and concepts of individualisation were neither clearly articulated nor present. These elements question the reliability of the methods used.

This chapter further examines theoretical concepts associated with identification made directly from photographs. It examines, from a historical and contemporary perspective, the need for greater understanding of forensic identification methodologies including concepts associated with individuality.

8.1 A Historical Perspective Regarding Identification Evidence

Contemporary Australian law concepts and practices evolved and developed from early English law principles. Law and order, before the establishment of the first police force, was maintained in England and other countries by appointees of the court. These civilians had special constable powers of arrest and were responsible for bringing offenders of crime to a court of law [Beavan 2002]. Court systems also replaced barbaric ‘trial by ordeal’ which was a system of justice from the Dark Ages and ceased in 1215 when Pope Innocent III (1160-1216) prohibited clergy from taking part in these proceedings and hence officially removing God from the process and its validation [Peters 1998, Beavan 2002].

Early trials using an investigating jury were established and presented before a court judge. The facts of the case were presented to the judge by the investigating jury and the accused was not allowed to contribute to the hearing in any capacity (remain mute). The lack of any objectivity in this process, especially when the facts presented from the investigation were mostly based on gossip and speculation, was problematic
and heavily weighted against the accused. An Act by Henry VII (1457-1509) in 1504 introduced Crown witnesses who presented eyewitness evidence to the court and this system is the basis of the modern adversarial system. The accused were not allowed to call their own witnesses, although they were permitted to question those of the Crown. The first application of the word ‘evidence’ was seen in the Act of Henry VII [Beavan 2002]. Beavan describes the influence of this Act by suggesting:

*The Act’s promise of a ten-shilling reward blurred the line between a witness’s imagination and his memory, but the Act still led the march toward judicial examination of evidence, and a number of other acts calling for eyewitness testimony soon followed.* [Beavan 2002, p24]

Beavan (2002) further suggests that the introduction of physical items as evidence (physical evidence) was not until full-time professional detectives and law enforcement agencies were established in the nineteenth-century.

### 8.2 The Application of Identification

The industrial revolution is considered to be the beginning of the modern era and European communities witnessed extensive social changes when the population moved from rural settlements to more heavily populated urban and city spaces. This condition saw a sudden shift in community values when town populations transformed from a born-and-bred stable community to a transient one [Cole 2001]. Traditionally, town or village inhabitants and their families would live in the same vicinity all their lives and for generations. This meant that every resident was known to the community and the need for identification credentials was not necessary. A newer transient population caused by the industrial revolution, produced strangers living and working within the community while their identity and heredity was unknown [Noiriel 2001, Cole 2001].

This situation caused some concerns to the community because tried methods of trust that were built up by generations were no longer functional. Business transactions were also based on faith established by knowing the person and his/her family or through formal introductions. The itinerant population caused problems with this culture and fraudsters were moving from town to town pilfering the community with
some degree of immunity from their true identity being discovered. Cole suggests that in 1792 the French Government developed legislation that required foreign and domestic travellers to be issued with travel documents as a method of identification. He further suggests that this system was prone to fraud and did not quell the concerns regarding the identity of unknown travellers. Early attempts to identify transitory individuals were fraught with difficulties. It also became difficult to separate law-abiding citizens and felons from the many legitimate peripatetic workers and their families [Kaluszynski 2001, Cole 2001]. Noiriel argues:

…… it was obviously necessary to establish in advance some means of recognizing the civil identity of an individual. [Noiriel 2001, p28].

This cultural paradigm shift and urgent need to establish a system of identity was before photography was invented and before the first police force had not been established. The first official police force was formed by Sir Robert ‘Bobby’ Peel (1788-1850), the UK’s Home Secretary, who established the Metropolitan Police Force through an Act of Parliament in 1829 [Tagg 1993, McConville 1998, Lentz & Chaires 2007]. The Metropolitan Police was established with 3,000 officers and had jurisdiction within a seven-mile radius around Charing Cross [Tagg 1993]. The officers were colloquially known as ‘the Peelers’ or ‘Bobbies’ after its founder. Despite some strong support for its abolishment, the service was expanded to urban areas of England and Wales in 1835 and rural areas in 1856 [Tagg 1993]. Peel also established Special Constables in keeping with traditional ancient Common Law practices. The rank structure established by Peel included Police Constables, Sergeants, Inspectors and Superintendents which remain today with many contemporary Western law enforcement agencies.

As legal and social reforms developed during the nineteenth century, the need to identify recidivists became paramount [Kaluszynski 2001, Cole 2001]. Law reforms included harsher sentencing for repeat offenders making the sentencing process conditional to the previous criminal record of the offenders. With the absence of any reliable form of establishing identity, the accused often used aliases so they could present themselves as first-time offenders. The pursuit of developing a reliable and objective method of identifying individuals came from two institutions, both associated with criminal justice. Law enforcement and the penal institutions became
heavily involved with establishing identity systems around the same time as the discovering of photography.

Some social commentators see the establishment of identity as a method of enforcing social order and the repression of its communities. Martine Kaluszynski states;

Invented by Alphonse Bertillon (1853-1914), anthropometry was not simply a new weapon in the armoury of repression, but a revolutionary technique: it placed identity and identification at the heart of government policy, introducing a spirit and set of principles that still exists today. By tracing the evolution, consequences, and implications of this system, we shall see how it enabled first the maintenance of order and repression, and then the establishment of a technique and a politics of republican government based on the concept of identity. It was in the context of criminal policy, confronted by the struggle against crime and by galloping rates of recidivism, that this politics of identity was to emerge. [Kaluszynski 2001, p123].

This bohemian perspective certainly holds true with regard to the institutionalisation of objective identity systems and that they were, and continue to be, immersed into the criminal justice system. However, the issues of repression and social order are somewhat exaggerated, with the exception of a passport system which restricts free travel between nations. Identification also protects citizens.

Identity systems developed in the late nineteenth century used components of the body as a biological form of identification. This approach took certain controls away from the individual. In many cases, including the Adolf Beck (1844-1909) case in 1896 and again in 1904, identity systems can provide protection against wrongful conviction and may allow for a more liberal welfare system. Identity systems used by the state do also provide tangible benefits to its citizens. Notwithstanding, the power given to the possessor of the surveillance image when presenting evidence in a court, as described in the case involving the truck driver (refer to Chapter 3) and the Jung and Johnson cases, images do have power and can present an inequitable condition. Especially when considering criminal proceedings instigated by the state to prosecute a citizen in a court of law [Tagg 1993, Banks 2007].

The identification of deceased victims of crime or accidents is another positive outcome for families and friends albeit in rather tragic circumstances. The process of
grieving for the family of victims is an important emotional process of closure and assists greatly in the overall emotional wellbeing of the surviving family and friends.

The need for identification of individuals in the criminal justice systems include:

- The identification of victims of crimes and accidents (especially deceased victims).
- The identity of individuals being brought before courts of law and imprisoned in correctional facilities.
- The identity of individuals committing crimes using eyewitnesses or physical evidence left at crime scenes.

The latter need for identification also includes identification of individuals depicted by CCTV at the crime scene or locations associated with the criminal activity. There have been three significant scientific developments regarding methods of identification of individuals using biological aspects of the body since the nineteenth century. These methods are:


The most relevant form of identification relating to this research is Bertillon’s anthropometrical identification method. When considering the reliability of identification methods in relation to CCTV images it is important to review

\(^{57}\) Several others also contributed to the understanding and classification of human fingerprint ridge patterns including early Chinese and Japanese communities (using fingerprint patterns as a method of signature) as early as 600AD [Nickell & Fischer 1999, Beavan 2002, Sengoopta 2003, Saferstein 2004]. However, Faulds is credited as the first to consider its application in identification for criminalistics [Lee & Gaensslen 1994].
Bertillon’s concepts and methodology especially given that these methods are no longer used in forensic science due to problems encountered with the Will West and William West situation in 1903.

### 8.3 Bertillonage: Anthropometrical Identification

Without any scientific method to identify persons being brought before the courts, sentencing procedures that took into account the person’s criminal record were critically fraught when recidivists presented themselves as first-time offenders to gain a less severe prison sentence. The need for correct identification of the accused became an important consequence for the nineteenth century judicial system.

The first most widely used identification system was developed by Frenchman, Alphonse Bertillon in 1882. Bertillon’s method consisted of eleven different physical anthropometric measurements including; height or stature, length and breadth of ear, length of elbow to end of middle finger, lengths of ring and middle fingers, length of trunk, length of left foot, and reach (length of outstretched arms from each middle fingertip) [Bertillon 1896, Rhodes 1956, Beavan 2002]. Bertillon’s professional experience as a clerk and his family’s history in anthropology and demography provided him with two significant attributes; the ability and understanding of efficient filing systems and codes, and an intellectual resource for scientifically based physical anthropological research. Bertillon’s father, Louis-Adolphe Bertillon (1821-1883), was the founding Vice President of the School of Anthropology and his grandfather was Achille Guillard (1789-1876) who was one of the first authors to publish work on European demography. Both men were highly respected anthropologists, statisticians and scientists [Beavan 2002].

Bertillon’s method of identification required various attributes to be successful. He needed to establish a system that could;

- individualise between different people,
- accurately record human data to a file,
- convert the data into classifications for a searchable and retrieval database and
• be repeatable and scientifically validated.

Bertillon developed a database based on an ingenious card index that categorised the cards using anthropometry taxonomy he learnt from his father [Rhodes 1956]. Bertillon’s filing system was highly successful and was later adopted by the fingerprint identification system developed by Scotland Yard. Cards of suspects could be retrieved in minutes from a collection of thousands [Rhodes 1956]. Each card included the physical anthropometric values and in addition, a frontal and side photograph of the face. Bertillon also developed the concept of a systemised arrest photograph consisting of a frontal and side view of the face. This is still widely used in law enforcement today.

The profile photograph was used to provide a view of the morphology of the ear, which was considered to be a distinguishing anatomical feature. The level of application Bertillon showed to photography provides confirmation he considered photography to be an central tool in identification methods. However, photographs...
could not provide him with empirical data of individuals unlike his anthropometry method. The relationship between the photographs illustrating likeness with empirical anthropometric data was a well-considered combination. Figure 8.2 is a Bertillonage index card with Alphonse Bertillon himself pictured.

When Bertillon approached a very sceptical Prefect of Police with the proposal of an anthropometry identification system he applied scientific principles to determine the level of individuality that could be expected. Bertillon used his father’s much-admired scientist Adolphe Quételet’s (1796-1874) work on concepts of what was considered as ‘social physics’ and the understanding of the ‘average man’. Quételet’s work on applied statistical analysis on the heights and chest widths from army recruits was published in a text called ‘A Treatise on Man’ [Rhodes 1956, Beavan 2002, Saks & Koehler 2008]. Quételet was one of the first to apply the then new statistical application of binomial distributions, mean values and error rates to social science studies [Cole 2001, Beavan 2002]. Rhodes suggests that Quételet’s work was instrumental in Bertillon’s concepts and his argument to the Prefecture of Police. Rhodes (1956) proposes in his biography of Bertillon;
Without this pioneer work [Quételet’s data], there would have been no system of criminal anthropometry, the first method of identifying habitual criminals, with which began a new era in crime investigation. [Rhodes 1956, p21].

Bertillon applied Quetelet’s normal distributed data of human physique to determine that two people having the same anthropometry of a single feature (e.g. foot size, head width etc) as a 4 to 1 probability [Bertillon 1896, Beavan 2002]. Bertillon then statistically applied the product rule to develop the probability of two subjects having the same physical anthropometry by calculating the probability as 1 x 4^n, and ‘n’ being the number of different anthropometric measurements taken in the examination [Beavan 2002, Saks & Koehler 2008]. Hence, Bertillon proposed his method of identification, using eleven different anatomical features would produce a probability of two subjects having the same results as 4^{11} or 4,191,304 to 1 [Rhodes 1956, Beavan 2002]. Rhodes suggests that Bertillon miscalculated by applying eleven measurements as validation and suggested if he increased the number of measurements to fourteen, the probability would have risen to 4^{14} or 268,435,456 to 1 [Rhodes 1956].

It can be argued that a ≈4,000,000 to 1 probability is not a sufficient figure to support the notion that every person has a unique Bertillonage result. In a modern city like London with a population exceeding 20 million, this level of probability suggests there would be 5 people with the same result. The probability is also reduced with people presenting measurements that are considered more towards the mean values as indicated in normal distribution and less frequent with a greater deviation from the

Figure 8.3: A Quetelet binomial curve illustrated a normal distribution [image sourced from www.math.yorku.ca].
mean. Bertillon’s statistics also do not allow for the condition of independence or for the measurements not been mutually exclusive. For example, people who present as been very tall are most likely to have a large arm span. Furthermore, people at the same height may have similar foot sizes. It is also unlikely that a 6’8’ male would have a size 4 shoe, as it is most likely he would have a large foot. Biological variation may not always be exclusive when it comes to physical measurements and some correlation of size is a possibility.

Bertillonage identity system was readily adopted by several law enforcement agencies and penal institutions outside of France. Cole argues Bertillon’s anthropometric identification was institutionalised in the United States, Canada, Argentina, Bengal and Great Britain within approximately a decade of its formulation. In 1898, a conference in Rome was held because of an increase in political assassinations in Europe. The following year saw other countries use anthropometric identification in an attempt to standardised police identification methods and increase surveillance of terrorists. During 1899, Belgium, the Netherlands, Germany, Italy, Spain, Sweden, Russia, Norway, Turkey, Luxembourg, Romania, Monaco and Switzerland also implemented anthropometrical identification. Furthermore, most of the countries in South America also adopted this form of identification [Cole 2001]. Bertillon’s identification system became wide spread in the West.

Bertillonage was however, eventually abandoned when in 1903 two Leavenworth Penitentiary (USA) inmates named Will West and William West were found to have the same anthropometric results [Nickell 1994, Cole 2001, Beavan 2002]. It was believed both men were not identical twins and were not related. William West was serving a life sentence for murder while Will West was charged with manslaughter. Figure 8.4 is the two prison identification photographs of Will West and William West.

Table 8.1 illustrates the results and similarities of the anthropometric measurements from Will West and William West in 1903, which are considered the same when incorporating measurement thresholds or error rates. The West situation was the start of the end of Bertillonage. Fingerprinting appeared to be a more efficient and more
detailed method of determining identification. Francis Galton’s (1822-1911) studies determined the chances of finding two individual fingerprints being the same was 64 billion to 1 [Jackson & Jackson 2008] which is significantly more theoretically reliable than Bertillon’s 4 million to 1. Fingerprints were also found to be different in monozygotic twins58. Fingerprint identification can not only be used to routinely determine the identity of a person being arrested or presented before a court, they may also be discovered at crime scenes which can further lead to the detection and identification of offenders. According to Jackson & Jackson (2008), no two fingerprints have yet been found to be the same.

Another problem with Bertillonage, is the level of precision required by its technicians when obtaining the anthropometric measurements. Alphonse Bertillon was considered as a hard taskmaster to ensure a high standard of anthropometric

58 Identical twins.
accuracy in his Paris bureau. However, Cole (2001) indicates the level of accuracy declined rapidly as the technique moved further away from France.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Will West (manslaughter)</th>
<th>William West (murder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Length</td>
<td>19.7</td>
<td>19.8</td>
</tr>
<tr>
<td>Head Breadth</td>
<td>15.8</td>
<td>15.9</td>
</tr>
<tr>
<td>Middle Finger</td>
<td>12.3</td>
<td>12.2</td>
</tr>
<tr>
<td>Foot Length</td>
<td>28.2</td>
<td>27.5</td>
</tr>
<tr>
<td>Forearm Length</td>
<td>50.2</td>
<td>50.3</td>
</tr>
<tr>
<td>Height</td>
<td>178.5</td>
<td>177.5</td>
</tr>
<tr>
<td>Little Finger</td>
<td>9.7</td>
<td>9.6</td>
</tr>
<tr>
<td>Trunk</td>
<td>91.3</td>
<td>91.3</td>
</tr>
<tr>
<td>Arm Span</td>
<td>187.0</td>
<td>188.0</td>
</tr>
<tr>
<td>Ear Length</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Cheek Width</td>
<td>14.8</td>
<td>14.8</td>
</tr>
</tbody>
</table>

*Table 8.1: Anthropometric measurements of Will West and William West taken at the Leavenworth Penitentiary (adapted from Cole 2001, p145).*

### 8.4 Identification Methodological Questions

In hindsight, certain questions can be raised regarding the individualisation of Bertillon’s anthropometric identification system. Unlike fingerprinting, Bertillon’s method has been proven unreliable because two unrelated individuals were found to have the same anthropometric result. Hence, this method is no longer used in contemporary law enforcement practices and raises important questions;

- Is the failure of this system a complete coincidence or was the probability rate too low and eventually the West situation was going to happen as the database became larger?
- Could further research define a number of anthropometric measurements to determine a threshold and standard to be considered a method of individuality for use in determining identity?
- Should identification evidence when presented exclusively with no further corroborating evidence, be considered with caution as the weight of the evidence and its reliability may result in an injustice?
In Johnson, the expert evidence was not presented to the court and the lay witness recognition from the CCTV images was not exclusively used as the only evidence. Other corroborating circumstantial evidence was supported in the Crown’s case and while this may reduce the risk of an injustice, it does not eliminate this risk and the weighting of the identification evidence should be considered appropriately.

In contemporary forensic science, the concept of individuality is a debate that is continuing with some vigour. The central question of identification reliability from the Jung and Johnson cases must also be carefully considered in relation to Bertillon’s method. The comparison table (8.2) illustrates some comparisons between Bertillon’s method and the methods used by the Crown’s experts in Jung and Johnson. It is interesting to compare current CCTV identification methods with Bertillon’s method to gain some perspective of reliability of the identification evidence.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Method comprised of physical anthropometric measurements of the body.</td>
<td>1. Method does not include measurements.</td>
<td>1. Method does not include measurements.</td>
</tr>
<tr>
<td>2. Comparison is conducted using measurements made directly from the body.</td>
<td>2. Comparison is conducted using photographic representation exclusively.</td>
<td>2. Comparison is conducted using photographic representation exclusively.</td>
</tr>
<tr>
<td>3. Method validated by statistics.</td>
<td>3. No statistic data to support findings or method.</td>
<td>3. No statistic data to support findings or method.</td>
</tr>
<tr>
<td>4. Found to be unreliable.</td>
<td>4. Reliability unknown and questionable.</td>
<td>4. Reliability unknown and questionable.</td>
</tr>
<tr>
<td>5. Method consists of 11 separate components of the body.</td>
<td>5. Many more anatomical components of the body are used.</td>
<td>5. Very few components of the body are used.</td>
</tr>
<tr>
<td>6. Method uses very specific anatomical references.</td>
<td>6. Method uses very specific anatomical references.</td>
<td>6. No specific anatomical references are used.</td>
</tr>
<tr>
<td>7. Comparisons use an objective examination.</td>
<td>7. Comparisons use a subjective examination.</td>
<td>7. Comparisons use a subjective examination.</td>
</tr>
</tbody>
</table>

Table 8.2: Comparison of anatomical identification methods used by Bertillon, Sutisno and Henneberg.
Sutisno (*Jung*) and Henneberg’s (*Johnson*) methods do not seem to address any conceptual aspects of individualisation, even though they make these claims. Other significant differences between their methods and those of Bertillon are that their examinations are based on a subjective rather than objective assessment and the analysis is determined from photographs rather than directly from the body. Furthermore, the subjective analysis of the anatomy presented in the photographs does not use any empirical method to validate or confirm the findings.

It may be suggested that a solitary, more subjective method than Bertillon’s anthropometrical identification methods would have to be considered as less reliable. Determining positive identifications from an inferior methodology may also present dangerous circumstances for innocent people accused of crimes. Anatomical methods of identification from CCTV images must consider aspects of Bertillon’s failure to produce a unique method of identification. Newer identification methods could include an adaptation of Bertillonage, while including other distinguishing features that may be present in the CCTV footage. Another important methodological consideration, when the examination comprises of photographic comparisons, is the photographic condition. The reliability of photographic representation must be included when validating the identification results.

The advantage of CCTV images is its potential ability to record other distinguishing features on the person of interest. Distinguishing marks such as scars, moles, warts, facial creases, freckles and tattoos could be considered as unique features and assist in developing identification methods for CCTV and other photographic sources. There is common agreement that these distinguishing features could be considered as ‘*unique identifiers*’ [Iscan & Helmer 1993, Nickell & Fischer 1999, Porter & Doran 2000, Bromby 2003]. It is assumed that the random nature of these markings and their orientation could be considered as a distinctive feature. The questions raised here however are; how many distinguishing features or marks are required to be considered as a safe identification? What other supporting evidence (i.e. anthropometry) is required for a reliable confirmative identification, and what statistical reference could validate this notion of individualisation? The notion of including population statistics is considered by some scholars as an essential
requirement for identification evidence based on morphological aspects of the body [Edmond et al., 2009].

Bertillon’s anatomical identification method also included the recording of distinguishing marks. In fact, Bertillon’s identification method consisted of three components; i) anthropometrical measurement, ii) descriptive morphology of the body and more detailed features, and iii) distinguishing marks [Bertillon 1896]. The complex design of ear morphology also provides a more detailed source of morphological comparison and there are further suggestions that the ear is distinctive between individuals [Iannarelli 1964, Nickell & Fischer 1999, Purkait & Singh 2008]. The ears definable morphology was what prompted Bertillon to establish the inclusion of profile photographs in arrest photographs [Cole 2001] and remains a standard today.

To enable the examination of these features CCTV will need to have the capacity to resolve the necessary detail. The resolution displayed in the case studies discussed in this research lacked the ability to resolve fine detail and any potential distinguishing marks. This significantly reduces the level of examination possibilities and the reliability of the source material (CCTV images).

A method of facial identification from ID photographs was published in 2000 by Porter and Doran. They suggested a holistic method that considers identifying or distinctive features in combination with anthropometry and morphological aspects. Porter and Doran’s (2000) holistic method consists of;

- Individual facial characteristics (moles, freckles, scars etc).
- Form, size and shape of facial features (facial morphology)
- Facial symmetry (or degree of asymmetry).
- Photoanthropometric analysis.

The proposed holistic identification method suggests several different approaches be used to corroborate the results rather than a solitary identification method. It also combines subjective examination methods with objective methods. An important aspect of this suggestion is however, the inclusion of distinguishing marks. Porter
and Doran (2000) further suggested that any notion of a positive identification, must also include distinguishing marks and be substantiated with the other three investigative modes. An issue with this method, however, is the validation of the modes as being individual and the fact that identification is made from photographic representation of the body and not physical biology. Approaching identification from several combined methods is a positive concept to consider.

Questions regarding methods of identification strongly relate to concepts of individualisation and how this can be validated. Bertillon’s method failed with eleven different empirically measured anatomical references. Methods used in the Jung and Johnson cases, exclusively used a single non-empirical method. Furthermore, the comparison methods did not carefully consider aspects of photographic representation when subjective examinations were conducted. Critical questions regarding the validation of individualisation concepts were also not articulated in the reports and could be considered as highly questionable.

8.5 Recognition Evidence: Identification

Several researchers have extensively studied the reliability of eyewitnesses to identify perpetrators of crime. The most notably researchers are Elizabeth Loftus and Gary Wells from the United States. Their studies, and others, found eyewitnesses to be unreliable and this conclusion is widely accepted [Loftus 1979, Wells et al., 1998, Wells et al., 2000, Doyle 2005]. Lay witness identification of suspects from photographs has also been comprehensively studied and was previously discussed in the Johnson case study.

The concept of ‘wanted posters’ used by law enforcement agencies to gain information from the public has a deep-rooted tradition in policing. Images gained from CCTV can provide images of persons of interest for seeking information from the public using various media forms (television, newspapers and internet). Figure 8.5 is a poster issued by the Metropolitan Police of the suspects of the 2005 London Bombing. This type of critical mass distribution of information and images can lead to important developments in the investigation.
8.6 Other Forms of CCTV Identification

In addition to the identification of suspects from CCTV using components of the body, items associated with the accused may also be identified and linked to the suspect. Various personal items recovered from a suspect may be linked to the crime scene and used as circumstantial evidence during prosecutions [Vorder Bruegge 1999]. Two case studies have been reported in the forensic science literature that provide a good example of this application.

The first case described by Oz et al., (1999) involves the apprehension and conviction of a male who sexually assaulted, with aggravated violence, a woman in Israel in 1997. Oz et al., reported there was no semen, hair or fingerprints found at the crime scene, however a lollipop and a pair of prescription glasses which did not belong to the victim, were located at the scene. The glasses had distinctive marks on the arms comprised of specks of white paint, some metal damage and a distinctive mottle pattern on the plastic arm tip. Investigating police located a local optician that recognised the glasses and supplied police with the customer’s name [Oz et al., 1999].
Police discovered the accused had been previously arrested for other offences and arrest photographs were on their criminal database. These images included the suspect wearing his glasses. A photographic analysis was conducted on the distinctive marks found on the glasses earpiece or arm with the profile arrest photograph of the accused to determine whether they were the same. The profile image also recorded the left side of the glasses earpiece. The examination found that the patterns made from the metal damage, paint specks and the mottle pattern in the plastic, all matched perfectly with respect to position (orientation), size and shape [Oz et al., 1999]. The profile arrest photograph taken of the accused while wearing his glasses provided a link to the same glasses found at the scene. This evidence was further corroborated with DNA evidence recovered from the lollipop [Oz et al., 1999]. While this case does not involve CCTV images, it highlights how photographic evidence can link suspects to items and clothing that may be left at a scene of crime. Items depicted on CCTV may also provide linkages to suspects, although the reliability of this evidence will be reliant on the inherent resolution of the CCTV system.

A second case study is described by Richard Vorder Bruegge (1999) from the FBI’s Special Photographic Unit and involves the identification of an armed bank robber using the suspect’s denim jeans as the source of identification. Images obtained from the bank’s security cameras show the suspect carrying a rifle and wearing a large coat, a balaclava, gloves, sneakers and denim jeans. The resolution of the images is sufficient to resolve the side seam of the denim jeans, which reveals a distinctive barcode type pattern on the seam. Vorder Bruegge considers this pattern, caused by the stitching and wear, as distinctive and featuring on the jeans as an identifying characteristic that would warrant identification [Vorder Bruegge 1999]. According to Vorder Bruegge, 27 denim trousers were seized from four suspect’s homes during the execution of various search warrants. The questioned jeans seized from the suspect’s homes were examined by the FBI’s Special Photographic Unit to determine whether any of the seized jeans matched the jeans photographed by the bank’s security camera [Vorder Bruegge 1999].

Vorder Bruegge indicated the initial examination of the denim jeans involved an examination of class characteristics. This examination revealed that 26 suspect pair
of jeans were found not to display similar class characteristics and were eliminated from the examination. One pair did display similarities and underwent a further examination to determine any identifying features or individual characteristics.

Figure 8.6: Bank surveillance images in Vorder Bruegge’s case report depicting the person of interest wearing denim jeans [images sourced from Vorder Bruegge 1999, p617].

Figure 8.7: Vorder Bruegge’s identification points indicated on questioned and exemplar (known) images [images sourced from Vorder Bruegge 1999, p621].
Exemplar photographs were made from the questioned pair of jeans using similar photographic parameters as the questioned photographs captured by the bank security camera. The questioned and exemplar photographs of the suspect jeans were then compared in a side-by-side comparison and the barcode pattern in the seam was considered a match [Vorder Bruegge 1999]. The examination provided an identification of the clothing captured on the bank’s security camera which, in turn, was linked back to the suspect. While this may not be considered as identification of the person of interest, it does provide strong circumstantial or linkage evidence.

The cases reported by Oz et al., (1999) and Vorder Bruegge (1999) demonstrate alternative applications of identification using physical items that were linked back to the suspect. Future CCTV applications in the context of this evidence would need to be of a level of resolution that could resolve the fine detail required to allow this type of comparative analysis. The identification of clothing and other items depicted in CCTV images could provide valuable forensic evidence. Reliability of CCTV systems should also take these applications into account when determining resolution limitations provided by the technology.

The ability of CCTV to place a person at a specific place at a specific time has several positive advantages for the investigation of crime. Identifications from these sources can also provide an alibi for suspects, although law enforcement rarely actively spend resources to provide suspects with alibis. Police will investigate the authenticity of alibis given by the suspects, however developing an alibi is usually on the onus of the accused. Unfortunately, suspects have limited access to surveillance sources and may not know that CCTV evidence is a possibility.

A Los Angeles (USA) homicide case in 2003 demonstrates the value of this form of alibi. Juan Catalan had been charged with the murder of a 16-year-old girl who had given evidence at a previous homicide case where Catalan’s brother was one of the accused [Lusetich 2004]. A police informant placed Catalan near the scene at the time the 16-year-old was killed. Catalan denied this and stated he was at a baseball match with his six-year-old daughter at the time of the killing. Catalan produced seating stubs of the match, which were dismissed by the police as not providing any evidence of value (he could have obtained the stubs from another person who
attended the event). Catalan was held in prison awaiting his trial and faced a possible death penalty if convicted. His lawyer, Todd Melnik, petitioned the courts for all CCTV footage made on the day by the Dodgers Stadium security staff to be available for Catalan’s defence. Melnik’s legal team searched through all the available CCTV footage and located a visual of two people sitting at the seats described on the stubs. However, the resolution of the CCTV was unable to determine the identity of the people sitting in the seats [Lusetich 2004].

By coincidence, a film crew was filming an episode of a comedy sitcom ‘*Curb Your Enthusiasm*’ made by comedian Larry David. David was approached by Melnik and he provided all the footage that was filmed at the stadium on the day Catalan said he attended. Two clear shots, each time coded, shows Catalan eating a hotdog while sitting in the stand at the baseball game. The footage gave credence to Catalan’s alibi and placed him at the baseball game at the time in question. The charges were dismissed and Catalan was released [Lusetich 2004]. Photographic evidence in this instance was a valuable evidentiary tool to substantiate the claims of the accused and provide an alibi.

### 8.7 Concepts of Unique Identifiers and Individualisation

A fundamental principle regarding identification is the ability to distinguish one person or object from others of similar appearance. Identification then needs to be further questioned in relation to how is distinctness described or quantified and what factors are inherent in a person or object’s appearance that could provide evidence that prove their distinctiveness.

Concepts of distinctive features have been described in several areas of criminalistics as ‘unique identifiers’ or ‘individual characteristics’ [Bodziak 2000, Porter & Doran 2000, Lee *et al.*, 2001, Inman & Rudin 2001, Bromby 2003, Horswell 2004, Fisher 2004, Saferstein 2007, Jackson & Jackson 2008] and these expressions have also been used throughout this thesis. The concept of individualisation is also expressed by Vorder Bruegge (1999) in his case report regarding the photographic identification of denim jeans worn by a bank robber. Vorder Bruegge articulates in his paper, the principles of individualisation he used to determine a positive match of
the clothing and quotes Tuthill from his text ‘Individualization: Principles and Procedures in Criminalistics’ [Tuthill 1994];

The individualization of an impression [or other piece of physical evidence] is established by finding agreement of corresponding individual characteristics of such number and significance to preclude the possibility (or probability) of their having occurred by mere coincidence, and establishing that there are no differences that cannot be accounted for. [found in Vorder Bruegge 1999 p613 sourced from Tuthill 1994]

This type of definition of individuality is commonly used by forensic practitioners engaged in criminalistics including; footwear and tyre impressions, fingerprint identification, physical fits (i.e. broken glass or car taillight) toolmark examination, firearm identification and others. The working methodologies using this conceptual framework are however, significantly more than just searching for individual characteristics. They also include an extensive understanding and theoretical separation between features that are considered as ‘class characteristics’ and ‘individual characteristics’.

This is a significant component of this individualisation theoretical framework. The purpose of separating these two descriptive features is to place differing levels of weight and significance on each feature when determining an identification. It further provides a framework to ensure features used in the identification process are distinctive features (individual characteristics) and not common features (class characteristics) that may be found on similar makes and models (i.e. the same shoe type and size). Class characteristics are beneficial in the first phase of the examination, which involves an attempt to exclude the person or item based on its dissimilarity of class. Class characteristics are not used during the identification phase of the examination and, if they are misread as individual features, misidentifications can easily occur. The understanding of these two distinctive features and their role during forensic identification is pivotal to the reliability and accuracy of the examination. There are six possible results when using this theoretical framework in comparative analysis examinations. These results are listed in Table 8.3.

A match or identification can only be possible when similarities are observed in both forms of characteristics, that is in both class and individual characteristics.
Similarities observed in class characteristics only, cannot result in a match or identification however, it may provide an equally important result of elimination.

<table>
<thead>
<tr>
<th>Examination Observations</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissimilar class characteristics</td>
<td>Exclusion</td>
</tr>
<tr>
<td>Similarities present in class characteristics, similarities of individual characteristics</td>
<td>Match</td>
</tr>
<tr>
<td>Similarities present in class, not enough detail to distinguish individual characteristics</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>Similarities in class, dissimilar individual</td>
<td>Exclusion</td>
</tr>
<tr>
<td>Not enough detail to distinguish class characteristics</td>
<td>Inconclusive</td>
</tr>
<tr>
<td>Dissimilar class, similarities of individual</td>
<td>(not possible)</td>
</tr>
</tbody>
</table>

*Table 8.3: Six possible results using criminalistic forms of describing identification.*

This concept of individualisation however, has recently come under some criticism from outside the forensic sciences and from academia within law, sociology and psychology disciplines. These criticisms are well founded and supported by an increasing level of misidentifications. [Saks & Koehler 2005, Bowers 2006]. Saks and Koehler (2005) have reported on the cause of 86 misidentification cases in the USA, where DNA evidence exonerated the accused after their convictions. Figure 8.8 provides details of those cases and indicates forensic science testing errors were 63% and false or misleading evidence by forensic scientists as 27%. The total percentage exceeds 100% due to multiple causes.

The results indicated by Saks and Koehler (2005) are a compelling realisation regarding levels of vulnerability within the criminal justice system and the responsibility of forensic science to correct this condition. Their criticism of several forms of forensic identification evidence is the principles associated with the notion of ‘individualisation’ or ‘uniqueness’ and they refer to this issue as the ‘individualisation fallacy’. Saks and Koehler (2008) state;

*The concept of individualization, which lies at the core of numerous forensic science subfields, exists only in a metaphysical or rhetorical sense. There is no scientific basis for the individualisation claims in forensic science.* [Saks & Koehler 2008, p202]
In many respects, Saks and Koehler’s statement above is obvious. The concept of individualisation or uniqueness can only ever be metaphysical because these elements cannot be proven using science or statistical representation. Therefore, using a philosophical argument, if individuality cannot be proven does it exist in the real world? It does of course conceptually or metaphysically. Another point to Saks and Koehler’s criticism is the inference that criminalists misrepresent the concept of individuality by presenting it as an ‘evidence of fact’ rather than ‘metaphysically’.

This view is not one that would find agreement in forensic science and many criminalists do make concessions regularly regarding the true nature of individualisation and admit, for example, there could be an identical fingerprint found on two individuals and that this notion is a possibility. The suggestion that because no two identical fingerprints have yet to be found, does not provide proof that fingerprints are unique. This thinking is well accepted within fingerprint expertise and other criminalistic disciplines. It is noted however, that the danger of using the concept of individualisation, is its misunderstanding, misuse and exaggeration when presenting evidence as evident in the various cases already illustrated.

Figure 8.8: Factors associated with wrongful convictions. n=86 cases. Total results exceed 100% due to multiple causes [sourced and adapted from Saks & Koehler 2005 p892].
Saks and Koehler (2008) also imply that metaphysical ideals cannot coexist within a forensic science or scientific ideological construct. This may be true when comparing the fundamentals of scientific principles based on the exclusivity of empirical analysis, or from an epistemological ideology of positivism, however there are also exceptions found in science. An example of the application of metaphysics in the hard sciences is the utilisation of the number zero (0) and infinity (∞) in mathematics and physics. Mathematics and physics are the most pure forms of empirically based sciences. The concepts of zero and infinity are closely related and are relatively new in the history of mathematics [Garland 1987, Seife 2000, Atalay 2004].

It is difficult to consider modern mathematics without the concept of zero (and infinity). Yet the number zero cannot exist in reality because it represents nothing. For example, you cannot have zero apples in a basket because there are no apples – they do not exist in the space of the basket. An empirical measurement of the number of apples in the basket cannot be conducted because there are no apples to count. Zero can only exist in a metaphysical sense, but it is a concept that is readily understood by philosophers, scientists, mathematicians, physicists and most modern laypersons.

Zero’s concept and application in mathematics comfortably coexists in science, despite the fact that it cannot exist in the real world and that it actually destroys or contradicts many mathematic principles. When zero is added or subtracted to a number, the number does not alter. When zero is multiplied by any number, the resulting answer is always the same, zero, and despite the value of the original number. The relationship between multiplication and division of numerical values does not exist with zero and zero cannot be divided by any number. This affect is the antithesis of mathematic principles, yet the concept is accommodated and regularly used throughout science. It coexists within the principles of science and mathematics. Seife (2000) further suggests;

The Greek universe, created by Pythagoras, Aristotle, and Ptolemy, survived long after the collapse of Greek civilization. In that universe there is no such thing as nothing. There is no zero. Because of this, the West could not accept zero for nearly two millennia. The consequences were dire. Zero’s absence would stunt the growth of mathematics, stifle innovation in science, and,
incidentally, make a mess of the calendar. Before they could accept zero, philosophers in the West would have to destroy their universe. [Seife 2000, p25]

Individualisation as a metaphysical concept also poses beneficial outcomes for the purpose of various forms of forensic identification. It is essential however, that identification methods must have some form of identifiable sources and distinguishing features. This thinking does not dismiss the essential forensic science requirement of validating identification methods. Edmond (2008) also argues the notion of validation and testing in regards to identification of persons from CCTV and suggests;

*Trial judges and appellate courts should be looking for evidence of testing, validation and accuracy rates, as well as germane studies published in authoritative literatures. The burden of reliability should lie with the prosecution. If dissatisfied in terms of reliability or fairness, trial judges and appellate courts should be willing to exclude the prosecution’s expert opinion evidence. [Edmond 2008, p45]*

Validation should consider the following conditions in relation to identification of individuals using CCTV images;

- The development of clear and unambiguous articulation of distinguishing marks or individual characteristics associated with identification.
- The determination of identification thresholds when using distinguishing features.
- The application of corroborating methods and not the reliance on a solitary method.
- The error rates amongst practitioners using particular methodologies.
- Validation of methods should be included in forensic reporting so it may be scrutinised.

The quest to determine individuality through statistical representation may be difficult because the notion of individuality is a metaphysical construct. The determination of uniqueness requires a consensus rather that a representational sample by its nature of the question of uniqueness. To ensure or scientifically prove uniqueness, all objects or people of the same class must be included in the testing or when developing a database. The criticism directed to forensic science, suggests this
is a leap of faith and is not based on hard science. Inman and Rudin (2001) suggest the following regarding individualisation;

*Neither the Bayesian model using likelihood ratios nor hypothesis testing is very helpful in expressing an individualization. Strict Bayesians exclude the possibility that one alternative is ever completely wrong, allowing us to accept the other one as true; strict frequentists insist that a number must always be proffered, however irrational such a number might be in the context of an actual population.*

*Although it may seem irrelevant to discuss probabilities for evidence that has been individualized to a single source, we must remember that an opinion of unique common source still relies on a body of data. Consciously or not, the data convince the analyst to make the leap. No evidence to the contrary would change the analyst’s belief that the evidence and reference share a common source. The state of the practice of forensic science is that examiners do provide opinions of individualization.* [Inman & Rudin 2001, p147-148].

The concept of individualisation offers several advantages in the forensic sciences and as Inman and Rudin suggest, it is an essential requirement for forensic science identification practice. However, the validation of methods used must be considered to advance reliability and accuracy of practices that use this concept. The application and determination of thresholds regarding distinctive marks or features, error rates and a balanced methodology are essential requirements in the advancement of identification of persons of interest depicted on CCTV. The experience with Bertillon’s method has shown good reasons to be cautious regarding claims of individuality. The validation attributes must be also included in the reports of forensic experts and published in the forensic science literature. At the time of writing, there are significant shortfalls in the knowledge of validating identification methods, as demonstrated in the case studies illustrated in this thesis.

### 8.8 Chapter Discussion

This chapter has examined identification from several different perspectives and has highlighted the issues associated with identification reliability. Identification evidence is, and will continue to be, a critical function in law enforcement and the forensic sciences. With recent research indicating the unreliability of eyewitnesses of crime to identify offenders [Doyle 2005, Edmond *et al.*, 2009, Wells & Quinlivan 2009], the reliance of other forms of witnessing will become more fundamental in
police investigation and forensic science practices. The exponential increase of CCTV surveillance within our community may provide an obvious source of images that could witness crime and offer the identity of offenders. Ensuring their reliability is a paramount requirement in current forensic science and photography practice.

Reliability in the context of identification of persons of interest from CCTV images can be considered from three distinctive components;

- the method used in the examination,
- the articulation and verification of concepts of individualisation and
- the validation of the method.

Methods suggest the process in which the examination was carried out. There are few known standard methods recognised in the forensic and photographic science literature that provide a framework for identification from CCTV images. Possible methods are further complicated due to the multidisciplinary nature of identification, which includes forensic photography and forensic anatomy.

Furthermore, the photographic quality and representation must also be considered when considering the method used in the examination. It was previously shown in Chapter 6, that the image representation of several aspects of the body and facial features were significantly influenced by image perspective. The preparation of exemplar material used in the photographic comparative analysis methods (see Chapter 4) must be compatible or match the photographic parameters of the questioned CCTV images.

Like the number zero’s application in modern mathematics, the concept of individualisation can and must coexist within the forensic and identification sciences. However, some safeguards and thresholds are required to enhance the reliability of identification evidence.

The application of ‘individuality’ concepts must also be clearly articulated in the reporting of the expert’s findings. This may take form as a statement that presents a theoretical framework in which the identification evidence was formed. The
statement must be unambiguous and clearly state what components were considered in the determination that warrants an identification. This detail would include what components were considered as ‘unique identifiers’ (distinctive features) and what components are considered as more general similarities like morphological aspects. This is central to the determination of reliability. That is, to produce a forensic report that can be repeated and more importantly, the thresholds associated with distinctiveness tested for reliability. Practitioner error rates may also be included in this section of the report.

This type of reporting was not evident in the reports presented by the two Crown experts in the case studies illustrated in this thesis. Instead, the concept of individualisation was concealed and presented as an assumption of fact, or as described by some critics, as a leap of faith. The basis of how the examination determined identification was not indicated, which increased the level of ambiguity and, in turn, prevented any hypothesis from being tested. This situation is not acceptable in the context of fairness, transparency and impartiality of expert opinion evidence.

The question of validation remains an issue for identification methods using a variety of criminalistic approaches and including CCTV images. The critical point to this problem is establishing what constitutes reliable identification thresholds of individual characteristics that can be standardised across each discipline. Establishing the necessary thresholds of these characteristics to determine, or not determine, an identification remains problematic within the criminalistic and identification sciences domain.

If thresholds could be established and standards within the methods formalised, validation could take the form of testing the forensic practitioners using a standardised test. A collective error rate may be determined from the tests using the same method and may then be cited as error rates using that particular method (and threshold). This concept may provide important known error rates that are currently missing in contemporary forensic identification practices.
As previously discussed in Chapter 3, there are a range of forensic applications and information that may utilise images sourced from CCTV outside of identification of persons of interest. The following chapter examines other applications involving photointerpretation and discuss aspects of reliability associated with forensic intelligence sourced directly from CCTV and other photographic sources.
Chapter 9

9.0 CCTV Evidence: Interpretation, Visual Narratives, Reconstruction and Forensic Intelligence

This is not the power of the camera but the power of the apparatuses of the local state which deploy it and guarantee the authority of the images it constructs to stand as evidence or register a truth

John Tagg [Tagg 1993, p64]

The print media have recently suggested that the effectiveness of CCTV to reduce crime in the UK is highly doubtful. It was reported that Detective Inspector Mike Neville, who heads Scotland Yard’s ‘Visual Images, Identifications and Detections Office’ suggested that only 3% of London’s robberies had been solved using CCTV. It was further reported that Neville suggested that no thought has gone into how police should use CCTV and that it is an utter fiasco [Bates 2008, Bowcott 2008, Kerin 2008]. The Wells, Allard and Wilson report (2006 p iii) also concluded that ‘the effectiveness of CCTV as a crime prevention tool is questionable’. However,
they also indicated that CCTV appeared effective at detecting violent crimes [Wells et al., 2006]. This thinking regarding the application of CCTV is not surprising. The implementation and application of CCTV for police investigation, and particularly as forensic evidence, has not yet developed any theoretical or practical framework that ensures consistency and evidence reliability.

This thesis critically examines the reliability of CCTV images as forensic evidence and does not include crime prevention aspects of CCTV. The work examines how CCTV images become forensic evidence and their application in police investigation, identification, intelligence and forensic evidence. This chapter critically analyses how forensic evidence derived from visual sources including CCTV may become evidence, and how methods used during photointerpretation and reconstruction may be an important factor when determining the reliability of this type of evidence.

The general application of CCTV images during the investigation of crime is multifaceted and produces a passive form of witnessing. The recording of the event may be passive, however the development of the evidence may be quite the opposite. Images sourced from CCTV may be considered for all four modes of inquiry as described in Chapter 4, although the majority of CCTV images provide limited opportunity for empirical analysis. Images captured by CCTV may provide;

- A visual narrative of the event for interpretation.
- Forensic intelligence to assist police investigations.
- Identification of person/s of interest.
- Forensic or physical evidence.
- Public safety by the detection of criminal activity (if monitored).

There is increasing anecdotal evidence that suggests police investigators regularly source and use footage captured by CCTV during criminal investigations. Police often use this sourced CCTV material to; i) show the suspect the footage during a police interview, ii) show witnesses while obtaining a statement, iii) for intelligence seeking purposes and iv) for forensic examination and evidence (including establishing identity).
This chapter examines the function of CCTV images as evidence when the evidence is constructed through an interpretation of the visual elements. As indicated in the UK press and from Scotland Yard, the transition of image to evidence has not been systemised or successfully established within law enforcement and the forensic sciences. This chapter discusses concepts associated with this transition from sourced image to forensic evidence. It investigates how evidence from other cases has been used and the problems they encountered with reliability. These cases do not necessarily use images directly sourced from CCTV, however the process from ‘image to evidence’ is considered to be the same regardless of the source of the original visual material (crime scene photographs, witness photographs, CCTV and images taken from mobile phones). This chapter further discusses what may be required to develop reliable forensic evidence standards from images sourced from CCTV and other visual media.

9.1 The Photointerpretation, Intelligence and Evidence Paradigm

A systemised or scientific approach to gain information from photographs and CCTV images has yet to be established in forensic science. This lack of any recognised process presents serious risks to the reliability of forensic evidence when presenting images as evidence to a court.

Chapter 4 describes physical evidence and its relationship between different forms of photographic evidence. Figure 4.12 illustrates this relationship and describes photographic evidence in four modes of inquiry; i) analyse, ii) document, iii) describe and iv) witness. Furthermore, the model describes the relationship between these photographic evidence forms and how they may support various modes of physical evidence inquiry. Surveillance images, including CCTV, may be described as witness photographs and are generally used to support a simplistic observation evidence mode of inquiry. However, images from CCTV may actually be used across all four modes of physical evidence inquiry including; i) empirical analysis, ii) comparative analysis, iii) interpretative analysis and iv) observation evidence. The

59 Empirical analysis from CCTV images may include counting the number of offenders, determining POI height etc.

60 As seen in the Jung and Johnson cases.
interpretative analysis mode of inquiry requires photointerpretation and this chapter investigates this process in more detail and it includes a discussion regarding the fundamental difficulties with this type examination.

Photointerpretation is central to the interpretative analysis mode of inquiry practice when using photographic material as the source for forensic evidence. Understanding the mechanisms involved in photointerpretation is critical when determining concepts of reliability associated with physical evidence and/or forensic intelligence.

Figure 9.1 introduces a logic map that conveys a paradigm in relation to the process of obtaining forensic evidence from photographs when using interpretative analysis methods. The model suggests that forensic evidence and intelligence is produced using both qualitative and quantitative interpretation of the visual data that is intrinsically captured within the images. An important component of this model is the photointerpretation of the image. The model also suggests that the reliability of forensic evidence derived directly from photographs heavily relies on the accuracy of this photointerpretation stage. The critical question that requires attention in forensic science is how to ensure this stage of the process is accurate, reliable and reproducible scientifically.

Reliability also includes incorporating safeguards into forensic reporting that identify any possible (or the degree of) inaccuracies that may be found in the results, especially when the conclusions are derived from a photointerpretation process. It is imperative, due to the strong persuasive nature of photographic evidence, that the evidence developed from photointerpretation is not exaggerated or include inappropriate inferences. Furthermore, photointerpretation methodologies must be conducted using a scientific-like approach similar to other forms of forensic evidence. Verification of the findings need to consider the methods used during the examination and the degree of interpretation should be clearly stated to allow other experts to examine the findings based on similar methods. Transparency of forensic evidence should be apparent in the reporting.

The fundamental basis of reliable photointerpretation involves the establishment of a systemised method that has four core components. Firstly, the question or developed
hypothesis being asked of the photographic material must be clearly understood and expressed in the examination process. Secondly, the photographic material must be evaluated based on the hypothesis and it must be determined whether the photographic material has the ability to answer the question or basis of the inquiry. Thirdly, the integrity of the photographic material must be satisfied to be genuine without excessive manipulation or forgery. Lastly, the photographic material is examined and findings reported in an appropriately transparent manner and include details regarding the interpretative method used.

This may appear to be a logical approach to the use of this form of evidence, however as illustrated in the cases discussed in this chapter and others in the thesis, methodical approaches when using this form of forensic evidence are not applied and are void of any transparency in the reports.

The information provided by CCTV when a criminal activity has been recorded, often provides the forensic practitioner with a multitude of visual opportunities. There is firstly continuous footage (depicting motion), footage from multiple cameras, locations and angles. Footage may also be accessed from a variety of sources including carparks (to identify the vehicle the person of interest drove, including the registration plate for identification), public streets (to determine the direction the person of interest arrived and left the scene) and public transport (taxis,
buses and trains). The collective visual information that may be sourced can provide a simplistic or highly complex visual narrative. With the addition of time/date stamps embedded into the image metadata, the level of visual data may be quite significant and has the potential to provide valuable forensic intelligence.

Photographic evidence obtained from sources such as CCTV cameras located in various positions, may provide extensive vision before, during and after criminal activities have occurred. However, the captured images while they may collectively develop a powerful visual narrative, do not necessarily tell the story without some interpretation. Janina Struk (2004) makes a similar observation regarding the interpretation of the vast collection of photographic evidence from the Holocaust during the Second World War. In her book titled ‘Photographing the Holocaust: Interpretations of the Evidence’; Struk suggests;

> The photographic representation of the Holocaust does not give a comprehensive account of the historical events which photographic narratives generally lead us to believe; that is not possible. Photographs are fragments. They illustrate stories, they do not tell them. It has been left to the curators, film-makers, historians and propagandists to determine how they are interpreted. [Struk 2004, p15].

The interpretation by various people with an interest in understanding the significance of the events of the Holocaust may vary depending on their photointerpretative skills, the original photographers agenda and any possible agenda or bias from the forensic examiner. As previously explained in Chapter 3, images and visual narratives, may be interpreted quite differently and is not as simple as it may appear.

Intentional or unintentional bias based on the examiners personal or organisational agenda, can affect photointerpretation accuracy. This bias or transference during subjective qualitative assessment is often quite difficult to prove and renders this type of evidence dangerous in jurisprudence processes. Reliability is also easily corrupted by vagaries when the evidence is presented without a transparent and systemised assessment process. Furthermore, when vague inferences from photointerpretation are made before a jury, there is a chance the jury will also begin to interpret the image/s and include the forensic witness’s evidence into the narrative.
The risks associated with intertextuality were discussed in the *Johnson* case study and vague superficial analysis can easily become of a significant weight when the jury’s interpretation becomes incorporated within the forensic evidence. The narrative can easily surpass the reality in these situations. Evidence is also often led in a way that evokes this condition and the vagaries of the evidence hidden behind the presentation of the photographic evidence. Transparency of the forensic approach is needed to prevent the passive corruption of forensic evidence and reliability.

The depth of photointerpretation may also vary depending on the questions being asked of the images, the photo-interpretive process and the skill and training of the interpreter. Babington Smith (1954) suggested that in WWII, the Allied Central Interpretation Unit developed and used a process that included three different stages of photointerpretation and these stages were all significantly different. The first phase used a very superficial assessment of the photographs by viewing aerial photographs and reporting on what was visible in the photographs. The second and third phases developed a more comprehensive analysis that included other forms of intelligence using interpretative analysis.

To deconstruct various thinking associated with forensic evidence derived from the interpretation of photographs, this chapter includes samples taken from a recent Australian case (Zak 2007) and includes photographic evidence provided during the investigation into the assassination of John Fitzgerald Kennedy (1917-1963) (JFK). This chapter also discusses difficulties and misconceptions associated with photointerpretation and explores how methods developed originally in the UK military may provide a platform to ensure some consistency with interpretive analysis methods.

**9.2 Issues with Photointerpretation Accuracies**

Photointerpretation of CCTV images is often more complex than it appears. Establishing an understanding of the real and evidence requires sound knowledge in several visual disciplines that include photography, photographic science and visual culture. Having expertise in a particular forensic discipline does not mean the expert has the skill, experience or specialised knowledge required for photointerpretation.
This is a common misunderstanding. Photointerpretation skills are not automatic and require further knowledge involving the photographic condition of the supporting evidence.

Limited or no training is this field does not prevent forensic practitioners from making claims based on their interpretation of images as seen in the case studies illustrated in this thesis. The reliance on visual information to make decisions is also witnessed in the sporting arena where video referees or umpires are now a component of how sporting events are officiated. Sports such as rugby league, tennis and cricket incorporate decisions based on the official’s interpretation of the video footage (visual media). Examination of the footage provides the advantage of multiple views and camera angles to assist with the decision. However, there are many instances when video referees decisions have been known to be erroneous and the technology employed to improve decision-making has proven to be fallible. Inappropriate application of the visual material is a common occurrence with this type of photointerpretation and decision making process. Nevertheless, what this form of photointerpretation does appropriately is establish the question being asked of the imagery used by the interpreter. In other words, a question is defined and clearly articulated between the field and video referees before the examination commences.

Concepts regarding ‘photographic truth’ are also currently being debated among visual culture scholars (as discussed in Chapter 3). The accuracy of photointerpretation directly relates to the reliability of forensic evidence obtained from the visual media. The danger when inaccurate photointerpretations are made before a lay jury is the weighting photographic evidence may have on their verdict. The condition of intertextuality as described by Doyle (2003) can also falsely enhance any incorrect photointerpretations or unreliable evidence, which makes this evidence difficult to prove inappropriate.

Western societies are considered to have a high level of visual literacy and are continuously saturated with the application of images from the media and advertising industries. This level of literacy does not naturally translate to expertise in photointerpretation and, is in fact, regularly manipulated by the media and especially
advertising. Nevertheless, simplistic representation of evidence through photographs and images can be highly persuasive, but not necessarily accurate. Further cases involving this level of inaccuracy are discussed in this chapter. The impossible triangle described below also illustrates the inconsistencies with photographic representation and reality.

Difficulties regarding interpretation may be demonstrated in Dutch artist Mauritis Cornelis (M.C.) Escher’s (1898-1972) woodcut lithographs. Escher’s work is known not only for the artistic body of work, but also for their illusionary qualities [Gregory 1970, Escher & Locher 1984, Escher 1984]. Escher’s work produces buildings that are constructed with impossible perspectives that illustrate, for example, a stairwell that continually travels up or continually down, depending on the direction of the gaze (Ascending and Descending 1960). Three of his works that illustrate this impossible perspective include; ‘Belvedere’ (1958), ‘Ascending and Descending’ (1960) and ‘Waterfall’ (1961) [Gregory 1970, Escher 1984, Ramachandran & Rogers-Ramachandran 2008].

Escher’s visual constructions form the basis of an ‘impossible triangle’ (see Figure 9.2) which is thought to be first illustrated by a Swedish artist Oscar Reutersvard (1915-2002) in 1934. Reutersvard’s work represented impossible figures and his impossible triangle was actually a series of cubes to form a triangular shape. The geometric structure of the impossible triangle was first articulated by Roger and Lionel Penrose in 1958 when they published an article in the British Journal of Psychology [Draper 1978, Escher 1984, Zakia 2002, Ramachandran & Rogers-Ramachandran 2008].

The drawing in Figure 9.2 depicts the structure of an impossible triangle (also known as the ‘Penrose triangle’) as described by Penrose and Penrose in 1958. It is called an impossible triangle because the perspective cannot exist in real life. If an item could not exist in real life, then it would be fair to assume obtaining a photograph (without digital manipulation) would not be possible. This thinking suggests that an object must exist in reality before a photograph can be produced of the object.
Figure 9.3 is however, a photograph of an impossible triangle and it has been taken with a camera with no digital manipulation. It is a straightforward photograph of a timber structure. Based on the theory the object must exist in reality to be photographed, two poignant questions emerge; i) how could this structure exist in real life, ii) can the object have an impossible dimensional structure?

This object is most certainly interpreted as an impossible triangle, but it is not what it seems. It is safe to assume that objects that do not exist, cannot be photographed. However, photointerpretation may be quite inaccurate when based on the reality. The solution to this photographic puzzle is revealed in Figure 9.4. The misinterpretation is due to the three-dimensional object being represented in a two-dimensional form. The photograph also produces strong Gestalt psychology principles including continuity, similarity and proximity [Zakia 2002] that reinforce an inaccurate interpretation of the structure.

Neuropsychologist Richard Gregory (1970) describes the visual phenomena of the impossible triangle as a visual paradox. Neuroscientists, Vilayanur Ramachandran and Diane Rogers-Ramachandran (2008) suggest the goal of perception is to compute a rapid answer based on rational logic. Images such as the impossible triangle and Escher’s etching of stairways and waterfalls create paradoxical perceptions because the mind sees an image for which rational and logical thinking
Figure 9.3; The impossible triangle as a photograph.

Figure 9.4; The photographic solution to the impossible triangle.
cannot provide an answer – the two concepts, seeing and perception are paradoxical. Ramachandran and Rogers-Ramachandran (2008) suggest;

*Despite the common view that ‘we see what we believe,’ the perceptual mechanisms are really on autopilot as they compute and signal various aspects of the visual environment. You cannot choose to see what you want to see.* [Ramachandran & Rogers-Ramachandran 2008, p71]

Visual elements within photographs can corrupt the interpretation and misrepresent reality. This is an important consideration when evaluating the reliability of forensic evidence derived directly and exclusively from photographs or images. Gregory (1970) argues;

*All pictures are paradoxical – in the sense that they have visually this extraordinary double reality: flat objects seen as flat, and the same time as quite different three-dimensional objects in a different space. This double reality is an essential paradox of all pictures.* [Gregory 1970, p51].

The following sections examine evidence sourced from photographs in two separate cases; i) the JFK assassination (USA) in 1963 and ii) the Zak coronial inquiry in Western Australia (WA) in 2007. These cases further highlight how photographic evidence can become unreliable evidence and that the evidence is often produced (and given in court) by people without knowledge of photographic and visual processes and conditions. In addition to dangers associated with incorrect or exaggerated interpretations, or more specifically, inappropriate information sourced from the visual data, is that the interpretations are only ever conducted at a superficial level without exploring other methodologies of photointerpretation.

### 9.3 Photographic Evidence from the JFK Assassination Case (1963)

An examination of forensic intelligence and evidence derived from photographic media cannot be conducted without some reference to the JFK assassination and the Zapruder film. John Fitzgerald Kennedy (JFK), the President of the United States, was assassinated on 22 November 1963 in Dallas, Texas [Hunt 1996].

When the President’s motorcade approached Dealey Plaza during his Dallas visit, Abraham Zapruder, a local dressmaker, positioned himself on a short wall located on
a grassy knoll overlooking the roadway in readiness for the arrival of the President [Motyl 1998]. As the President’s limousine turned the corner in front of the Texas School Book Depository building, Zapruider began to film the motorcade using his Bell and Howell movie camera at 18.3 frames per second and inadvertently recorded the President been struck by a bullet in the neck followed by the fatal wound to the head [Nickell 1994]. This continuous footage of the assassination of the President of the United States has become an evocative component of American history which is embedded into the visual vernacular of its citizens.

There were several investigations into the death of JFK including the ‘Warren Commission’ in 1964 and the ‘U.S. House of Representatives Select Committee on Assassinations’ in 1977 [Nickell 1994, Saferstein 2007]. Photographs and other visual media were examined during both inquiries and Hunt (1996) indicated;

The Warren Commission used some enhancement techniques to examine the photographic evidence from the scene of the crime, but scientific advances after 1964 allowed the House Committee to employ new technology in evaluating visual materials associated with the murder. Another look was needed because the critical community had dozens of photographs taken at the scene and claimed to spot snipers hiding in the bushes. [Hunt 1996, p93]

The Warren Commission found that; Lee Harvey Oswald was responsible for the assassination, he had fired three shots from the Texas Book Depository building from behind the President, two shots hit the President (the last being fatal), that Oswald was a lone assassin and there was not a conspiracy [Warren 1964, Saferstein 2007]. The Warren Commission examined 510 pieces of visual media [Hunt 1996] during the proceedings of the inquiry including a second-generation copy of the Zapruder film [Motyl 1998].

There were many critics of the Warren Commission’s findings who purported a conspiracy theory led by the US Government and who believed that the Government had covered-up and fabricated evidence. This conspiracy theory rhetoric included Harold Weisberg (1967) who published a book highly critical of the Warren Commission findings in 1967. Weisberg makes this broad allegation regarding the photographic evidence used in the inquiry;
‘None of the Commission’s photographic evidence of the assassination is untainted.
None of it was introduced into evidence properly.
None of it was interpreted properly.
None of it was used properly.
None of it was complete in itself. Not a single motion picture, not the still pictures of a single photographer, was not ‘edited’ or ‘cut’.’ [Weisberg 1967, p14]

Weisberg’s criticisms of the handling of the photographic evidence and interpretation are well founded. Stills made from the Zapruder film were published by Life Magazine on 06 December 1963 and according to Vicki Goldberg (1991), the stills were so graphic the images appearing in the magazine had the blood spatter retouched out. However, the Zapruder film footage was not shown to the public until conspiracy theorist Robert Groden provided a poor several-generation copy of the Zapruder film to a current affair television programme in 1976 [Rivera 1975, Motyl 1998]. The US Government never released the footage, which raised the conspiracy theorists’ suspicions about a cover-up.

There are several possible reasons why the Zapruder film was not shown to a television audience earlier than 1975, including its highly graphic appearance combined with the sensitivity of American broadcasting authorities. Time Inc actually owned the rights to the Zapruder film after they bought the film rights from Zapruder. The US Government did not have the right to broadcast the film without Time’s approval.

Despite ownership of the film rights, the Zapruder film was first aired on American television on 06 March 1975 on ABC Television’s ‘Good Night America’ hosted by Geraldo Rivera and was a ‘World Wide Special’ episode [Rivera 1975, Motyl 1998]. The showing of the Zapruder film on television increased the public’s scepticism of the Warren Commission findings and provided some evidence, albeit incorrect, that the fatal injury was caused by a gunshot wound that came from the front of the President and not from behind (as would be the case if Oswald was the shooter located in the building situated behind the President when he was shot). This theory was developed due to the sharp backward movement of JFK’s head as he was struck by the bullet. The theory of a second gunman was strongly supported by the public
due to the airing of the Zapruder film with commentary by Groden on the ‘Good Night America’ programme. Groden alleged during the programme;

Now the Warren Commission said that, all the shots were fired from behind by Lee Harvey Oswald, a lone assassin. Firing at the President and as you can see, clearly, the head is thrown violently backwards, completely consistent with a shot from the front, right [Rivera 1975]

The blood spatter pattern seen on the Zapruder film would suggest otherwise. It is consistent with the bullet entering the skull from the back of the head and exiting from the front due to the forward-spatter pattern. The pathology report also supports this notion [Hunt 1996]. However, the airing of the Zapruder film on ‘Good Night America’ raised the American public suspicions. They had good reason to distrust the Government shortly after the Watergate scandal in 1972. A second inquiry was conducted by the House Committee and Hunt (1996) suggests;

The Warren investigation examined about 510 visuals; the House Committee checked this body of material, plus the autopsy photographs and X-rays and some additional assassination photographs not made public in 1963-1964. The House also had the benefit of independent scientific work that had been done over the years by private researcher Robert Groden to clarify the images in the Zapruder film. The photographic specialists empanelled by the House used new chemical processes and photographic digitization to ‘read’ the ‘visual record’. Since amateur photographers took most of the visuals that recorded the assassination and its environment, scientists working for the House Committee had to enhance image contrast, remove blur, and otherwise try to clean up the images. They looked for gunman in the windows of the sixth floor and the bushes in the grassy knoll. [Hunt 1996, p93-94]

One particular image that was examined by the House Committee is a Polaroid\(^{61}\) photograph taken by Mary Moorman [Hunt 1996, Fetzer 2003, White 2003b]. Moorman’s photograph (Figure 9.5) was taken immediately before JFK sustained the wound to the head [Hunt 1996]. Moorman was positioned alongside the President’s limousine as it drove down the street and she can be seen in the Zapruder film. Figure 9.7 is a still taken from the Zapruder film (frame 303) and is approximately the same time as Moorman was taking the photograph. Moorman can be seen with what may be the camera in front of her face.

\(^{61}\) An instant photographic process developed and manufactured by the Polaroid™ corporation
Moorman’s very grainy Polaroid photograph allegedly displays figures that are unaccounted for in the background on the grassy knoll. One such figure was designated as ‘Badgeman’ and is located on the small wall (refer to Figures 9.6a and 9.6b). Badgeman’s figure appears to be a uniformed person, crouched in a firing position and pointing a gun in the direction of the President. Zapruder and his assistant may also be seen (albeit very grainy) to the far right of the wall. The scale between Zapruder and Badgeman does not seem to be consistent; however, conspiracy theory advocate Jack White suggests;

When viewed close-up, the features are clearly seen – hair, eyes, eyebrows, nose, cheek, ear, uniform with shoulder patch and badge, and left arm in rifle-firing position. The government had the Moorman photo in its possession – but it was not published in The Warren Report (1964). Perhaps they noticed the presence of Badgeman, and could not afford for the public to see a gunman on the knoll. If they would withhold evidence like this, they would not hesitate to alter the Zfilm62 and other evidence [White 2003a, p53]

The photointerpretation of the Moorman photograph to suggest the detail described by White is considerably exaggerated. There has been no evidence to support the notion that Badgeman exists and this claim is speculative and without substance. The figure suggested to be the unknown assassin on the grassy knoll, could be just as easily, and more explainable, a simple pattern made from the combination of the tree foliage and light coming through the leaves.

Hunt (1996) suggests the House Committee paid a great deal of attention towards investigating the notion of a conspiracy. Their investigation revealed that there were several connections between people associated with the assassination and that there were possible conspirators. However, they dismissed any Government involvement (including the Governments of Russia and Cuba) or from any Government agent.

The attempt to find evidence in photographic material that proves a conspiracy is continuing with the JFK assassination. Another example is the claim of a bullet hole on the windscreen of the limousine confirming shots must have came from the front and on the grassy knoll rather than from the Texas Book Depository building.

62 Referring to the Zapruder film.
Figure 9.5: Mary Moorman’s Polaroid photograph of JFK’s assassination moments after he received the fatal wound. Moorman’s photograph was said to contain information that shows a uniformed person positioned on the grassy knoll and crouched in a position that appears to be firing a weapon. This figure was described as ‘Badge Man’ [Image sourced from Hunt 1996, p10].

Figure 9.6a (above): Detail of Mary Moorman’s photograph depicting location of Zapruder and the alleged ‘Badgeman’. The insert is a detail of the section showing Badge Man [Image sourced from Hunt 1996, p10].

Figure 9.6b (right): Detail of section indicating ‘Badgeman’ [Image sourced from Hunt 1996, p10].
Figure 9.7: Mary Moorman shown in frame 303 of Zapruder’s film taking the Polaroid photograph. Moorman is on the right dressed in black standing next to Jean Hill. JFK is seen in the bottom of the frame holding his neck as a result of the first gunshot wound [image still made from Zapruder’s film and sourced from MPI Teleproductions].

Figure 9.8: Photograph taken by Phil Willis moments before JFK was shot and before Moorman’s photograph. Zapruder can be seen standing on the wall with his assistant filming the motorcade (right of the sign). The area of interest where ‘Badge Man’ was located in Moorman’s photograph is also in view. The arrow depicts the President [image sourced from Hunt 1996, p8].

Figure 9.9: Photograph by Wilma Bond a short time after the incident, depicting the area of interest. Mary Moorman and Jill Hill can be seen seated near the police bike [image sourced from Hunt 1996, p13].
Figure 9.10a & 9.10b: Frame 138 with a white mark on the front windscreen described as a bullet-hole. It is also possible the mark is simply a specular reflection of the sun. The images are shown in the sprocket holes of the 8mm film [still taken from Zapruder’s film sourced from MPI Teleproductions 1998].

Figure 9.11: Aerial photography of Sydney. Photogrammerists generally conduct photointerpretation from stereo images like this one of Sydney. These images are very different than photointerpretation evidence sourced from CCTV both from a technical and methodological perspective. [Image sourced from www.jatsstuff.dev.java.net].
Various frames on the Zapruder film show a white mark on the windscreen of the Presidential limousine. Figure 9.10a and 9.10b illustrates the mark, which could also be consistent with a specular reflection from the sun reflecting off the windscreen or metal rear-view mirror bracket. Fetzer (2003) however, makes this somewhat definitive claim;

That there had indeed been a shot through the windshield is confirmed by frame 225. A shot through the windshield from the front implies a conspiracy. [Fetzer 2003, p21].

The mark on the windscreen is not evidence that; i) it is actually a hole, ii) it was made by a bullet and iii) it cannot be explained by another event. The likelihood of the mark being a specular reflection is likely and immediately challenges any definitive proof of a conspiracy based on the photographic evidence. The frame depicted in Figures 9.10a and 9.10b was filmed before JFK received the fatal head wound.

There is a vast array of alleged photographic evidence that some suggest lead to evidence of a conspiracy. None has actually been supported as actual evidence. The few photographic evidence examples illustrated in this chapter provide some indication of the risks when superficial and ill-informed photointerpretations are made from images. They also highlight how people with an agenda can use photographs inappropriately and misleadingly when presenting so called evidence from photographic sources. If some slight indication can be seen on the photographs that support the evidential notion put forward, then a higher degree of believability is achieved, even when there is no further substance beyond the claim.

9.4 The Zak Coronial Inquiry (2007)

The Zak coronial inquiry (2007) provides a further insight into how forensic experts may use photographs to form evidence. It particularly highlights the problems associated with placing significant reliance on the photographic representation and how inaccurate photointerpretation can lead to serious issues within the judicial system. The Western Australian (WA) state coroner provides comment regarding how evidence can be misrepresented and these points are covered in this section.
A second coronial inquiry into the death of Mr Romuald Todd Zak was ordered by the WA Supreme Court when an application to the court was made by the family of the deceased to make the original Coroner’s findings void. New evidence was presented to the WA Supreme Court and subsequently at the second inquest ordered by Murray J in 2006 when he granted the application and made the first inquest findings void [Hope 2007].

The second inquest was held in 2007 before WA State Coroner Alastair Neil Hope and after examining the evidence, he found that Zak had died as a result of suicide by hanging on or about 27 May 1997 in the grounds of the psychiatric hospital to which he was admitted as a voluntary patient. These findings were consistent with the original Coronal inquiry in 1998. Zak was diagnosed with severe mental health problems and was voluntarily hospitalised due to suicidal tendencies and severe depression [Hope 2007].

The issues raised by the parties representing the family of the deceased were based on claims that suggested the death was not suicide and instead was the result of murder. Evidence was presented that challenged the original Coroner’s findings. This evidence was primarily based on the examination (interpretation) of photographs taken at the post mortem and at the scene where the body was discovered. The new evidence given at the Supreme Court hearing and later during the second inquest consisted of three central arguments based on; i) forensic pathology evidence, ii) forensic entomology evidence and iii) the identification of a chainsaw at the scene.

This case provides a good insight into how interpretation of photographs is used during the investigation and is later presented as forensic evidence. It also highlights realistic dangers with regard to the reliability of the forensic evidence when inappropriate, exaggerated and erroneous evidence is derived from the interpretative analysis of the photographic material. The following section focuses on this evidence and its reliability as indicated by the State Coroner. It uses the State Coroner’s published decision as the source.
9.4.1 Forensic Pathology Evidence

Professor Maciej Henneberg, Professor of Anatomy from University of Adelaide provided a report and gave evidence suggesting he examined photographs of the deceased taken at the scene and during the post mortem. Henneberg’s evidence considered the cause of death and during questioning he conceded he was not a forensic pathologist and that he did not read the post mortem report made by the investigating forensic pathologist, Dr Cadden. The Coroner summarised Henneberg’s findings suggesting Zak was murdered rather than committed suicide;

... significant struggle preceding death and serious head injuries that could lead to the death of Mr Zak. Therefore, there are no grounds for suspicion of suicide while evidence of physical abuse possibly leading to homicide or murder is substantial. Since there is no evidence of struggle under the tree where the deceased has been found, the injuries had to be inflicted in some other location and the body moved to the place it was found in. [Hope 2007, p35]

Hope (2007) further added:

*It is clear that in his report and in his evidence Professor Henneberg sought to address many issues which were within the realm of expertise of the forensic pathologist. He sought to comment on purging and lividity, profuse bleeding, injuries such as bruising and abrasions, patterns of blood stains, the appearance of the ligature mark and its cause, haemorrhaging in the cranial cavity and the seepage of cerebrospinal fluid.* [Hope 2007, p36]

Henneberg’s findings were made directly from the photographs and claimed Zak’s death was not suicide, but more consistent with murder. Coroner Hope made the following comment regarding Henneberg’s evidence:

*In respect of the opinion evidence of Professor Henneberg, it appears to have been based on very limited information and many of the opinions stray outside his own area of expertise. He sought no guidance from the post mortem report which contained a substantial amount of objective information which was not, and could not have been, contained in the photographs which he saw.* [Hope 2007, p37]

This is an important point to consider when examining the reliability of photointerpretation in the context of Henneberg’s evidence. Hope suggests the reliance solely on the data pertained in the photographs was inappropriate, especially when further information such as the post mortem report was available. A more
holistic approach to the photographic evidence, by incorporating other sources of information or data (reports, scene examination etc) could improve the reliability of the evidence. A more in-depth analysis and better photointerpretation can be achieved by using various sources of fact rather than a superficial interpretation of the photographs exclusively. Henneberg’s findings were also polarised in comparison to the original forensic pathologist report (Dr Cadden) and two other forensic pathology consultants who also reviewed Cadden’s results and the police investigation findings. Dr Lawrence (for the State and Police Commissioner) and Associate Professor Hilton (for the deceased’s family) both supported Cadden’s report. Cadden, Lawrence and Hilton were all qualified forensic pathology practitioners in contrast to Henneberg [Hope 2007].

9.4.2 Forensic Entomology Evidence

Entomological evidence was presented by Associated Professor Ian Dadour from the University of Western Australia during the Supreme Court hearing and the second Coroner’s inquiry. Dadour’s findings were also exclusively based on his examination of the photographs - he did not directly examine the insects found on the deceased. His evidence also indicated he did not refer to Cadden’s post mortem report. Hope (2007) describes Dadour’s evidence as;

> *In the decision to declare the findings of the original inquest void, one of the matters taken into account by Murray J was a report provided by Associate Professor Ian Dadour. At page 6 of his reasons Murray J made the following observation –*

> ‘Associate Professor Dadour provides a report effectively as a forensic entomologist. Using the photographic evidence, he estimates that the deceased was in the place where he was found for a minimum of 24 hours, but no longer than 48 hours after his death to the time when the photographs were taken.’ [Hope 2007, p29]

The time of death was an issue raised by the complainants and was considered a critical point of reference to prove the mishandling of the original police investigation and Coroner’s findings. Hope (2007) found this evidence problematic

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63 Forensic entomology is the study of insect activity on deceased victims that may determine the minimum time of death according to the type and development of the insect larvae found populating the body.
and the ability of the photointerpretation by Dadour was questioned by the Coroner. Hope (2007) suggesting:

*In his report he claimed that in one of the photographs fly larvae were present around the base of the eye and fly eggs were evident in the cheek area of the face. In his report he stated that the fly larvae were either first or second instar larvae but that it could not be determined whether the larvae were from an ovipositing or a larvipositing fly species (flies which lay eggs are ovipositing and flies which have live larvae are larvipositing).*

*In evidence Associate Professor Dadour identified areas of white in one of the photographs which he stated he believed were the maggots and fly eggs. [Hope 2007, p32]*

Hope’s (2007) concerns regarding the accuracy of the evidence is further expressed:

*In this particular case, however, I have serious concerns about the advice provided by Associate Professor Dadour.*

*Not only do his opinions as to the time since death appear to be clearly wrong in the context of other evidence, they appear to have been based on inadequate information. [Hope 2007, p30]*

Hope comments on the accuracy of the evidence based on the interpretation of what he suggests were ‘white marks’ and questioned whether they were actually fly eggs or maggots as Dadour claimed. Hope’s comments regarding the interpretation of the photographs further include:

*Having viewed the photographs and compared that photograph with a number of other photographs taken at about the same time, I am by no means certain that the areas of white identified by Associate Professor Dadour are in fact maggots or fly eggs. I agree with observations made by Dr Cadden and by Dr Archer who also were unconvinced as to the nature of the areas of white.*

*Dr Archer observed that she could not locate any feature which she could confidently determine to be a maggot in any of the photographs provided to her. She noted that some objects might have been maggots, but the anatomical details which would allow her to be certain were hidden. [Hope 2007, p32]*

The evidence given in these two instances (Henneberg and Dadour) demonstrate the dangers when evidence is derived directly and exclusively from photographs. Both forensic pathology and forensic entomology are complex disciplines and findings require very detailed examinations. A legitimate challenge to the evidence of the

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64 Dr Archer is a forensic entomologist.
experts could have included questions regarding their ability, knowledge, experience and training in photointerpretation. The reliability of their evidence was directly related to the information purported to the photographic evidence and the expert’s ability to interpret those photographs. Not accessing other information like Cadden’s post mortem report, places an exclusiveness on photointerpretation. The Coroner also makes a comment on the expert evidence in his summing-up and these comments are discussed further in this section.

9.4.3 The Chainsaw Evidence

An example of the importance of reliable photointerpretation evidence is further highlighted in the evidence presented by Robin Napper from the University of Western Australia. Napper was formerly a police officer in the UK and Hope introduces his report as;

> Murray J, in determining that the findings of the previous inquest should be declared void, placed considerable reliance on a report provided to him prepared by Mr Napper as well as a powerpoint photographic presentation which he had produced.

> Mr Napper’s report was a most unusual document prepared by a person claiming to have expertise in respect of forensic investigations. [Hope 2007, p20]

According to Hope (2007), Napper’s report makes two central claims. He refers to the condition of the body as seen in the photographs, suggesting there was blunt force trauma and bruising that was not consistent with hanging. He compares the photographs to the post mortem report by Cadden and asserts inconsistencies with the pathologists report and photographic evidence. Napper does not have any medical qualifications or training and this evidence appears somewhat outside his area of expertise, as indicated by Hope;

> In the context of the evidence of forensic pathologists in this case that there were no antemortem injuries discovered on the body of the deceased, aspects of Mr Napper’s report are surprising. He refers to a photograph which he numbered 19 and makes the following observation –

> The swollen left eye and bruising around the ear and side of the head appear to be the result of blunt force trauma more than post mortem staining? The blow appearance to the head is not consistent with hanging, which by definition
forces the blood to drain to the lowest part of the body during suspension, and not to engorge the head.

In his review of photographs of the deceased he referred to a number of ‘unexplained bruises’.

In his comments and conclusions Mr Napper makes the observation that –

‘The pathologist mentions several times that the body was decomposed with putrefaction changes readily evident. The pictures simply do not reflect this’.

Later in his report Mr Napper makes the observation that –

‘The body has numerous unexplained bruises all over. The left eye, left ear, left shoulder, back and middle of the stomach’.

Mr Napper was questioned about these assertions, particularly in the context of the evidence of the forensic pathologist Dr Cadden and he agreed that evidence relating to injuries and lividity was the provenance of a forensic pathologist and was outside his area of expertise’ [Hope 2007, p21]

Napper challenged the accuracy of the original post mortem report based solely on his unqualified interpretation of the photographs. The obvious points here is that Napper is not a forensic pathologist nor a photographic expert. By accepting Napper’s evidence in this context, the photographs, or more specifically Napper’s interpretation of the photographs, would be afforded more factual weighting than the qualified forensic pathologist who made his findings based on an examination of the actual body in incorporation with other resources (such as toxicology reports, photographs etc). Furthermore, Napper’s assumptions were not consistent with Lawrence and Hilton’s independent forensic pathology examination of the post mortem findings even though both are qualified forensic pathologists. To accept Napper’s opinion, would be placing enormous weighting exclusively on the somewhat unqualified photointerpretation and suggests the evidence pertaining in the photographs is factual, while the observation from the real was erroneous. This would be a dangerous proposition to entertain when trying to establish facts. The weighting of photointerpretation must be placed in an appropriate context and not exaggerated as a new and exclusive source of facts and, as it was in this case, despite the opinions of appropriately qualified practitioners.

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65 Examination made directly from the deceased.
During questioning at the inquiry, Napper conceded he was not qualified to make opinions on injuries and suggested his report was merely trying to raise questions rather than provide answers [Hope 2007]. The other claim Napper introduces is the idea that the scene had been tampered with, hence raising the suspicions of a murder rather than a suicide. He indicated there was evidence of a tree branch been ‘freshly’ cut and that a chainsaw can be seen in one of the scene photographs (see Figures 9.12 and 9.13) [Hope 2007]. Hope reports on this claim suggesting Napper said:

‘A branch appears to have been freshly cut on the trunk of the tree above the body (indicated by a yellow marker and a red arrow). Above the right arm (indicated by the orange marker) appears to be the back of a chainsaw, similar to the one shown on picture 15. Who did this and why? Where did the chainsaw come from? It is essential to understand the scene to see it as found without any disturbance’. [Hope 2007, p23]

Furthermore, the Coroner found Napper’s claims regarding the chainsaw to be erroneous and stated:

Mr Napper’s powerpoint presentation contained the photographs referred to in his report and photograph numbered 15 in the presentation depicted a view of a chainsaw.

One of the witnesses approached by Mr Napper to assist, Detective Sergeant McDonald of the Placer County Sheriff’s Office, provided a report dated 12 March 2003 which contained the following observation –

The presence of a chainsaw in the proximity of an apparently fresh/new cut limb just above Zak’s body is not explained. There are no shavings/saw dust on Zak to indicate he was under the limb when it was cut. It may indicate the timing of Zak’s presence under tree if limb was cut by a groundskeeper prior. The above is reproduced from Mr Napper’s powerpoint presentation photograph numbered ‘15’.

When Mr Napper gave evidence at the inquest he was shown a number of photographs which clearly showed that the item described by Detective Sergeant McDonald and by him as a ‘chainsaw’ was in fact a Coca-Cola can.

At the inquest Mr Napper accepted that, having been shown the photographs, and particularly having been shown the photographs taken from a different angle, what he had described as appearing to be a ‘chainsaw’ was in fact a Coca-Cola can (t.301).

The following exchange took place with Mr Napper in respect of this matter at t.301 –

CORONER : Why did you say it appeared to be the back of a chainsaw?
NAPPER: Because when you look at the chainsaw photograph, sir, and you look at the red marking on the photograph I have, it possibly could have been the back of a chainsaw. That's the comment I make. ...

CORONER: It just looks like a red object to me. What was it about the red object that made you think it was a chainsaw?
NAPPER: That was the indication I had from the family.

CORONER: What was?
NAPPER: The red object was in fact a chainsaw.

The above detail depicts the Coca-Cola can from a different view over the right arm of the deceased [part of 6A of Exhibit ‘30’]

The above photograph shows a different view of the Coca-Cola can identified by Mr Napper as appearing to be a chainsaw [4E of Exhibit ‘30’].

Nowhere in Mr Napper’s report provided to the Supreme Court or in his powerpoint presentation did he make any reference to the basis for his opinion that the red item was a chainsaw as coming from advice given to him from the family of the deceased.

Mr Napper was asked how it was that Detective Sergeant McDonald in his report of 12 March 2003 had also referred to a ‘chainsaw’ being ‘in the proximity of an apparently fresh/new cut limb just over Zak’s body. Mr Napper stated that Detective Sergeant McDonald must have made this error as a result of a ‘verbal conversation’ with himself and possibly as a result of the inclusion of a photograph of a chainsaw with scene photographs taken by police (t.302).

This error on the part of Detective Sergeant McDonald in mistaking a Coca-Cola can for a chainsaw demonstrates the dangers associated with reliance on information provided in an unprofessional and potentially misleading way. It also highlights the need for persons purporting to give expert overview evidence to clearly identify the factual and evidentiary material on which their opinions are based.

While there were a small number of photographs which were located at the time of the second inquest and were not available at the time when Mr Napper compiled his report, a number of the photographs available to him depicted the Coca-Cola can at the scene and a review of those photographs should have enabled the identity of the red object to be ascertained.

Police who attended the scene recorded all objects which they located in the area in a log. The relevant entry reads –

‘1135-1 Coke can 325ml from underneath tree deceased next to’. [Hope 2007, pp24-26]

The notion of a chainsaw depicted in the scene photographs was not substantiated and its implication in the suggestion that Zak was murdered was immaterial. Errors in photointerpretation are a serious concern when evidence is derived from photographs and given as fact in a court (see Figures 9.14a, 9.14b and 9.15).
Figure 9.12: Crime scene photograph as presented in Napper's PowerPoint presentation (photograph numbered 14) of his evidence depicting what Napper claims is a chainsaw and freshly cut branches (arrows indicating items) [image sourced from Hope 2007, p23].

Figure 9.13: Napper's PowerPoint presentation image (photograph numbered 15) from his evidence claiming the alleged chainsaw in the crime scene image is similar to this chainsaw [image sourced from Hope 2007, p24].
Figure 9.14a: Crime scene photograph of the deceased from a slightly different viewpoint from Figure 9.11. This image depicts the ‘red object’ differently than the photograph presented by Napper. Figure 9.14b is a detail of the ‘red object’ or Coca-Cola can [image sourced from Hope 2007, p25].

Figure 9.15: Another crime scene photograph depicting the Coca-Cola can from a different viewpoint and in close-up [image sourced from Hope 2007, p25].
9.4.4 Hopes Comments on the Expert Evidence

The WA State Coroner reported in his conclusion that Zak’s death arose from suicide. An interesting aspect of his report however, is the comments he made after his findings. Coroner Hope makes further comment on the expert evidence heard before him during the inquest. He is highly critical of the reliability of the evidence and especially; i) the level of reliability of evidence when it was exclusively derived from photointerpretation of the scene and post mortem photographs, ii) the reliance on the photographic evidence was not made clear in the experts’ reports and iii) the inappropriateness of the witnesses to give opinion evidence outside their area of specialised knowledge (expertise).

Due to the significance of Hope’s comments in relation to this thesis research question, the complete comments on expert witnesses have been reproduced below;

**COMMENTS ON EXPERT EVIDENCE**

In this case, as indicated in these reasons, I have a number of concerns in respect of some of the overview evidence which was provided as ‘expert’ evidence in this case.

It is a very serious matter to allege that a death has, or may have, resulted from homicide. There is a potential for injustice to occur if such assertions are made without adequate investigation or made by persons who are not in fact experts in the area in respect of which they are purporting to provide expert opinion evidence.

I note that a number of organisations and societies provide guidelines for members for giving expert evidence. In my view all expert reports which purport to give overview analysis should comply with a number of prerequisites including –

1. **The expert’s report should clearly identify the evidence on which the expert has relied.**

An expert’s opinion can only be as good as the evidence upon which it is based and so it is of fundamental importance that this evidence should be clearly identifiable so that in any review of the expert opinion, the evidence upon which it is based can also be examined.

In this case Professor Henneberg relied on photographs and information provided to him by Mrs Zak. His report should have identified the photographs and particularised the evidence given to him by Mrs Zak on which he relied, particularly as Mrs Zak’s account was likely to contain a subjective analysis of events.
The report of Mr Napper was also deficient in this regard. Mr Napper referred to an item which he stated ‘appears to be the back of a chainsaw’. It was only when it was pointed out to him that the item was in fact a Coca-Cola can that he claimed that he had relied on information provided to him by the family (t.229). Nowhere in Mr Napper’s report was there a reference to any information provided by the family suggesting that an item visible in photographs close to the body of the deceased was a chainsaw.

2. An expert witness report and expert evidence should clearly identify the basis on which expertise is claimed and should specify the limits of that expertise

All expert reports should clearly identify the basis on which expertise is claimed and the nature and extent of that expertise.

Opinions should not be given outside of the area of expertise except in exceptional circumstances and in those circumstances the fact that the opinion is not based on expertise should be clearly stated.

In the present case Mr Napper prepared a report which he was aware contained expressions of opinion in areas where he was not an expert. If it was his intention to merely raise questions for investigation by others, he should have clearly stated that that was what he was doing.

Professor Henneberg also purported to give expert opinion evidence in respect of a number of matters which he conceded at the inquest hearing were not matters in respect of which he had any real expertise. Both in his report and in his evidence he should have clearly identified the opinions which he gave which were outside his area of expertise and explained the reason why he considered it appropriate to express opinions in respect of these matters, particularly when he conceded that there were suitably qualified experts who could provide the opinions sought.

3. Experts should attempt to review and become familiar with all of the pertinent data of the particular matter at hand.

In the present case both Associate Professor Dadour and Professor Henneberg gave opinion evidence based on limited information when important information was available to them but was not reviewed. Associate Professor Dadour purported to provide an opinion as to post mortem interval based on white areas in a photograph which he believed to be maggots and maggot eggs, without making any real effort to determine whether maggots had been discovered at the time of post mortem examination which could have provided him with much more reliable data. Even if he had been misled by Mr Napper about the post mortem findings as he claimed, he should have reviewed the report to determine whether it contained any information about insect infestation of the body and should have sought access to all of the available photographs prior to expressing any opinion.

Professor Henneberg purported to give expert opinion evidence about what he thought were injuries to the body of the deceased based wholly on photographs shown to him without seeking access to important information contained in the post mortem report.
Professor Henneberg, for example, made comments about ‘multiple injuries to dorsal sides of both hands’, ‘haemorrhaging’ in the cranial cavity, ‘prolifer bleeding from the nose, mouth and possibly the left ear’, the possibility of ‘seepage of the cerebrospinal fluid’ etc (see his report of 27 October 2005) without even reading the post mortem report. Professor Henneberg should have known that the pathologist conducting the post mortem would have had the opportunity to see the body in a cleaned state from many angles and to look and feel for injuries as well as to conduct a range of tests and examinations. He had no reason to suppose that the report based on these observations would not be comprehensive and reliable, yet he made no effort to even obtain and read it.

The fact that Professor Henneberg was prepared to state that ‘…. evidence of physical abuse possibly leading to homicide or murder is substantial’ (report of 27 October 2005) based on limited information and his own opinions in areas outside his area of specialist expertise is extremely disappointing. Had Professor Henneberg’s opinions been relied upon by police, the possibility of a serious miscarriage of justice would have existed. Professor Henneberg’s opinions as to injuries was in direct conflict with the opinions of the forensic pathologists Dr Cadden, Dr Lawrence and Professor Hilton. In my view his opinions were not only wrong, they were knowingly based on inadequate information and limited expertise.

4. Expert testimony should clearly identify the limits of reliability of that testimony and identify factors which could have a bearing on the reliability of any opinions expressed

In this case Associate Professor Dadour failed to identify any of the limits on the reliability of his opinion and particularly failed to identify such issues as the possibility that the oldest life history stage of any maggots on the body of the deceased did not appear in photographs, problems associated with ageing maggots based on the very limited information contained in the photographs and the importance of variations such as ambient temperatures at the body discovery site.

This is particularly significant in this case as based on other evidence I am satisfied that his evidence as to the maximum time period of placement of the body and/or death until the time of discovery of the body as 48 hours was wrong. In this context I rely on the opinion evidence of Professor Joyce to the effect that the death occurred within approximately 24 hours of the deceased’s last dose of his prescribed medications (which would put the death four days earlier than Associate Professor Dadour’s maximum period), the fact that post mortem lividity was such that the deceased could not have been moved after eight or twelve hours of his death and the evidence of the witness Cheryl Tester referred to earlier in these reasons. I also note that there is no other evidence which would suggest that the deceased was alive for any significant period after his disappearance on 21 May 1997.

While Associate Professor Dadour is qualified to give expert opinion evidence about forensic entomology matters and in cases where adequate information is available, about post mortem interval, his report and evidence in this case did not adequately identify the limits to the reliability of his opinion. In the absence of any such expressed limits, Associate Professor Dadour’s opinion was not only incorrect, it had the potential to cause a serious misunderstanding and even a miscarriage of justice.
Comments on Expert Evidence - Conclusion

Evidence in this case has highlighted the fact that there is a real risk of error and even of a miscarriage of justice if courts act upon the evidence of witnesses who claim to be experts unless the expert has –

- clearly identified the evidence the expert has relied upon in a way which permits scrutiny of the reliability of that evidence;
- clearly identified the basis on which the witness claims to be an expert so the limits to that expertise can be readily determined;
- reviewed and become familiar with all pertinent information and diligently and thoroughly prepared himself or herself; and
- clearly identified the limits to the reliability of any opinions expressed and identified any factors which could have a bearing on the reliability of those opinions. [Hope 2007, pp47-52]

Hope’s comments are explicit and highlight the seriousness of the issues associated with forensic evidence derived from photographic sources. He also captures the somewhat latent affect of this type of evidence, which is the reliance by experts on the believability of the photographs to support an exaggerated notion.

Photography and political theorist David Levi Strauss summed up this position very well. Referring to how the media infer a condition of fact, while actually presenting a different narrative to the reality, he said in his book ‘Between the Eyes: Essays on Photography and Politics’;

In theory, photographs are used to back up or ‘prove’ contentions made in the article. They are the visual evidence, the facts in the matter. In actuality they needn’t perform that role. They only need to appear, to give the appearance of evidence. Beyond this they can do anything. Their factualness is never questioned. [Levi Strauss 2003, p30]

This same strategy is also seen when some forensic experts and non-experts are using photographic evidence when presenting forensic evidence. In the context of a jurisprudence environment, as opposed to the media, this is of great concern. The WA coroner, Alistair Hope (2007), also alludes to this danger in Zak during his summing up of the expert evidence. Confirmation of this strategy is also seen in Zak and the two case studies, Jung and Johnson, used in this study and also includes other recent NSW cases including; Police -v- Hooper (2006), Regina -v- Morgan (2009) and Police -v- Freckleton (2009). This practice is not warranted in the context of jurisprudence and Hope’s (2007) warnings need to be given more serious attention.
Photointerpretation Methodologies for CCTV and Forensic Evidence

The term *photographic interpretation* is synonymous with photogrammetry and has a history with aerial surveys of sites involving archaeology, environmental science, agriculture, mining and military intelligence. Photogrammetry is a specialised discipline that focuses on aerial photography (and other sources) for mapping, measuring, interpreting and evaluating landscapes and inanimate objects recorded in scenes. A range of specialised disciplines use photogrammetry including; geologists, soil scientists, foresters, agricultural scientists, hydrologists, military intelligence officers, archaeologists, urban planners and mining engineers to survey the topographical aspects of sites, soil structures, geographic formations, farm yields and the study of built environments [Colwell 1960, Spurr 1960, Ebert 2007]. Image sources for photogrammetry mostly include aerial photography from aircraft and remote sensing from satellites, although terrestrial photogrammetry utilises stereo images taken from the land.

Photointerpretation within the photogrammetry domain predominantly involves the analysis of stereo-paired photographs. Examinations are conducted using three-dimensional images to allow for the visualisation of depth (or ‘z’ axis). Photointerpretation of aerial photographs was extensively developed by the British and Allied forces during WWII for military intelligence and it was further developed by the US during the Cold War years with satellite imagery [Nickell 1994]. Photointerpretation in the context of photogrammetry and aerial photography forms a significantly different function than the interpretation of CCTV images that record criminal activity. However, both are highly complex and require a significant degree of understanding of photographic sciences and principles. Photogrammetrist, James Ebert (2007) suggests;

> Regardless of colloquialisms that suggest aerial or any other sort of photographs speak for themselves, they do not. In order to get answers from aerial photographs, questions must be asked of them. And there are as wide a range of kinds of questions to be asked, and ways of asking them, as there are scientific, technical, and other disciplines. [Ebert 2007, p50].

Ebert’s (2007) comments are a common theme of the present research. That is, the interpretation of photographic evidence is more complex than it seems and reliability
heavily depends on the examiner’s experience and knowledge in photointerpretation, photographic science and visual culture. The level of highly speculative evidence resulting in significantly unreliable evidence, are seen in various cases illustrated in this thesis.

CCTV images are also significantly different to the type of photographs photogrammetrists examine. The most notable differences are that CCTV images are not taken as stereo pairs for three-dimensional examination, the images regularly suffer from curvilinear and rectilinear distortion (unlike photogrammetry images taken with high quality and matched optics) and resolution is often far less than optimal. A comparison between Figure 9.11 and images in Figures; 5.1, 5.11 (Jung), 7.1, 7.2, 7.3 and 7.4 (Johnson) clearly reveal these differences. Figure 9.11 is an aerial photograph taken of Sydney and is a typical image used by photogrammetry in photointerpretation.

The other consideration with CCTV images is the visual narrative that is also present with this type of visual material. The CCTV images used in Jung and Johnson underwent photointerpretation by anatomists; however, any evidence of a systemised and well-considered methodology associated with the photointerpretation process did not exist in the forensic reports. This raises a significant question of reliability, accuracy, transparency and repeatability of the findings.

9.5.1 Photointerpretation of CCTV Images

There is a serious lack of any systematic methods of interpreting images sourced from CCTV or other images used within the forensic sciences. This situation is one aspect of what Detective Inspector Neville described as an ‘utter fiasco’ [Bates 2008, Bowcott 2008, Kerin 2008]. The other being, the lack of common standards within the technology itself making the thousands of CCTV cameras and systems mostly incompatible with each other.

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66 From Scotland Yard (UK)
67 Due to different codecs, proprietary players and software.
The lack of any theoretical and practical methods for photointerpretation of CCTV images presents a situation that undermines the reliability of forensic evidence derived from this source. Alternatively, it may also produce erroneous evidence that cannot be scrutinised appropriately through a systemised and repeatable forensic process. Neither outcome can lead to reliable forensic evidence and is problematic for forensic science with the increasing prevalence of sourced surveillance images used during criminal investigations.

The present research has developed a method that could enhance the reliability of evidence derived from interpretative analysis and significantly improve the level of transparency for this type of evidence through a systemised and documentable methodology. The photointerpretation paradigm developed earlier in this chapter, defines the relationship between the interpretation process, forensic evidence and forensic intelligence. The photointerpretation process consists of two separate phases; i) the interpretation process and ii) the interpretation method.

9.5.2 CCTV Interpretative Process

The interpretation process consists of three basic elements. Firstly, the question being asked of the images must be clearly articulated and developed into a hypothesis. The second step involves a technical review to determine whether the image quality is capable of testing the developed hypothesis and thirdly, test the hypothesis using a defined method of photointerpretation.

9.5.3 CCTV Interpretative Methods

Babington Smith (1957) describes the photointerpretation methods developed and used by military intelligence during WWII. The accuracy of the intelligence developed from the interpretations was of upmost importance, otherwise operations could result in dangerous consequences. Babington Smith indicated that Peter Riddell from the RAF\textsuperscript{68}, created a highly successful photointerpretation system that synthesised three separate phases of interpretation.

\textsuperscript{68} Royal Air Force
The first phase consisted of the initial reporting of important news items such as the movement of ships, trains and aircraft, bomb damage of targets and location of ammunition dumps etc. This phase of the interpretation was reported within three hours of the aircraft landing. The second phase was conducted within twenty-four hours and included more detail regarding the general activities of the enemy and consisted of a more consolidated range of photo-intelligence data across the whole day. The third phase of interpretation comprised of a significantly increased detailed report that considered deeper intelligence information about airfields, factories and the identification of military targets [Babington Smith 1957]. Babington Smith makes the following comment in relation to the conceptual framework that Riddell developed around the photointerpretation intelligence;

> In the summer of 1940, when everyone was demanding more immediate information, it would have been easy to ignore everything else and concentrate entirely on First Phase. But Riddell had the grasp and foresight to see that the photographs held infinitely more then snap answers, and he planned accordingly. [Babington Smith 1957, pp59-60]

This is a significant point Babington Smith makes regarding developing intelligence from photointerpretation. At the surface level interpretation the results may be quite useful, however with a deeper level of analysis and bringing together additional data, the intelligence can be significantly more valuable. Another important consideration relevant to this practice, is the level of training afforded to the photointerpreters. Photointerpretation was considered as a highly specialised discipline that require extensive training and testing.

While Babington Smith’s description of photointerpretation revolves around the development of intelligence and not evidence, the approach for forensic science can utilise this theoretical framework. The photointerpretation, forensic evidence and intelligence paradigm developed earlier in this chapter (Figure 9.1) illustrates the separation between forensic intelligence and evidence. It is also important to note that when intelligence is developed it does not automatically develop into evidence and vice versa (as witness in the Gulf War with the alleged weapons of mass destruction). The conceptual separation between criminal intelligence and forensic evidence must be maintained, which is illustrated in the model.
This research presents three methods of photointerpretation for forensic analysis of CCTV images and other photographs. Methods involve the physical component of the examination and are incorporated within the earlier described interpretation process. The three methods include;

- Qualitative assessment of the visual information presenting in the images.
- Content analysis or reconstruction of the image with the scene and/or objects depicted in the images.
- A holistic interpretation that incorporates further information and/or intelligence from a range of sources.

All methods of photointerpretation remain subject to whether the visual data within the images is technically competent to answer the question raised in the hypothesis and its provenance must be *bona fide*. The research method is used to test the hypothesis proposed in the early stage of the photointerpretation process and this focus should be maintained throughout the examination.

**9.5.4 CCTV Interpretative Methods: Qualitative Assessment Method**

This method of photointerpretation uses a superficial visual interpretation of what is obvious within the photographs. Babington Smith (1957) describes this type of analysis as phase one - does not involve an in-depth analysis of the images. The objective of this method is to test the photointerpretation hypothesis. This form of photointerpretation is highly valued despite its superficial nature. There remain some interpretation complexities with this type of interpretation in spite of its apparently simplistic approach. Good knowledge of photographic science and practices remains a high priority with this form of interpretation. Without the appropriate level of photointerpretation skills, errors can be easily made in this form of assessment, as seen in the Zak coronial inquiry when interpretations such as chainsaws, maggots and bruising were all cited as a reality based on the alleged photographic proof.
Content analysis or reconstruction methods involve the recreation of the scene or object presented within the photographs. There are several different approaches to reconstruction; however the most common is to go to the scene where the photograph was taken to make the examination based on a comparison between the photographs and reality, to use physical measurements taken at the scene but depicted in the photographs and to incorporate reference material (i.e. linear scales) within the image. An advantage of CCTV images is that the position of the camera remains stationary for some time after the incident was recorded. Reconstruction may include recreation of the event and it may also include the incorporation of other reference material into the original CCTV images.

Other data within the CCTV and digital image include metadata stored within the digital file that can provide information such as the time and date the photographs were created. Some modern still cameras also have the facility to record GPS coordinates and store this information in the metadata. The metadata may also link the image to the serial number of a camera and provide linkage evidence to the suspect.

An example of the reconstruction photointerpretation method was illustrated in the case previously discussed in Chapter 3 and involved the examination of photographs taken of a truck driving on the incorrect side of the road and over a painted island. It was also alleged the driver of the truck was driving above the legal speed limit. Two photographs taken by a passenger in the vehicle travelling alongside the truck, depicted clear and unambiguous landmarks located on the road and near the front left wheel of the truck. The reconstruction method included the identification of both landmarks at the scene and a lineal measurement was made between each point. Using standard velocity formulae, the mean speed of the truck was determined using the known distance between the two identified landmarks and the time interval indicated in the time/date stamp in the digital image metadata. The important consideration with this example is that the photographs were used to determine the

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69 Global Positioning System
location of the landmarks at the scene and the measurements were made from those landmarks and not directly from the photographs. The information contained in the photographs provided the data for the reconstruction and calculation of the mean speed.

Another example of the reconstruction method of photointerpretation is described by Van Dijk and Sheldon (2004) involving the cultivation of a large cannabis crop. According to Van Dijk and Sheldon, a photograph was recovered by police at the suspect’s home that depicted a large crop of cannabis growing in a paddock. The photograph also depicted a detailed tree-lined background situated at the edge of the paddock.

A photograph was taken at approximately the same location as the suspected location where the crop was grown. There was no physical evidence of the crop at the location when police investigated. A comparison between the photograph of the crop in the possession of the suspect and the reconstructed photograph taken by police, revealed the details of the tree-lined background matched. The location where the crop was grown was proven using photointerpretation [Van Dijk & Sheldon 2004].

Images of narcotics (particularly large quantities) are sometimes found in the possession of suspected drug traffickers. These photographs are often taken by younger offenders as trophies of their illegal deeds with heroic connotations. If the photographs or images can be linked back to the camera they were taken with, or to a specific location, the intelligence and evidence gained from this type of photointerpretation can be valuable linkage evidence. Images stored on seized mobile phones may also provide useful evidence.

9.5.6 CCTV Interpretative Methods: Holistic Interpretation Method

Holistic photointerpretation method is the combination of data obtained from the photograph or image (both qualitatively and reconstructed) with other sources of information or intelligence. Holistic photointerpretation is a detailed investigation and is the equivalent to Babington Smith’s ‘phase three’ analysis used by the British military intelligence in WWII.
Other sources of information used in the holistic photointerpretation method include; witness statements, footage from other CCTV cameras (in the same premises, surrounding area, public places and transport), aerial surveys previous taken of the scene, crime scene reports, forensic pathology reports which include cause and time of death, forensic biology reports including time estimates of sexual contact, police reports, court transcripts and others. Holistic photointerpretation is a detailed and complex process; however it has the potential to provide a highly developed source of forensic intelligence or evidence.

9.5.7 CCTV Photointerpretation Process and Method Logic Map

Figure 9.12 is a workflow logic map that illustrates the systemised workflow used during photointerpretation of CCTV images and other photographs including crime scene photography. The map incorporates both the photointerpretation process and interpretation methodology.

The distinctive components within this model are clearly recognised within the illustration. The stages described in this map are also important concepts to establish a more objective working method and minimise unintentional bias by not beginning with the subjective components of the method. The three different types of photointerpretation methods are seen once the hypothesis and technical review has been completed. The structure of the model may also be used to develop testable methods for this type of photographic evidence.

9.6 CCTV Image Authentication & Quality

The paradigm illustrated in Figure 9.1 suggests the inclusion of a forensic authentication and technical review of the images examined. The function of this process stage is to establish whether the images have been fabricated or falsified, or whether the quality of the images is satisfactory to test the interpretation hypothesis. The Jung and Johnson cases demonstrated significant technical problems with the CCTV images used by the forensic experts and lay witnesses. As discussed, several claims made from the examination of the imagery (e.g. identifying the POI by his
DEVELOP HYPOTHESIS

The question requiring an answer through photointerpretation is considered, developed and clearly articulated in the form of a hypothesis.

TECHNICAL REVIEW & AUTHENTICATION

Is the quality of the visual data capable of testing this hypothesis?

YES

EXAMINE IMAGES USING A PHOTointerpretation METHOD

• Qualitative
• Content Analysis or Reconstruction
• Holistic

Also note any ambiguities or problems associated with the data and analysis.

NO

Images and visual data are not suitable for photointerpretation.

REPORT EXAMINATION METHODOLOGY & FINDINGS

Figure 9.16: Photointerpretation process logic map.
walk when the footage had a frame rate at approximately 1-2 fps in *Johnson*, and the
determination of skin tone from several differently photographed question and
exemplar sources from *Jung*) were not appropriate when an examination was
conducted of the technical attributes. In both cases, no forensic examination
regarding the authenticity, image quality or appropriateness of the material for
forensic evidence was conducted by the Crown’s experts.

Poorly resolved images are common with current CCTV technology. The Home
Office Scientific Development Branch in the UK published an operational manual
for CCTV in 2007 [Cohen *et al.*, 2007] and there appears to be significant gaps
between the operational aspects of CCTV technology and the requirements needed
for forensic investigation. The authors of the Home Office publication identify four
image quality parameters [Cohen *et al.*, 2007];

- Clarity – overall sharpness.
- Detail – the ability of the image to resolve fine detail.
- Colour – whether the colour is natural due to the light source and calibration
  of the camera.
- Artefacts – image artefacts include excessive noise, lens flare, lens distortion
  and other faults.

These quality parameters are influenced by several photographic conditions
involving; lens optics, lighting conditions, colour, curvilinear and rectilinear
distortion, image exposure, white balance and colour temperature, frame rate, sensor
size, and the digital file storage application. Size, shape and spacial qualities may
also be affected by image perspective as indicated in Chapter 6.

Another significant problem with digital systems is how to store the vast amounts of
memory needed for each CCTV camera. Memory storage requirements notably
increase with higher resolution and higher frame-rates. To reduce the amount of
memory needed for the storage of digital CCTV images the technology employs two
strategies;
- Smaller frame-rates are used. For example, 24-30 fps are required for natural motion while CCTV cameras can capture images as low as 2-4 fps which results in fewer images and less storage space.
- Codec algorithms are also employed. Codec algorithms are digital compression and decompression processes that allow the stored image to be reduced in sized and decompressed when played using a player that can read the codec [Cohen et al., 2007]. MP3 format is an example of a codec.

Codec’s are problematic for CCTV images used as forensic evidence. Quality is compromised during the compression and a certain degree of data is lost. A high degree of compression can result in a significant loss of image quality. High compression is a common imaging framework used on contemporary CCTV systems. Another major problem with this system is that codec processes are not generic and are specific to the system used to record the images. Digital photography also had this problem with RAW files, however industry standards have now included standard RAW processing applications including Adobe Raw™ and generic DNG™ (Digital Negative) file applications.

Codec algorithms also greatly reduce the ability to download highly resolved still images for forensic analysis, especially for comparative analysis methods. Instead, the forensic practitioner is tied to the propriety software player that supports the file codec and CCTV system. This is a significant problem with CCTV images as evidence because many players’ ability to capture still frames is generally of a low standard.

The provenance of CCTV images, and any other images, is a consideration that is often overlooked during the forensic investigation of CCTV images. The reliability of CCTV images as evidence should also include the provenance of the material. The collection of CCTV material from primary and secondary crimes scenes further requires the careful collection of technical detail from the camera system. Details associated with the CCTV cameras should include; the location of the cameras, whether they are static or PTZ (Pan-Tilt-Zoom), the focal length of the lens (or zoom range), lighting aspects, details of the codec used in the system/s and the metadata stored with the images.
An increasing role within forensic photography practice is the examination of images used as evidence to determine whether they are genuine or faked. Falsification of images includes adding or subtracting objects or people, misrepresenting the content of the image or changing the relationship of items (or people) within the photographs.

While any incidents of falsified CCTV images are currently unknown, there is a long history of faked photography used in the media and by Governments for propaganda [Jaubert 1989, Brugioni 1999, Russ 2001]. With the increasing application of image editing software, the likelihood of falsified images being presented to police is increasing. Despite a myth to the contrary, altered images are quite readily detectable by forensic photographic experts. Inconsistencies in image noise, lighting direction, colour, vanishing points, size, and image perspective are just a few aspects that may lead to the detection of faked images [Brugioni 1999, Russ 2001, Robinson 2007].

The falsification of events played before CCTV cameras and other video devices (mobile phones or portable digital cameras) is also a new component of forensic analysis of images. The increase in the number of social network internet sites has heightened the need to authenticate actions occurring before cameras. Footage posted on social networks that demonstrate violence and rough sexual activities are being investigated by police [Cohen 1987, Braithwaite & Cubby 2007, Saleh & Lawrence 2007a, Saleh & Lawrence 2007b, Lawrence 2007b]. Determining whether the incidents are real or acted out, creates some difficulties in the interpretation and authentication of the photographs.

### 9.7 Chapter Discussion

This chapter presents a range of reliability considerations regarding evidence derived from photographic sources including CCTV. The application of CCTV evidence requires a systemised and science-like approach to produce a reliable form of forensic evidence. This chapter presents several cases that suggest the reliability of the findings were questionable.
A central concept associated with reliability of evidence derived from photographs is the implementation of photointerpretation of the images including the visual narrative. This concept is illustrated in the construction of the photointerpretation paradigm illustrated in Figure 9.1 and also provides an important conceptual separation between forensic intelligence and evidence.

The two cases discussed in this chapter (JFK and Zak) highlight the dangers associated when a proposition of evidence is purported by forensic examiners who use the information in the photographs to support their claims. The creation of this type of visual narrative positions the evidence into a higher degree of believability, particularly if the audience (including a jury) can see the information in the photographs themselves and producing some manufactured confirmatory aspects of the evidence. While this action may be seen as a reasonable approach to present evidential findings, it is open to abuse and misappropriate evidence if the transparency of the examination is not included in the forensic reporting.

Transparency of findings can only be achieved if there are photointerpretation methodologies identified specifically for forensic evidence. Currently this does not exist in forensic science and the model described in Figure 9.12 is an approach that may offer more reliable and transparent forensic evidence when photographs and CCTV images are used as the source of information or data. The model suggests three different types of photointerpretation methods including; qualitative, content analysis or reconstructive and holistic approaches. This approach was modelled on military intelligence methods developed by the RAF during the Second World War.

The photointerpretation approaches used in the examples illustrated in this chapter, highlight the dangers of how exaggerated or inaccurate evidence can be introduced into courts and Government inquiries. They also highlight the need for transparency of methods used so they may be tested to determine their reliability. Three issues were identified in these cases; i) the accuracy of the evidence, ii) the inability to verify the results of the photointerpretation methods are not included in the reports and iii) the degree of support for unreliable evidence because of the visual narrative supported by the photographs, even if the evidence is not accurate.
This chapter also argues for the notion that qualified practitioners must be used during the process of conducting photointerpretation examinations. Practitioners qualified in photography and photographic science are essential to ensure the reliability of the evidence derived from photographic sources including CCTV. The cases used in this chapter and others in the thesis highlight the dangers of photointerpretation without essential knowledge of photographic science, photography practice and visual culture.

This lack of appropriate expertise in forensic science applications of photointerpretation may also be contrasted against how images are interpreted in medicine. Imaging has developed into a critical diagnostic tool in the medical discipline and interpretation of these images is conducted by medical practitioners who are specifically trained and qualified in interpretation. Radiologists are qualified practitioners who interpret images derived from various instruments including; x-rays, ultrasound, nuclear medicine, computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and others. Radiologists report their interpretation of the medical images to medical practitioners and specialists and their reports are critical in the process of diagnosing patient’s ailments and diseases.

Forensic pathologist John Hilton (2009) suggests there are three critical people involved in the accurate interpretation of medical images from CT scans when determining the cause of death. These three critical people include the deceased, the radiologist and the forensic pathologist. Incorporating the areas of expertise in determining the cause of death in forensic pathology appears to be an ideal situation for accuracy and reliability to be a principal outcome during the forensic examination.

This approach also makes perfect sense with other general forensic science applications. The inaccuracies experienced in the case studies discussed in this thesis could have been avoided and reliability improved if qualified photographic experts were used in the forensic examination. The reporting of these examinations may also include a more systemised method of photointerpretation and forensic evidence as expressed in Figure 9.12.
Chapter 10

10.0 Discussion

Ever since its invention in the 1830’s, many have seen photography as a medium of truth and unassailable accuracy. Photographs have been used by scientists to map the planets, by police to identify criminals, and by magazine editors to document events around the world.

Jennifer Tucker [Tucker 2005, p1]

Obtaining evidence from CCTV images will become an ever-increasing role for forensic science in support of criminal investigations. The danger associated with CCTV images as evidence is the weighting it can be afforded when supporting claims during a trial. The greatest risk is when inaccurate evidence is presented during a court hearing and photographs are presented as proof the evidence is reliable. Evidence supported by photographs can be made more convincing especially when the oral and photographic evidence is combined to produce the
condition of intertextuality. Simply presenting photographs as proof can be as misleading as it can lend support to a claim. A vitally important issue for the judicial system is to have the capacity to recognise any unsafe practices associated with photographic evidence, because its unyielding power of persuasion can easily lead to wrongful convictions.

Evidence derived from photographic sources (including CCTV) should be supported by a scientific-like methodology and be presented objectively whenever possible. Members of the law fraternity including judges, lawyers, juries, police and forensic scientists, need a greater awareness of the consequences of the use of photographic evidence and their relationship with concepts of truth (see Chapter 3).

Images sourced from CCTV should be considered in the appropriate context when they are used as evidence. Images obtained from CCTV are not reality, but representations. This distinction must be considered when forensic practitioners examine CCTV images seeking evidence. CCTV images should be considered as;

- A representation of a criminal event.
- A representation of evidence.
- A representation of identity.

How these representations support facts is pivotal to their reliability as photographic evidence. The first step is to understand that not all photographs and images offer the same type and level of inquiry. The taxonomy developed in Chapter 4 provides a framework to understand these differences. It suggests photographs used to support physical evidence have four different applications, or modes of inquiry, and include; i) analyse, ii) document, iii) describe (visual narrative) and iv) witness.

Furthermore, the model suggests there are four modes of inquiry that photographic evidence may support. These physical evidence modes of inquiry are also described in Chapter 4 and include; i) empirical analysis, ii) comparative analysis, iii) interpretative analysis and iv) observation evidence. The model, illustrated in Figure 4.12, demonstrates the relationship between photographic evidence and physical evidence with pathways that provide possible forensic outcomes.
The identification of persons of interest captured on CCTV is a highly valued idea for the investigation of criminal activity. Even though the identification from CCTV has been used during the prosecution of two murder cases illustrated in this research, there remain significant gaps in the forensic science and photography knowledge regarding how reliable identifications can be made from CCTV images.

The case studies and experimental work discussed in this thesis has illustrated the following problems with the reliability of forensic identification evidence from CCTV:

- Comparative analysis using questioned and exemplar images for identification present numerous parametric differences including image perspective and camera angle.
- Inappropriate inferences lead to misleading evidence.
- Erroneous photointerpretation.
- A lack of understanding and/or explanation of photographic science principles when images are used for analysis.
- Assumptions, speculation or exaggeration of the photographic evidence.
- No methods relating to the treatment and application of the photographic evidence is presented in the forensic reports.

The contextualisation of CCTV images is also an important concept for understanding the degree of reliability of forensic evidence derived from images sourced from CCTV. Contextualisation should also include principles associated with visual culture.

The role of forensic science within the criminal justice system and the wider general community is often portrayed as one of assisting police with the apprehension and conviction of people involved in criminal activity. This portrayal is not only reflected in television dramas, but often in the print media. While forensic science does provide this important function, it has a more significant role that is often not typified. Forensic sciences’ greater responsibility is to the wider community and not just to law enforcement. While it aids in the protection of the community by assisting
in removing people involved with crime (especially violent criminals), forensic science must also be a process that protects its citizens against wrongful conviction.

This level of protection may be seen from two separate perspectives. Firstly, any evidence used in the prosecution of the accused, including evidence from CCTV images, must be reliable and the reliability should to be able to be tested by other forensic experts. This requires transparent reporting of the examination findings and should include details regarding the methods used so that other forensic experts can test the results. Secondly, the prompt elimination of innocent suspects from the police investigation.

Elimination of suspects is just as an important concept as gaining positive identifications. It involves similar processes as identification, however the outcome of elimination is based on dissimilarities rather than matching individual characteristics. Elimination processes provide important community and law enforcement advantages which include;

- Eliminations early into a criminal investigation can better utilise police investigation and forensic resources.
- Early eliminations can minimise the stress to an individual and his/her family when accused of a serious crime. This aspect has considerable social, family and financial consequences for the accused and often the family suffers from being ostracised from the community, public humiliation and loss of employment. Early elimination, if appropriate, can prevent family and social issues and assist in protecting its citizens.
- Evidence objectivity may be enhanced when forensic identification processes include methods of elimination before identification.
- Elimination of innocent suspects and preventing any possibility of a wrongful conviction.

Eliminations may be conducted on a variety of forensic science identification applications including; fingerprinting, DNA, blood grouping, hairs, footwear impressions, tyre impressions and facial identification (using morphological comparison) from CCTV.
An objective framework is essential when developing and applying methods used to identify individuals and especially when using CCTV images as the single source of identification (as seen in Jung). Levels of subjectivity should be minimised from the process.

If subjective methods are used during a forensic examination, this should be made clear to the court. Subjective examinations are regularly used within forensic science in such disciplines as bloodstain pattern analysis, fire investigation and forensic pathology. This mode of inquiry has been expressed in the model presented in this study as interpretative analysis. Interpretative analysis mode of physical evidence inquiry is accepted in forensic science, however it must be clearly identified that this form of inquiry was used to obtain the forensic evidence. What is most inappropriate and misleading is evidence presented as an objective mode of inquiry when it was actually subjective.

In Jung and Johnson, both forensic experts used subjective methods and without any references to their methodologies being accepted by peer review in the scientific literature. In fact, as the chapter on identification illustrated, even previous objective methods of anthropometry devised by Bertillon have proven to be fallible. Subjective methodologies can mask issues of reliability by being based on opinion rather than fact. Subjective methods are also difficult to test and can be further prejudiced by a level of ambiguity. If Bertillon’s method was based on a subjective interpretation of physical anatomy rather than objective measurements, then its fallibility may be still unknown today because it could not be objectively tested. The anthropometric measurements obtained from West and West produced the same results which became known when the results were compared (see Table 8.1).

The development of an elimination principle within identification procedures can greatly assist with the objectivity of identification evidence from CCTV images. Rather than approaching an identification process with the aim to ‘identify’ a person of interest, the initial objective should be to attempt to ‘eliminate’ the suspect. If the examination cannot eliminate the suspect, the examination should then proceed by

70 Will West and William West, 1903
examining corresponding or individual characteristics for identification. While this process does not offer a complete solution to objective methods, it de-emphasises identification. If the examiner is attempting to eliminate the suspect before looking for similarities (by looking for dissimilarities first) a more robust framework is established. The problem associated with not establishing such a framework is that it encourages examiners to ‘find’ identification points that can be convincing without seeing dissimilarities that could lead to exclusory evidence. While this suggestion may seem trivial, it provides an important concept for examination objectivity and can minimise unintentional bias by the examiner.

Figure 10.1 provides a logic map that illustrates pathways to possible identification results. It suggests the first stage is to try to eliminate the person of interest by using dissimilarities of class characteristics or facial morphology. If the examination reveals distinctive dissimilarities in facial morphology, then the suspect can be eliminated or considered not to be the same as the person depicted in the CCTV images. If there are similarities of facial morphology, then the next stage of the examination is conducted. This stage involves examining any distinguishing individual characteristics to determine a possible identification. Individual characteristics may be described by distinguishing features such as freckles, scars, moles, skin creases and other anomalies.
Inconclusive results may also be a legitimate outcome for identification evidence from CCTV. Inconclusive results are determined when:

- Significant dissimilarities for elimination cannot be observed.
- The detail or quality in the CCTV images is not sufficient to determine distinguishing or individual characteristic features.
- The CCTV material is unsuitable for examination due to poor resolution or image artefacts.

Inconclusive results are an important possible outcome option for identification evidence from CCTV especially because many CCTV images and systems produce poor image quality and resolution.

The reliability of forensic evidence has recently come under some scrutiny. In the United States Supreme Court in 1993, a decision regarding the admissibility of expert evidence was determined in the *Daubert v- Merrell Dow Pharmaceuticals*. The decision known as the ‘*Daubert ruling*’ provided a framework for expert scientific evidence to be evaluated by judges when determining their admissibility [Edmond & Mercer 1997, Bingham *et al.*, 2003, Christensen 2004]. *Daubert* provides the following questions to be asked of expert evidence and its reliability:

- Is the evidence based on a testable theory or technique?
- Has the theory or technique been peer reviewed?
- In the case of a particular technique, does it have a known error rate and standards controlling the techniques operation?
- Is the underlying science generally accepted?

It is understood that this standard is not to be a definitive checklist or test, but it is considered a guide to provide some insight into how the reliability of scientific evidence may be considered [Bingham *et al.*, 2003, Christensen 2004]. This standard is used in United States courts and does not have any Australian jurisdiction although *Daubert* is regularly cited. The application of *Daubert* for CCTV images could provide a framework for establishing reliable methods of identification.
Evidence sourced from CCTV images may also provide other physical evidence and forensic intelligence. The information gained from CCTV images may be useful when seeking investigation leads associated with the criminal event or linkage evidence associating the suspect to the scene. Other evidence that may link the suspect to the CCTV images, and ultimately the crime scene, may include unusual clothing, marks on clothing or other items in the possession of the person of interest, the identification of vehicles driven by persons of interest, information regarding the weapons and tools used in the crime, and a narrative of the criminal event (see Chapter 8).

The interpretation of CCTV images forms a critical component of physical evidence and forensic intelligence. However, there are no recognised or peer reviewed methods within forensic science that provide a systemised photointerpretation approach. An important principle for photointerpretation reliability is that a systemised approach is used that can;

- Articulate the questions being asked of the interpretation.
- Provide a clear working methodology.
- Test the suitability and authenticity of the photographic material, and
- Clearly describe the methods used during the examination in the forensic report so other experts can examine the reliability of results.
- The evidence must use testable methods.

Chapter 9 introduces a model for photointerpretation that consists of three different types of analysis. Modelled from the British military that developed photointerpretation during WWII, these methods provide a transparent, repeatable and testable form of analysis. The three models proposed are;

- Qualitative assessment method.
- Content analysis or reconstruction method.
- Holistic interpretation method.

Each photointerpretation method provides a different level of interpretation. Qualitative assessment offers a superficial evaluation, while reconstructive method
uses the photographs incorporated with an examination of the scene or item. The holistic interpretation method is a deeper analysis that utilises various other sources of information to incorporate with the images.

Figure 9.12 presents a systemised workflow that includes the key photointerpretation principles including:

- Developing a hypothesis or question.
- A technical review and authentication.
- A photointerpretation methodology.
- Reporting.

Most importantly, forensic examinations of CCTV images must include a practitioner that possesses specialised knowledge in forensic photography theory and practice with a sound knowledge of photographic science and visual culture. This point is imperative. Practitioners without this level of specialised knowledge should not carry out forensic examinations of CCTV images, otherwise they are practicing outside their area of expertise and risk making serious errors. Inappropriate examinations may lead to miscarriages of justice which are extremely harmful to the community, law enforcement agencies, the judicial system and the accused.
Chapter 11

11.0 Conclusion

*In theory, photographs are used to back up or ‘prove’ contentions made in the article. They are the visual evidence, the facts in the matter. In actuality they needn’t perform that role. They only need to appear, to give the appearance of evidence. Beyond this they can do anything. Their factualness is never questioned.*

David Levi Strauss [Strauss 2003, p30]

The concluding chapter addresses the central research question, other associated questions and the research aims. This study has used a mixed method research design and has incorporated a range of knowledge sources including; photography theory and visual culture, case studies, Australian law and jurisprudence, forensic science and forensic photography practices.

This research has developed new thinking including theoretical models that may become an integral component to the practice of examining evidence derived from
CCTV. This work will provide some platform to improve the reliability of photographic evidence and evidence derived from CCTV. The following sections answer the research questions.

11.1 The Central Research Question

*What are the critical considerations required to improve the reliability of forensic evidence sourced from CCTV images?*

This work has identified serious problems with the contemporary application of forensic evidence derived from CCTV images. The various cases described illustrate a propensity to use the photographic evidence as a tool for providing convincing evidence rather than factual evidence. This misuse of photographic evidence presents serious reliability issues.

The most critical consideration to improve the reliability of forensic evidence sourced from CCTV images is to provide a more scientific approach for photographic evidence. This approach includes a method of analysis that can be repeated by other forensic photography experts to test the accuracy of the evidence. Furthermore, this approach requires more transparent reporting that outlines; i) the specific question asked of the photographic material, ii) the method of analysis/interpretation used, iii) the result and iv) any difficulties or inaccuracies discovered during the examination.

Improvements in the reliability of photographic evidence can only be achieved if standard methods of photointerpretation and analysis are developed for use in the forensic science domain. No recognised methods regarding photographic evidence currently exists within forensic science meaning there is a significant gap in the knowledge and practice. In Chapter 9, a paradigm that considers the relationship between photointerpretation, forensic evidence and forensic intelligence was developed and discussed. Furthermore, three different methods of photointerpretation for photographic evidence were illustrated and may be used for CCTV cases. It is recommended that such a model be adopted so that the reliability of photographic evidence is improved when examining CCTV images as evidence.
The model suggested in Chapter 9 uses the photographic taxonomy developed in Chapter 4. Chapters 3 and 4 discuss the complex nature of photographic evidence and how it relates to concepts of evidence and truth. An issue that hinders the development of photographic evidence examination methods is the lack of any formal recognition of the significant differences in various types of photography and the variation in evidential outcomes depending on its relationship with physical evidence modes of inquiry. Chapter 4 provides a model that illustrates this relationship and provides a taxonomy that may be used to articulate photographic evidence applications or photographic modes of inquiry. If the reliability of forensic evidence sourced from CCTV images is to be improved, forensic science needs to adopt a universal taxonomy so that it can define the application of photographic evidence more clearly and so it can be better understood by practitioners.

This research identified significant errors in the photographic evidence presented in the case studies illustrated in this study. These errors may stem from various difficulties, however what was most apparent was the need for photographic expertise when examining photographic evidence. To improve reliability, experts with specialised knowledge in forensic photography must be employed and be included in the process. This necessary specialised knowledge includes; qualifications in photography and imaging, experience in photographic practice, sound knowledge in photographic science and experience in photointerpretation and visual culture.

Identification from CCTV images was discussed in Chapter 8 and in the case studies. The reliability of identification evidence sourced from CCTV images can be significantly improved by; i) ensuring the identification method is clearly described in the forensic report, ii) identification must be made from distinguishing features, iii) the individuality concepts of the distinguishing features must be clearly articulated in the report and supported scientifically and iv) an examination of the CCTV images is used to determine whether the integrity of the images is sufficient for the forensic examination.

A final important consideration with all photographic evidence is whether the examination and results can be considered using the Daubert ruling as a standard of
reliability. It is further noted, that to apply Daubert there needs to be more research, development and publication of these issues in peer reviewed literature.

In summary, the following points are considered as critical to improve the reliability of forensic evidence sourced from CCTV images;

- Increased transparency in forensic reporting which includes details of the photographic evidence methodologies used in the examination.
- The use of a model that provides a photographic taxonomy to improve the understanding of how the photographic evidence relates to specific physical evidence outcomes.
- The forensic examination of the photographic material must be conducted by, or in collaboration with, a forensic practitioner with specialised knowledge in forensic photography, photographic science and visual culture.
- Identification evidence methodology must be clearly documented in the forensic reporting.
- Identification must be based on unique distinguishing features and not exclusively use generalised features (i.e. facial morphology descriptions).
- The Daubert ruling should be used as a standard of reliability.

11.2 Other Questions Relating to the Research

i) What type of evidence may be gained from CCTV images?

Chapter 9 introduces a photographic evidence paradigm that suggests forensic evidence and forensic intelligence may be obtained from CCTV images. The differences between evidence and intelligence are also discussed. A variety of evidence may be sourced from CCTV images; however the critical point is to clearly articulate the question being asked of the visual material so a methodical, technical and theoretical critique of its evidential value may be determined.

ii) Can accurate identification of persons depicted in surveillance photographs be made directly from the sourced photographs?
The case studies presented in Chapters 5 and 7 demonstrate significant problems with identification from CCTV images. Chapter 6 presents an experiment on how differing image perspective affects facial morphology and its representation in photographs, while Chapter 8 examines CCTV as identification evidence.

The ability to identify persons of interest from CCTV images is dependent on the following:

- The resolution of the captured image on CCTV must be able to record distinctive features.
- The degree of artefact found in the CCTV images (i.e. distortion).
- The identification method used in the examination and including the matching of questioned and exemplar images (camera angle and image perspective) when using comparative analysis methods (promote like-for-like specimens).
- The articulation and verification of concepts of individualisation.
- The validation of the identification method.
- The forensic examination must incorporate a person possessing specialised knowledge in photographic science, photography practice, photointerpretation and visual culture.

Identification determined exclusively from facial morphology cannot be considered as reliable, although significant differences observed in facial morphology could be used for exculpatory evidence. It is recommended further research is needed to determine a reliable methodology for the identification of persons of interest depicted on CCTV.

**iii) What methods may be considered to provide a transparent application of photographic evidence that can more reliably represent truth?**

Establishing a taxonomy that describes differences found in various photographic forms, and the development of a model that can articulate the relationship between photographic evidence and physical evidence, significantly increases the level of transparency with photographic evidence and the representation of truth.
Articulating and facilitating photointerpretation methodologies that may be tested by other photographic experts is the most suitable way forward to provide greater transparency and understanding of the reliability or the representation of truth in photographic evidence. The model presented in Chapter 9 provides a model that explains the differences between photointerpretation processes and methods. It further establishes different levels of photointerpretation including; qualitative, reconstructive and holistic methods.

Testing the degree of accuracy of photographic evidence is an important consideration and especially when considering the exaggerations presented in contemporary cases. Testing the degree of accuracy or the representation of truth when photointerpretation is used requires the following attributes to be included in the forensic reporting:

- The question/s asked of the photographic material must be clearly articulated together with the result/s.
- The method used in the photointerpretation (qualitative, reconstructive or holistic).
- The documentation relating to the provenance and custody of the photographic material.
- The treatment and considerations made regarding the technical attributes of the photographic material (i.e. resolution, distortion).

Without these attributes clearly identified in the forensic report, the reliability and representation of truth cannot be thoroughly tested and could render this form of evidence unsafe for use in a court of law.

Photographic evidence derived from an ‘analysis’ mode of inquiry should be tested to determine the photographic material’s suitability to provide accurate data rather than establishing truth. This form of photographic evidence is more objective and does not submit to the same level of ambiguities as other modes of inquiry (document, describe or photo narrative and witness).
iv) How important is the validation of photographic evidence when used in forensic science and sourced from CCTV?

The validation of photographic evidence, like all other types of forensic evidence is essential. A chain of custody must be established with CCTV images in addition to their provenance and be subjected to testing to determine if the image has been inappropriately altered (faked). This is an essential requirement for CCTV images and evidence reliability.

v) What safeguards are necessary to ensure reliability when images undergo photointerpretation?

Transparency of the findings in the forensic report is the most important safeguard to ensure reliability of photographic evidence that has undergone photointerpretation. Results should be made available to other forensic experts so they may be examined and tested for accuracy. However, improvements in reporting are only achievable if photointerpretation processes and methodologies can be established within forensic photography and forensic science practices.

The reliability of photointerpretation evidence urgently needs more attention within forensic photography and forensic science to establish practices that are more robust. As seen in the case studies and examples illustrated in this research, unsafe practices are currently being employed which may lead to serious miscarriages of justice.

The *Daubert ruling* should also be considered as a standard of reliability for photointerpretation evidence and evidence derived from CCTV images. *Daubert* asks the following questions;

- Is the evidence based on a testable theory or technique?
- Has the theory or technique been peered reviewed?
- In the case of a particular technique, does it have a known error rate and standards controlling the techniques operation?
- Is the underlying science generally accepted?
11.3 Conclusion

This research has found that improvements are urgently needed to increase the reliability of forensic evidence sourced from CCTV images and other forms of photographic evidence. The forensic photography and forensic science industry urgently needs to adopt examination methodologies that can promote more consistency, transparency, testability and more reliable forensic evidence. Adopting the Daubert ruling for CCTV images and evidence, is an ideal starting point to ensure the reliability of CCTV evidence.
References


Braithwaite D., Cubby B., (2007, 05 April) ‘Gang Rape Filmed on Mobile Phone’ *Sydney Morning Herald*, p1


Conway M., (2006, 14 August) Director of Research at the Institute of Psychological Sciences, Leeds University, Radio Interview on ABC Classic FM with Margaret Throsby.


Cited Cases & Case Law


Makita (Australia) Pty Ltd -v- Sprowles [2001] 52 NSWLR 705

Smith -v- The Queen (2001) HCA 50


Regina -v- Murdoch (No. 4) [2005] NTSC 78


The Queen -v- Atkins & Atkins [2009] EWCA 1876, Case No: 200801604 D4 200801607 D4
Appendixes
Appendix A: Abbreviations Used in Thesis

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ABFO</td>
<td>American Board of Forensic Odontology</td>
</tr>
<tr>
<td>ACPO</td>
<td>Association of Chief Police Officers of England, Wales and Northern Ireland</td>
</tr>
<tr>
<td>AFP</td>
<td>Australian Federal Police</td>
</tr>
<tr>
<td>ANZ</td>
<td>Australian &amp; New Zealand Bank</td>
</tr>
<tr>
<td>ATM</td>
<td>Automated Teller Machine</td>
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<tr>
<td>CCA</td>
<td>Court of Criminal Appeal</td>
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<td>CCTV</td>
<td>Closed Circuit Television</td>
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<td>CIA</td>
<td>Central Intelligence Agency</td>
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<tr>
<td>CJ</td>
<td>Chief Justice</td>
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<tr>
<td>CMOS</td>
<td>Complimentary Metal-Oxide Semiconductor</td>
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<tr>
<td>CODEC</td>
<td>Compression &amp; Decompression Computer Algorithm</td>
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<td>CT</td>
<td>Computed Tomography</td>
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<td>DNA</td>
<td>Deoxyribonucleic Acid</td>
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<td>DPP</td>
<td>Director of Public Prosecutions</td>
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<td>FBI</td>
<td>Federal Bureau of Investigation</td>
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<tr>
<td>fps</td>
<td>Frames per Second</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>HMTQ</td>
<td>Her Majesty the Queen</td>
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<td>ID</td>
<td>Identification</td>
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<td>Judge</td>
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<td>JFK</td>
<td>President John Fitzgerald Kennedy</td>
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<td>LAPD</td>
<td>Los Angeles Police Department</td>
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<tr>
<td>MPEG</td>
<td>Movie File Application</td>
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<td>MTF</td>
<td>Modulation Transfer Function</td>
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<td>MTF50</td>
<td>Modulation Transfer Function at 50% Modulation</td>
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<td>n</td>
<td>Population Sample Size</td>
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<td>New South Wales</td>
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<td>Pan-Tilt-Zoom</td>
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<td>Regina (The Queen)</td>
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<td>Royal Air Force</td>
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<td>World War Two</td>
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<td>World War Two</td>
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Appendix B: Contact Sheets of Photographs used in the Perspective Experiment.
‘u’ Distance = 295 mm
‘u’ Distance = 400 mm
‘u’ Distance = 1,000 mm
'u' Distance = 1,500 mm
‘u’ Distance = 2,500 mm
‘u’ Distance = 3,000 mm
'u' Distance = 4,000 mm
'u' Distance = 6,000 mm
'u' Distance = 8,000 mm
Appendix C: File References for Photographs used in the Photoanthropometric Experiment

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<th>u (mm)</th>
<th>f (mm)</th>
<th>Photo File Reference Number</th>
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<th>Pink Ear</th>
<th>Green Ear</th>
<th>Red Nose with Purple Ear</th>
<th>Pink Ear</th>
<th>Green Ear</th>
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<td>295</td>
<td>15</td>
<td>006 004 008</td>
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Appendix D: Photoanthropometric Experiment Data

Results from values measured using the modelled noses

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<th>Known Value (mm)</th>
<th>Result Difference (mm)</th>
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Mean Indices for Black Nose

\((\text{Alare}(L)-\text{Alare}(R)) \times 100/(\text{Lateral Canthus (L)}-\text{Lateral Canthus (R)})\)

at various ‘u’ Distances \( (n = 32) \)

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<th>( \bar{x} ) (mm)</th>
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<th>Known Value (mm)</th>
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### Mean Indices for Orange Nose

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at various ‘\(u\)’ Distances \((n = 33)\)

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### Mean Indices for White Nose

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at various ‘\(u\)’ Distances \((n = 32)\)

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Results from values measured from the modelled ears.

### Mean Indices for Green Ear
(Superaurale-Subaurale) x100/(Lateral Canthus (L)-Lateral Canthus (R))
at various ‘u’ Distances \( (n = 42) \)

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### Mean Indices for Purple Ear
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at various ‘u’ Distances \( (n = 44) \)

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