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Assessing the effect of facial disguises on forensic facial comparison by morphological analysis

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Abstract

Disguises are commonly used to mask a person's facial appearance in areas under closed-circuit television (CCTV) surveillance. While many studies attempted to understand the effects of disguises, such as hats and glasses, on facial recognition, limited studies have looked at disguises in forensic facial comparison. The aim of this study was to compare the outcomes of forensic facial comparison by morphological analysis (MA) in a CCTV sample with sunglasses and brimmed caps. The sample was obtained from the Wits Face Database and organized into 81 face pools of one target facial image wearing a disguise (cap or sunglasses) and 10 potential matching images. MA was conducted across face pools, and confusion matrices were used to assess the outcomes. Surprisingly, sunglasses had limited effect on MA performance both in accuracy (90.4%) and in reliability (κ = 0.798), while caps markedly decreased both accuracy (68.1%) and reliability (κ = 0.639). Error rates were associated primarily with false negatives in both samples (caps: 42.4%; sunglasses: 16.1%) despite the sample distribution favoring false-positive errors, which were very low (caps: 0.6%; sunglasses: 0%). Similarly to other studies, hats and caps were more harmful to correct identification when compared to sunglasses, which actually resulted in better accuracy than regular CCTV recordings. The effect of brimmed caps on accuracy was attributed to the overall loss of facial information caused. On training analysts, it may be helpful to instruct purposefully avoiding overreliance on easily disguised facial features, as other regions of the face also contain substantial feature information.

KEYWORDS
caps, CCTV, disguise, facial identification, forensic facial comparison, glasses, morphological analysis

Highlights

- The effects of facial disguises are understudied in forensic facial comparison.
- This is the first study to test morphological analysis on disguised faces in a CCTV setting.
- Brimmed caps were found to hide more facial information than sunglasses and decrease accuracy most.
- Sunglasses were found to have minimal effects on feature-based facial comparison.

Any opinions, findings, and conclusions or recommendations expressed in this study are those of the authors, and therefore, the NRF and University of the Witwatersrand, Johannesburg, do not accept any liability in regard thereto.

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1 | INTRODUCTION

Closed-circuit television (CCTV) surveillance is common in both public and private areas [1–3]. CCTV recordings and images extracted from these recordings are often used for facial identification purposes [4], particularly in criminal proceedings. Unfamiliar face identification is widely considered a complex task [5–7],with experts performing relatively better than the general public [8]. As a result, many prosecutors rely on expert assessments and testimony for facial comparison cases [9,10].

Despite the many studies investigating human cognitive ability to correctly identify individuals' facial images (e.g., [11–14]), few take into consideration external confounding factors such as disguises [14–17]. It has long been accepted that various forms of disguises hamper the ability to identify faces [18], despite the occasional inconsistent findings of their effects on identification [19]. Disguises, in the form of sunglasses and hats, are often worn by criminals and are widely considered effective in obscuring facial appearance and maintaining anonymity [10,20]. However, these effects are relatively disregarded in facial comparison research and have not been investigated extensively in forensic facial comparison.

Eyeglasses or sunglasses and hats or caps are some of the most commonly used disguises affecting facial recognition and identification (e.g., [15,21,22]). The majority of studies investigating disguises do so in relation to some form of facial memory, often in the context of eyewitness identification (e.g., [19,23,24]), hence looking at faces with a level of familiarity. In a setting where CCTV evidence is analyzed by a facial comparison expert, faces are predominantly unfamiliar to the analyst performing the comparison, which relies on a different cognitive approach [12,25]. In fact, many studies suggest that when attempting familiar face recognition, priority is given to internal facial features, such as the eyes and nose, as opposed to peripheral features, such as face contour shape and ear morphology [25,26]. Others have suggested that familiar faces are recognized based on an average of the variations in their appearance [27], with further postulation that familiarization creates an understanding of the truly invariable features of each face [28]. Nonetheless, understanding which facial features are prioritized in unfamiliar face recognition is particularly relevant when disguises are involved, as it means that a further limitation on available features for facial comparison is imposed.

When conducting facial comparison, a systematic approach is recommended, particularly with the use of a facial feature list as it has been shown to improve accuracy [29–32]. Facial comparison in the forensic context is usually conducted under the recommendations proposed by the Facial Identification Scientific Working Group (FISWG), which has established policies and guidelines for practice and research in facial identification and facial recognition [33]. According to FISWG [31] and research in the field of facial identification (e.g., [8,10,34,35]), the recommended method for forensic facial comparison is considered to be morphological analysis with the aid of feature lists or instructions [29,30,36]. The most recent and extensive feature list developed for this purpose was put forward by FISWG in 2018 [37]. This feature list includes detailed descriptors regarding each individual anatomical facial feature to provide a thorough guide during analysis. This FISWG feature list has recently been tested and was found reliable in both photographic- and CCTV-derived images of relatively good quality [32]. Although multiple studies have looked at disguises in general face recognition (e.g., [14–17]), to date, feature list-based facial comparison has not been tested in the context of disguised faces, and it has been recommended that further research is required in suboptimal conditions [38]. Conducting thorough testing of methodologies is particularly relevant in the field of facial comparisons as its admissibility has been questioned due to lack of testing and validation [39].

The aim of this study was, hence, to test the effectiveness of facial comparison by morphological analysis using the most extensive available feature list [37] in CCTV footage with individuals wearing face obscuring accessories, namely brimmed caps and sunglasses. The study hypothesized that both caps and sunglasses would negatively impact the ability to identify faces using morphological analysis.

2 | MATERIALS AND METHODS

This study made use of standardized (ST) photographs and CCTV recordings originating from the Wits Face Database [40,41]. See Bacci et al. [41] for further details on database composition, design, and image data acquisition. Still images from the recordings and standardized photographs were used to compile face pools from a total of 86 consenting, known individual, young male adults of black South African descent. From this database, face pools were composed which included one still target image and 10 prospective matches/foils from the ST photographs. Of the 10 prospective matches, nine were incorrect matches in most of the face pools; however, a few face pools included 10 incorrect prospective matches so that the analyst did not feel obliged/subjectively pressurized to make a match in every analysis (Table 1). These face pools were compiled by someone other than the primary analyst to ensure blinding during analysis. Across all face pools, the maximum number of repetitions

TABLE 1 Analysis trials face pools: cohort subsample breakdown

Analysis cohort	Test trials	No-match trials	Analysis trials	Repeat trials	Total trials
Cap CCTV to ST photographs	33	4	37	5	42
Sunglasses CCTV to ST photographs	31	3	34	5	39

Abbreviations: CCTV, closed-circuit television; ST, standard.

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SUPPORTING INFORMATION

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