

# The reliability of facial recognition using CCTV images

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4/1/2014

## Introduction

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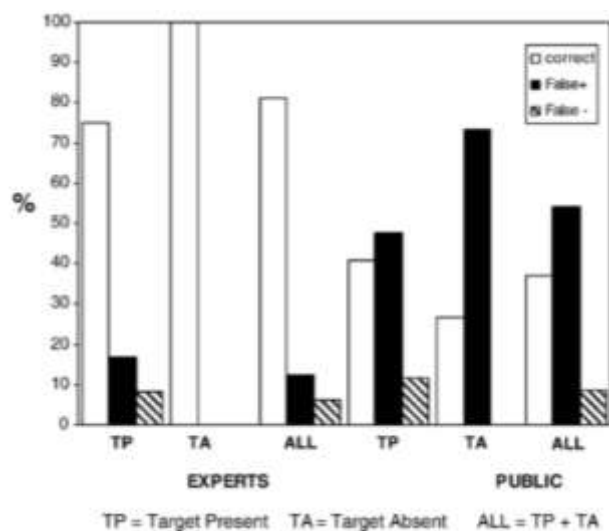
The introduction of Closed Circuit Television (CCTV) have revolutionised our view on security and its possible applications. Within the UK alone, it is believed that the number of CCTVs currently installed exceeds 4 million, with some private firms not accounted for. The popularity of CCTV has led to the rise of different facial recognition techniques used by police and forensic personnel exclusively for criminal identification purposes. (3)

The reliability of Facial mapping techniques is dependent on the quality of imagery and video provided. Ideal evidence would be unique facial morphology within a specific population enabling positive identification beyond reasonable doubt. But, unfortunately the majority of footage obtained from CCTV is far from ideal. A survey conducted in 2007 by Home Office National CCTV Strategy has suggested that 80% of evidence falls into the non-ideal categories. (4) Therefore its evidential value can be easily challenged if presented in court. The usefulness of the already poor quality imagery is further reduced and provides minimal evidential value which can only be used as supplement evidence.

Modern generations of CCTVs consists of increased frame rates per second and greater quality, providing stronger forms of evidence that can be used as primary evidence in suspect prosecution. Nonetheless, due to financial constraints and unwillingness to invest, many private and public firms still comprise of the older generation CCTV cameras, therefore systemic errors are still an on-going issue. (5) Common dilemmas faced by CCTV footage examiners include: lens distortion, lighting, motion, poor video quality, and perspective etc. It is occasionally arguable to say even the most professionally trained personnel fail to positively identify the suspect due to poor footage quality. (2)

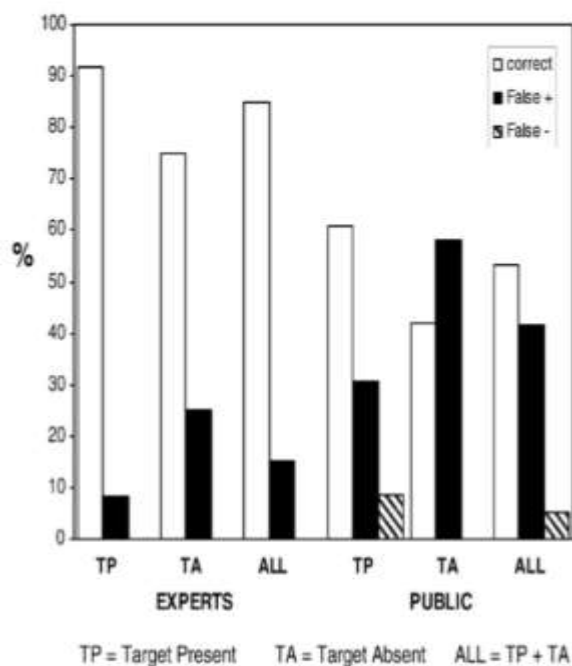
Unsatisfactory CCTV footage quality has led to the development of comparative techniques, where excellent image quality is not necessarily required but still provides degree of evidential value. Photo-anthropometry is an example of a comparative technique, this compares angular proportions of facial features and objects with known sizes to the suspect such as footwear, weapons, and to deduce the height of the suspect and facial features within a tolerable range. (6) Though, this technique is not always successful but the results form a crucial part in the suspect elimination process. However, the substantial information required is not always available and detailed understanding of geometric distortion, perspective, movement and posture is needed. The increment of dependent variable factors will impact the tolerance threshold affecting the final results. Another technique commonly applied to imagery analysis is morphological examination. This consists of purely analysing facial features and identifying unique features that can provide a positive match. It is also noted that this technique is believed to be subjective as the appearance is mostly based on the judgement of an individual. (2)

## Results



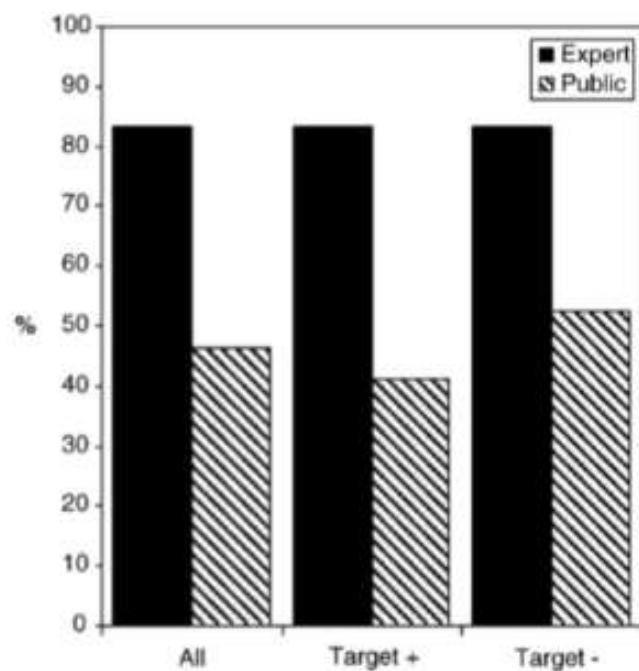
**Figure 1 – Full head identification (8)**

Front and side of full head imagery were shown to the participants; results were recorded according to the choice made. Available answers are either positive or negative. Missed identifications are recorded as false positive or false negative.



**Figure 2 – Facial identification (8)**

Only facial features were shown to the participants, other distinguishable features like hair line were removed, results are recorded in the same manner as figure 1.



**Figure 3 – The combination of facial and full head identification (8)**

The results from figure 1 and figure 2 are combined to generate a data which can provide some sort of representable value comparing the performance of experts to public.

## Discussion

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With the booming of surveillance cameras being installed across the globe, it is surprising that the amount of statistical data available analysing the reliability of facial recognition using CCTV images are still very scarce. Graphs implemented in the results section were not originally conducted for reliability purposes. The aim of the authors was to research the significance of professional facial recognition training. However, data created by the authors can also be looked at via a different perspective. Data were collected in a perfect ideal environment where image quality was not an issue and other variables were closely controlled. Therefore, it forms an ideal set of figures to analyse the reliability of facial recognition using CCTV images. (8)

The Graphs implemented in the results section are showing significance in professional facial recognition trainings. Professionally trained experts appear to offer a lower rate of false positive results possibly due to “confirmation bias” occurring naturally in unaware individuals. Experts in facial recognition also seem to offer promising results as shown in figure 3. Experts have managed to score all fields with an 80% average signifying facial recognition could be a viable form of evidence that can be used as both primary, secondary, or even as eliminating evidence under ideal conditions.

Aside from the general reliability of CCTV imagery, figures 1&2 show slight controversies. Experts are outperforming individuals in full head identifications, whereas the public are achieving better

results when it comes to facial identification. Conversely, evidence suggests that experts are more superior at the elimination process. According to figure 1, facial experts have scored approximately 13% false positive and 7% false negative in full head identifications whereas the public have mistaken over 60% of identification cases. This figure indicates it is only sufficient to be used as supplementary evidence. Figure 2 also shows similar trends with 20% error rate for facial experts in missed identification.

With vast growing numbers of CCTV, facial recognition has become a common form of evidence but supportive empirical data are still very limited. A possible explanation could be due to the nature of CCTV itself. (3) A successful conviction may not necessarily prove an individual to be guilty. In the past, the innocent were prosecuted and later released due to misidentification. Therefore, the reliability of facial recognition should be thoroughly considered by the judges. (1)

Currently, there are no standardised procedures in recruiting expert opinions. Typically, facial experts are given a set of incriminating images alongside referencing images to provide a subjective opinion with possible degree of 'confirmation bias' to the judge. (2) The psychological impact has been extensively researched where numerous literatures suggest extraneous information, for example the police suspicion and portraiture of the suspect has a tendency to generate "confirmation bias" during the identification process. Similar studies have also been conducted on fingerprint analysts and irrelevant information given to fingerprint analysts could alter their judgement and can possibly change their interpretations about an investigation. (2)

Furthermore, in comparison and analysis phases, facial experts have no standardised operating procedures in handling and processing evidence. Evidence generated via facial mapping techniques somewhat provides purely opinion based verdicts where statistical data was solely not present. Hence, facial experts are classified as "self-certificated". Currently, no experts have demonstrated methods for overcoming issues caused by systematic errors. As mentioned earlier, the daunting impact of distortions and other issues often void the reliability of the evidence itself. (2)

Expert witnesses often carry the image of a reputable individual who gives opinions using their extensive expertise in a specific area. However, they also carry a false sense of security when summoned in court. The jury can sometimes overlook possible human errors involved in different evidence analysing techniques. In most scenarios, incriminating subjective opinions in an area where the jury have insufficient knowledge in can skew the decision making capability of the judge himself. It is common for judges to rely on expert witnesses on their final verdicts. However, unlike other forms of evidence, facial recognition has no empirical data backup. Possible misidentification can occur quite frequently and issues from distortion and perspective can affect how an individual appear on images. Therefore, expert witnesses should always warn judges prior to making a statement in court. (2)

## Conclusion

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To conclude, the reliability of facial recognition is convincing but not perfect. It is a double-edged sword where jury and judges must ensure sufficient evidence is available prior to any prosecution. Conditions given in the study were almost unachievable in real life, and the reliability of expert opinions will dive steeply as quality goes down. More importantly, the possible effect of “confirmation bias” is a known human behaviour dictated by our psychological observance. The pressure to perform from the person of interest can occasionally induce unwanted errors.

The introduction of empirical data is also a must. The majority of evidence presented in court requires extensive statistic backup, but facial recognition is somewhat entirely subjective and the role of “expert witnesses” could have an overwhelming impact on the jury.

Current techniques in imagery analysis are at optimum efficiency for the next few years, standardisation of operating procedures should become mandatory. Evidence generated via standardised handling procedures often lead to less questioning and provide reliable results in a far more efficient manner.

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