The Relationship between Format of Facial Identification Information and Identification Accuracy

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Abstract

Eyewitness-identification evidence, such as person descriptions and facial composites, plays a fundamental role in criminal investigations and is regularly regarded as valuable attestation for apprehending and prosecuting perpetrators. However, the reliability and accuracy of eyewitness-identification information is often queried as person descriptions are frequently reported as indistinct and generalizable, whilst composites often tend to exhibit a poor likeness of an intended target-face. This raises questions regarding the reliability of facial identification information as means to accurately identify perpetrators of crimes. The current study utilized a mixed-measures design (N=167) to investigate this concept by directly comparing person descriptions, composites, and description-based synthetic faces generated by a multivariate regression model to evaluate the reliability of facial identification accuracy of a target amongst different formats of facial identification information. Results found a statistically significant main effect between formats of facial identification information (p<.001), with a higher target identification accuracy yielded by facial descriptions in comparison to composites and description-based synthetic faces. However, no statistically significant difference was established between composites and description-based synthetic faces for target identification accuracy. Overall, results indicated that facial descriptions allow for greater identification accuracy of a target-face than other forms of facial identification information. Further research is required into description-based synthetic faces as a means to produce an alternative visual form of facial identification information that may enable greater target identification accuracy of perpetrators than current composites allow.

Keywords: Composites, Descriptive-Based Synthetic Faces, Facial Descriptions, Face Recognition, Identification Accuracy

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Generally regarded as valuable attestation for apprehending and prosecuting perpetrators of crimes, eyewitness-identification evidence is heavily relied upon by the criminal justice system (Brown, Lloyd-Jones, & Robinson, 2008; McQuiston-Surrett, Topp, & Malpass, 2006). Moreover, law enforcement is especially contingent upon eyewitness-identification evidence to apprehend potential suspects when criminal investigations lack sufficient tangible or biological evidence to identify offenders (Laughery, Duval, & Wogalter, 1986). Produced by an eyewitness who will later identify the suspect from a lineup, eyewitness-identification evidence refers to any information regarding the physical appearance of an offender. Most common forms of eyewitness-identification evidence include person descriptions and facial composites, which are typically utilized by law enforcement to search for unknown perpetrators.

Despite a significant number of studies questioning the reliability of eyewitness testimony and whether eyewitnesses can accurately identify perpetrators, it is still commonly believed by law enforcement and the general public that eyewitness-identification evidence is a trustworthy portrayal of a criminal (Davies & Valentine, 2006; Gabbert & Brown, 2015). However, person descriptions have been shown to be ambiguous, indistinct and generalizable, whilst composites have been demonstrated to convey poor representations of intended faces (see, e.g., Meissner, Sporer, & Schooler, 2007; Wells & Hasel, 2007). Moreover, due to the suggestibility of human memory and errors in visual perception, eyewitness-identification testimony is considered one of the most unreliable forms of evidence (Hurley, 2017). Yet, law enforcement still places significant emphasis upon eyewitness-identification information even though utilizing it as a means to accurately identify offenders of crimes can lead to misidentification and conviction of innocent civilians as eyewitnesses can provide fictitious or inaccurate details regarding a perpetrator's appearance (see Innocence Project, 2019).

Elicitation Techniques and Contents of Person Descriptions

Person descriptions are defined as an eyewitness's verbal or written recall of the visually encoded observation of a perpetrator (Sporer, 1996). Various interviewing techniques, ranging from free-recall to feature checklists and the Cognitive Interview, are exercised by the police to elicit descriptions of offenders from eyewitnesses (Meissner et al., 2007). Moreover, differing levels of detail, accuracy and completeness of person descriptions are obtained dependent upon the elicitation techniques utilized (Milne & Bull, 1999).

One of the most successful techniques for eliciting person descriptions is the

Cognitive Interview, which consists of a number of mnemonics such as in-depth reporting and mental reinstatement of environmental and personal contexts (McLeod, 2019). The Cognitive Interview has been found to increase the recall of accurate descriptors pertaining to a suspect (Köhnken, Milne, Memon, & Bull, 1999). Whilst, feature checklists elicit more detailed person descriptions by prompting eyewitnesses into providing information regarding specific features of a perpetrator, they also lead to the reporting of potential erroneous information, resulting in less accurate person descriptions (Meissner et al., 2007). Conversely, free-recall methods which freely extract accurate although incomplete person descriptions have been found to be the most commonly utilized and effective technique by police officers, alongside the Cognitive Interview (Brown et al., 2008).

Considered as vague, generalizable and incomplete, person descriptions typically contain 7 to 9 descriptors (e.g., Fahsing, Ask, & Granhag, 2004; Meissner, Sporer, & Susa, 2008). Reported attributes have been found to frequently refer to a culprit's cardinal characteristics, such as gender, clothing, age, height, weight, and race, rather than more distinguishable and distinct, person-specific descriptors, such as facial features (Fahsing et al., 2004; Meissner et al., 2008; Sporer, 1996). When 'default values' have been reported by eyewitnesses, they have been found to be highly congruent to the perpetrator (Van Koppen & Lochun, 1997). Although, occasionally eyewitnesses fail to even include such fundamental descriptors (e.g., ethnicity or gender) in their portrayal of a suspect as they may be regarded as 'default values' by the eyewitness due to apparent saliency (Lindsay, Martin, & Webber, 1994).

Descriptions usually contain limited facial information, with inner-facial features being rarely mentioned (e.g., Granhag, Ask, Rebelius, Öhman, & Mac Giolla, 2013). However, when inner-facial features are reported, emphasis is generally placed upon the upper-facial region, specifically the hair and eyes, whilst lower-facial features, such as the chin and mouth, are seldom described (e.g., Davies, Shepherd, & Ellis, 1978). Moreover, eyewitnesses are quite accurate in their reporting of outer-facial features, whilst inner-facial features are regularly inaccurately described (Fahsing et al., 2004).

Despite the overall vagueness and incompleteness of person descriptions, witnesses are usually quite accurate in the descriptors they choose to provide (Woolnough & MacLeod, 2001). However, general findings regarding the level of inaccuracy and reliability of person descriptions differs amongst studies. Archival studies of police gathered person descriptions have established a high reliability and accuracy ranging from 84% to over 90% (Fahsing et al., 2004; Woolnough & MacLeod, 2001). Yet, Granhag et al. (2013) found 2 of 5 reported attributes to relay inaccurate or misleading information.

Defining Composites and Composite-Construction Software

Facial composites are employed by the police, to facilitate extensive searches for criminals via circulation amongst the public, when the identity of a perpetrator remains unknown (Kovera, Penrod, Pappas, & Thill, 1997). Constructed by eyewitnesses of crimes, facial composites are visual impressions depicting a culprit's face (Frowd, Bruce, McIntyre, & Hancock, 2007). Typically intended to stimulate identification by individuals familiar with the suspect, composites are produced by a variety of techniques (Kovera et al., 1997). Currently, four generations of composite systems exist; manual sketches, mechanical, software, and fourth-generation systems (Davies & Valentine, 2006).

Manual sketches require an artist to collaborate with an eyewitness in rendering a sketch of the culprit (Davies & Valentine, 2006). Subsequently, the advent of mechanical systems and software systems allows witness-guided feature selection of facial components to construct composites with the aid of an operator, who is an individual proficient in the composite-construction software (Davies & Valentine, 2006). Moreover, software systems produce more realistic composites than mechanical systems via enabling greater control of facial features with regards to feature selection and optimization, thus allowing digital blending and altering of facial features (Kovera et al., 1997). However, when constructing composites from memory, software systems are not more advantageous than mechanical systems in producing better and more accurate depictions of an intended target (McQuiston-Surrett et al., 2006).

Recently, fourth-generation systems have been developed to promote holistic-configural facial processing via utilizing a genetic algorithm that morphs and mutates faces to produce a composite (Wells & Hasel, 2007). Little research has been conducted to assess the quality of fourth-generation systems, but thus far research indicates no difference in composite quality between fourth-generation systems and earlier generations (Davies & Valentine, 2006). Although, based upon current face processing theories that advocate holistic facial processing, fourth-generation systems should theoretically produce more superior composites than earlier generations of composite systems (Wells & Hasel, 2007).

Factors Affecting Face Recall and Face Recognition

Accurate and comprehensive eyewitness evidence relies upon a witness's ability to externalize, either verbally or visually, the internalized visually-encoded memory of the perpetrator; a task which individuals struggle to accurately accomplish (Davies et al., 1978;

McQuiston-Surrett & Topp, 2008). Various factors have been suggested to negatively affect face recall, including insufficient vocabulary to accurately convey the internalized visual image of the culprit (Wogalter, 1996), ineffective communication between the eyewitness and investigator (Sporer, 1996), and composite-construction software being inadequate in producing accurate composites (Shepherd & Ellis, 1996). Moreover, various estimator and system variables present during encoding and recollection of the incident can negatively impact face recall and the quality of eyewitness-identification information (Meissner et al., 2007).

Sporer (1996) proposes that poor facial recall and subsequent facial recognition may occur during the dual process of transferring information from an eyewitness to another individual. Initial elicitation of person descriptions and production of composites using third-generation or earlier composite-construction systems requires eyewitnesses to translate the internalized, visually encoded face into verbalized information for creation of composites or person descriptions (Sporer, 1996). This necessitates the featural recall of a face to describe distinct features (Schooler & Engstler-Schooler, 1990), resulting in poor recollection of inner-facial features as negligible importance is placed upon distinct features during encoding; instead significant emphasis is placed upon spatial configuration of features and holistic processing during initial encounter with the culprit (Tanaka & Farah, 2003). Moreover, interference and contamination of the original memory-trace may occur during this creation process, negatively affecting later identification of a perpetrator (Ellis, Shepherd, & Davies, 1975). Further difficulties may also occur when the verbal person description obtained from the eyewitness requires decoding and retransformation into an internalized or physical visual representation, as the composite operator or individual reviewing the eyewitness-identification evidence may not hold an internalized visual image congruent to the eyewitness's memory (Sporer, 1996). This can result in operator bias during composite construction or even misidentification of suspects by police officers and the public (Innocence Project, 2019).

Finally, creating a visual composite concurrent to accessing the visual memory of the culprit has been hypothesized to cause modality-specific interference with the witness's original memory, affecting a witness's ability to effectively construct and evaluate the accuracy of the composite (Shepherd & Ellis, 1996). This is because holding a mental image of the culprit, whilst viewing a visual composite may cause tampering with the original memory trace of the culprit as features of the visual image of the composite may morph and distort the memory of the culprit's face (Shepherd & Ellis, 1996).

Composites versus Person Descriptions

Numerous studies have sought to determine the accuracy of facial composites and person descriptions in relation to facial identification of an intended target-face (e.g., Kovera et al., 1997; Meissner et al., 2008). However, few studies have directly compared different types of eyewitness-identification evidence in relation to whether composites or person descriptions are better in allowing for greater facial identification accuracy of a culprit.

Christie and Ellis (1981) found verbal person descriptions to be significantly more reliable than Photofit composites, when assessing accuracy via an identification and sorting task completed by judges independent from description and composite production. Subsequently, McQuiston-Surrett and Topp (2008) showed person descriptions to have higher accuracy than composites. Moreover, recent assessment of the relative utility of eyewitness-identification evidence found verbal person descriptions to be more useful in facial identification than the fourth-generation composite system, EFIT-V (Lech & Johnston, 2011). Hence, as initially suggested by Christie and Ellis (1981), it seems reasonable to propose that verbal descriptive ability may be impaired during composite construction and that verbal person descriptions may be able to convey information that is otherwise absent in composites.

Rationale

Eyewitness-identification evidence plays a fundamental role in criminal investigations (Brown et al., 2008; McQuiston-Surrett et al., 2006). However, various limitations in recalling faces and the production of person descriptions and composites can negatively impact the quality of eyewitness evidence, leading to the misidentification and prosecution of innocent individuals (Wells & Hasel, 2007). Hence, it is vital to evaluate the reliability and accuracy of eyewitness evidence as a means to correctly identify suspects.

Few studies have directly assessed the ability to accurately identify targets from person descriptions versus composites, but all findings indicate person descriptions to be more reliable and accurate than composites in allowing correct identification of an intended individual (Christie & Ellis, 1981; Lech & Johnston, 2011; McQuiston-Surrett & Topp, 2008). This may indicate that current composite-software is inadequate in producing sufficient representations of intended faces when constructing from memory or that person descriptions are able to convey details that are otherwise absent in composites (Christie & Ellis, 1981; Davies & Valentine, 2006). Moreover, poor performance of identification based on composites may be due to a variety of human instigated limitations, such as operator bias

(Frowd et al., 2007) or a modality-specific interference (Shepherd & Ellis, 1996), negatively impacting a composite's likeness to a target-face. Thus, with limited studies investigating the effectiveness of eyewitness-identification evidence in accurately identifying individuals and no verification of why composites perform poorer in facial identification than person descriptions, it is vital that this topic is further examined.

Moreover, given recent technological advancements in graphical processing, it is now possible to generate hyper-realistic synthetic faces utilizing neural networks (see Karras, Laine, & Aila, 2019). Computer-generated synthetic faces can also be created based upon a single person description (Chen, Qing, He, Luo, & Xu, 2019). Techniques such as this could potentially control for human instigated limitations that occur during composite construction as well as reveal whether person descriptions are able to convey information that is lost in human-constructed composites. Hence, it is necessary that the exploration of computer-generated synthetic faces based upon person descriptions is further explored as an alternative method to produce composites that may facilitate greater identification accuracy of offenders than current composite software allows.

Specific Aims and Hypotheses

The current study primarily seeks to evaluate the effectiveness of eyewitness-identification evidence as a means to accurately identify a suspect of a crime by directly comparing and assessing how successful different formats of facial identification information, particularly facial descriptions and composites, are in enabling correct facial identification. Secondly, statistical modelling techniques will be utilized to produce computer generated description-based synthetic faces modelled from facial descriptions. Hence, reducing human involvement in composite construction to determine whether limitations in target identification accuracy for composites resides within human instigation or the composite-construction systems themselves. Thus, the following hypotheses were tested:

1) Facial descriptions will exhibit a significantly higher target identification accuracy than composites and description-based synthetic faces.
2) Target identification accuracy for composites will be significantly poorer than description-based synthetic faces.

Methods

Design and Setting

This study adopted a randomized, experimental design to investigate the relationship between the format of facial identification information and target identification accuracy. Three independent variables were present: ‘Mode of Recall’ (with two levels; memory, in-view), ‘Target’ (with two levels; target A, target B), and ‘Facial Identification Information Format’ (with three levels; facial description, composite, description-based synthetic face).

‘Mode of Recall’ is a between-subjects factor referring to whether the facial identification information was produced when the target-face was absent (memory) or when the target-face was present (in-view). Whilst, ‘Facial Identification Information Format’, is a within-subjects variable defined by the format in which facial identification information portraying a target-face was presented to a participant (i.e., facial description, composite, or description-based synthetic face). The third independent variable, ‘Target’, is a between-subjects factor indicating which target-face a participant was exposed to. Refer to Figure 1 below, for an overview of the experimental design.

Figure 1. Overview of experimental design

Between-Subjects Factors		Within-Subjects Factor	Cells of the Study Design
Target	Mode of Recall	Format of Facial Identification Information	
Target A	Memory	Description	Cell 1: Target A, Memory, Description
		Composite	Cell 2: Target A, Memory, Composite
		Synthetic	Cell 3: Target A, Memory, Synthetic
	In-view	Description	Cell 4: Target A, In-view, Description
		Composite	Cell 5: Target A, In-view, Composite
		Synthetic	Cell 6: Target A, In-view, Synthetic
Target B	Memory	Description	Cell 7: Target B, Memory, Description
		Composite	Cell 8: Target B, Memory, Composite
		Synthetic	Cell 9: Target B, Memory, Synthetic
	In-view	Description	Cell 10: Target B, In-view, Description
		Composite	Cell 11: Target B, In-view, Composite
		Synthetic	Cell 12: Target B, In-view, Synthetic

Two dependent variables are measured in this study; ‘Identification Accuracy’ and ‘Identification Precision’. ‘Identification Accuracy’ measures how accurate the facial identification information is in enabling the correct identification of a target face. On the other hand, ‘Identification Precision’ measures how precisely individuals are able to reduce a set of faces to only faces that are believed to resemble the given facial identification information. This does not relate to ‘Identification Accuracy’ as the target-face does not have to be present within the reduced set of faces.

The control for this experiment was set to all facial identification information produced under the in-view condition of ‘Mode of Recall’ as recounting a face whilst it is in-view enables optimal conditions for generating facial identification information without interference from recall errors or memory decay.

Overall, the study consisted of 3 X 2 X 2 cells for ‘Facial Identification Information Format’, ‘Mode of Recall’, and ‘Target’, outcoming in 12 experimental groups, which participants were all randomly assigned to according to a randomization scheduler. However, the ‘Target’ variable was primarily introduced into the experiment as a sampling factor to mitigate target bias as a product of facial distinctiveness on target identification accuracy. Hence, where statistical analysis found no significant differences between ‘Target’, this condition was collapsed to result in 3 X 2 cells for ‘Facial Identification Information Format’ and ‘Mode of Recall’, producing 6 experimental conditions.

This study was electronically circulated as an online experiment hosted on the survey platform Qualtrics (https://www.qualtrics.com).

Participants

Recruitment. A total of 169 participants (*N* =169) partook in this study. Participants were voluntarily recruited via a snowball sampling technique that electronically invited individuals to take part in the study and asked them to share the online study to three or more individuals after their own completion.

Eligibility criteria. This study involved facial identification, which is known to be adversely affected by own-group bias, where individuals are less accurate in recognition of individuals not belonging to the same social group as them (Sporer, Trinkl, & Guberova, 2007). Hence, only individuals who had resided in South Africa or a bordering country for at least the past 5 years were permitted to participate as all target-faces utilized in the current study were of South African nationality. Furthermore, all persons had to be 18 years or older to participate in the study.

Of the total participants who partook in the study, 2 participants were excluded due to not meeting the above-mentioned eligibility criteria. Hence, the final sample size for the study comprised of 167 participants (*N*=167).

Sample characteristics. Of the total eligible participants recruited, 40.72% declared themselves male and 59.28% declared themselves female. Subsequently, 67.66% of participants identified as Caucasian, 14.37% as coloured, 11.38% as Indian, 5.39% as black, and 1.20% as Asian. The overall mean age of participants was 38.65 years (*SD*=15.55), ranging from a minimum age of 20 years to a maximum age of 87 years.

Power analysis. An effect size was calculated by using Lech and Johnston's (2011) reported F-statistic of $F(2,58)=5.04$, $p<.01$, resulting in $\eta^2 = 0.15$ and an equivalent effect size Cohen's $f = 0.72$, which was utilized to conduct a priori power analysis via G*Power to determine an estimate sample size (Faul, Erdfelder, Buchner, & Lang, 2009). Selection of a one-way ANOVA using the above reported effect size, power =.95, α=.05 and three groups, revealed a suggested sample size of *N*=93. This sample size was then multiplied by 1.5 to control for potential design effects and cluster sampling (Martínez-Mesa, González-Chica, Bastos, Bonamigo, & Duquia, 2014). Hence, an estimated sample size of *N*=140 was suggested for the study. Thus, with *N*=167 the study was adequately powered.

Materials

Composite Software. All composites were constructed using the composite construction software ID to produce coloured, computer-generated faces of the targets. ID utilizes face-databases, that consist of standardized and landmarked faces to extract information regarding face shape and texture. Principle Component Analysis (PCA) is then performed upon the extracted information to yield a set of underlying eigenfaces that are transformed and collated into a linear combination by the use of weighted co-ordinates to be projected onto a face-space, which is utilized to produce composites (Tredoux, Núñez, Oxtoby, & Prag, 2006). Genetic algorithms, such as population incremental learning (PBIL) and M-Choice, are then implemented by ID to search the face-space and generate composites of suitable facial likenesses to a perpetrator by promoting the construction of composites via holistic-configural facial processing (Tredoux et al., 2006).

Within the ID software, composites are produced by an iterative process of selecting multiple computer-generated faces from a 4X3 matrix for each iteration, until a composite resembling the target's face is produced. Upon each iteration, the previously selected faces are blended and morphed together to create a variation of 12 different novel faces, based upon previous selection, to repopulate the matrix with a new generation of faces. Users are also able to apply facial characteristic optimizations to the overall generation of 12 faces. Additionally, users are also allowed to alter characteristics for a single, selected face to obtain a better visual likeliness of an intended target-face. Characteristic alterations for a singular face include the ability to alter featural spacing and face shape as well as modify the shape, texture and overall appearance of individual facial attributes. See Tredoux et al., 2006 for a more in-depth explanation.

Face Stimuli and Face-Matrix Construction. Two young, South African, coloured males were selected as targets. Coloured, portrait photographs of the targets displaying neutral facial expressions were captured (see Appendix A) and separate 6x4 photographic, face-matrices were constructed for each target. The face-matrices consisted of 24 frontal, full-face portraits standardized to approximately 3.5cm by 5 cm in accordance to Christie and Ellis's study (1981). Additionally, all photographs were normalized by rectifying colour and brightness discrepancies as well as editing faces to have black shirts behind solid-grey backgrounds.

Twenty-three filler faces were then chosen to populate each face-matrix, alongside the respective target photograph. Filler faces were selected by having individuals (*N*=17) unrelated to the study provide free-recall, facial descriptions of both targets whilst viewing the respective target photographs. A modal description for each target was then created based upon frequently mentioned facial attributes from the gathered facial descriptions. The researcher then selected 23 filler faces per target, bearing similarity to the respective target modal description, from a face-database consisting of coloured, South African males.

Placement of photographs in the facial matrices were determined by a random number generator to ensure a standardized placement of faces that was not biased. Refer to Appendix B for both face-matrices.

Gathering of Facial Identification Information. Facial identification information was produced by sixteen individuals (*N*=16), independent from the online study. All individuals, who created facial identification information were undergraduate psychology students from the University of Cape Town (UCT). They were recruited via convenience sampling using the Psychology Department's Student Research Participation Programme (SRPP), where students were invited to participate in a 'Tarot-card reading' study via an advertisement posted on the university's student portal in exchange for 4 SRPP points, which are necessary for course DP (see Appendix C). Participants were deceived about the nature of the task being a 'Tarot-card reading' in order to mitigate potential priming and subject-expectancy effects.

The process of gathering facial identification information required individuals to visually encode a live target, who would later be recalled from memory to generate verbal facial descriptions and facial composites of the target's face. Description-based synthetic faces representing the target's face were generated upon facial descriptions modelled from the rating of a target's facial features by a facial checklist (Appendix D). A total of 32 facial descriptions, 32 composites, and 32 description-based synthetic faces were produced (see Appendix E for a break-down of the total number of facial identification information pieces that were produced for each condition). Refer to Appendix F for a summary of the procedure utilized to gather facial identification information.

Facial Descriptions and Composite Construction. Block randomization was used to randomly assign individuals (*N*=16) to one of two groups consisting of 8 individuals respectively (*n*=8). Individuals were then required to independently engage in an interactive task with one of the two targets, dependent upon group assignment. Individuals were welcomed by the researcher and presented with a consent form (Appendix G) to be read and signed before the Tarot-card reading commenced.

Interaction between the individual and target occurred via a Tarot-card reading conducted by the target for a duration of 10 minutes (see Appendix H for the script of the Tarot-card reading). Following the Tarot-card reading, the target exited the room and the researcher entered. The individual then completed a survey on the Tarot-card reading as a short distractor task (Appendix I) for 5 minutes. Upon completion of the survey, individuals were then informed that they would be required to produce facial identification information as they were participating in a facial recognition study.

A verbal facial description was then elicited from the individual's memory via free-recall, where the individual was instructed to describe in as much detail as possible the face of the Tarot-card reader. Following this, individuals were then required to complete a facial checklist, where they rated various facial features pertaining to the Tarot-card reader. This process of eliciting a verbal facial description and completing a facial checklist form was then repeated for the other target, who did not conduct the Tarot card reading. This second target was present, sitting in-front of the individual, for the entire duration that the verbal facial description was elicited as well as the facial checklist was being completed.

All verbal facial descriptions were audio recorded to transcribed at a later stage by the researcher as it formed part of the required materials for the online study. Next, a long distractor task was completed, where individuals had to play the online game '2048' (https://play2048.co) for a total of 15 minutes on the researcher's laptop. Subsequently, individuals were then required to construct a facial composite of the Tarot-card reader from memory using ID (Tredoux et al., 2006). This process was facilitated by the researcher, who gave a quick tutorial of the composite-construction software and supervised the construction process. Following this, another facial composite was created pertaining to the other target (i.e., non-Tarot card reader), who sat directly in-front of the individual for the entire duration of the composite construction. Upon completion of the composites, individuals were then debriefed by the researcher and thanked for their participation (see Appendix J). Refer to Appendix K for samples of the gathered facial identification information.

Generation of Description-Based Synthetic Faces. Utilizing the ID software (Tredoux et al., 2006), 32 description-based synthetic faces were generated based upon the responses from the facial checklist. The facial checklist consisted of 41 items and entailed the rating of various facial attributes and characteristics on a 5-point Likert scale, ranging from skin complexion to the shapes of facial features.

To allow for the generation of description-based synthetic faces, a multivariate regression model was built comprised of 138 coefficients based upon items listed in the facial checklist. The multivariate regression model outputted a predicted linear combination of eigenfaces based on an individual's ratings of facial features. This output was then entered into the ID composite software to allow for the generation of synthetic faces based solely on the description ratings of facial features via the facial checklist.

Training data was gathered using an independent sample of individuals (N=72). Individuals were randomly assigned 5 composites out of a set of 60 ID-constructed composites, where they were then required to rate the composites facial features using the facial checklist. This data was then utilized to train the multivariate regression model in predicting the underlying facial coefficients that are utilized by ID to construct a synthetic face. After training the multivariate regression model, the description-based synthetic faces were then generated based upon the facial checklist responses gathered from individuals during the Tarot-card reading task. These responses where then inputted into the multivariate regression model and the subsequent output was fed into ID to generate description-based synthetic faces modelled upon facial descriptions.

Procedure

This study abided by the University of Cape Town's Code for Research Involving Human Subjects and was granted ethical approval by the UCT Department of Psychology's Ethics Committee (see Appendix L for ethical considerations; reference: PSY2019-051; see Appendix M for ethical approval letter). Participants were electronically provided a consent and demographic information form to be completed and virtually signed before proceeding with the study (see Appendix N and O). Demographic information was gathered for the purposes of assessing the impact of potential own-race bias on facial recognition as it has been shown that individuals display superiority in remembering and recognizing same-race faces in comparison to other-race faces (Meissner & Brigham, 2001).

Upon commencement of the survey, participants were randomly assigned to one of four facial identification information conditions based upon ‘Target’ and ‘Mode of Recall’ (i.e., target A: memory, target A: in-view, target B: memory, target B: in-view). Hence, participants were only exposed to facial identification information that portrayed either target A or target B as well as only facial identification information that was either produced from memory or in-view of the target. Moreover, to control for order effects, participants were randomly presented with different types of facial identification information based on randomization of ‘Identification Information Format’.

Participants were then required to repeatedly evaluate arbitrarily allocated facial identification information, according to their assigned facial identification information condition, across all three types of facial identification information formats (i.e., facial description, composite, and description-based synthetic face). Evaluation of the identification accuracy of different formats of facial identification information occurred via an identification-reduction and identification-ranking task, where participants were required to complete both tasks for each format of facial identification information.

The identification-reduction task was first presented to participants, consisting of a 6x4 face-matrix alongside facial identification information for one of the three facial identification information formats. Participants were instructed to reduce the face-matrix by eliminating as many faces as possible that they judged did not resemble the facial identification information provided. Hence, only leaving behind faces that were believed to bear a resemblance to the given facial identification information. Following this, participants were then obligated to complete an identification-ranking task on the same piece of facial identification information that was provided for the identification-reduction task. The identification-ranking task asked participants to rank the 24 faces in the face-matrix from least likely to match the facial identification information to most likely to match the facial identification information. This set of identification tasks based upon the evaluation of facial identification information was repeated three times; once for each format of facial identification information.

Upon each completion of a set of identification tasks, participants engaged in a short distractor task where they had to play the online game ‘2048’ (https://play2048.co) for 3 minutes before commencing the next set of identification tasks based on new facial identification information. Thus, controlling for potential interference effects between viewing different formats of facial identification information.

Finally, at the completion of each identification-reduction task as well as each identification-ranking task, participants were required to rate how confident they were that eliminated faces did not resemble the facial identification information and that the 24th ranked face for the identification-ranking task was the best likely match to the given facial identification information. At the end of the study, participants were also asked whether they recognized the target-face before they were electronically debriefed (Appendix P) and thanked for their involvement in the study. Refer to Appendix Q for a summary of the study procedure.

Data Management and Statistical Analysis

A comprehensive statistical analysis was conducted utilizing the statistical software SPSS (version 25.0), with a threshold for statistical significance set at $\alpha=.05$ as per convention (Field, 2013). Data was grouped and analyzed according to the three independent variables; 'Facial Identification Information Format', 'Mode of Recall', and 'Target'. Two dependent variables were repeatedly measured across the different levels of 'Facial Identification Information Format'; 'Identification Accuracy', and 'Identification Precision'.

'Identification Accuracy' was coded as the position that a target-face was ranked at by a participant in the identification-ranking task, ranking from least likely to most likely to match the provided facial identification information. The scoring ranged from 1 to 24, where higher scores indicated better identification accuracy and lower scores showed poorer identification accuracy. Finally, 'Identification Precision' was coded as the reduced subset-size (i.e., total number of uneliminated faces in the face-matrix) after a participant performed the identification-reduction task. This ranged from a score between 0 to 24, where a smaller score indicated a better identification precision.

Initially, a full set of descriptive statistics were generated to evaluate general trends within the data and compare central tendencies between groups for both dependent variables. Due to the design of the study, a series of three-way mixed designs analysis of variance (ANOVA) were performed on the data to examine group differences over 'Facial Identification Information Format', whilst also evaluating the effect of 'Mode of Recall' and 'Target' on 'Identification Accuracy' and 'Identification Precision'. All assumptions for inferential analysis were met unless otherwise stated.

Results

Identification Accuracy

Initial inspection of descriptive statistics indicated that target-faces on average received the highest identification accuracy for facial descriptions (*M*=16.74, *SD*=6.87), followed by composites (*M*=12.38, *SD*=6.77). Whilst, description-based synthetic faces (*M*=11.05, *SD*=5.99) obtained the worst identification accuracy on average, resulting in facial descriptions performing on average 51.49% better in identification accuracy than description-based synthetic faces. See Table 1 for descriptive statistics for 'Identification Accuracy' across the different experimental conditions.

Table 1
Descriptive Statistics for Identification Accuracy (N=167)

	Target A		Target B		Total
	Memory (n= 37)	In-view (n= 39)	Memory (n= 51)	In-view (n= 40)	
Facial Description	16.89 (5.88)	16.41 (5.69)	16.71 (8.05)	16.98 (7.36)	16.74 (6.87)
Composite	12.95 (5.65)	15.00 (6.47)	10.00 (7.21)	12.33 (6.60)	12.38 (6.77)
Description-based Synthetic Face	12.97 (6.37)	12.38 (5.05)	9.08 (5.36)	10.50 (6.57)	11.05 (5.99)

Note. Standard deviations are reported in parentheses.
Means are presented without parentheses.

Visual assessment of the standardized residual distributions for 'Identification Accuracy' across each experimental cell found the assumption of normality to be violated, with the majority of experimental conditions depicting a non-normal and strongly, negatively skewed distribution. Appropriate reflections and logarithmic transformations were performed on the data across experimental cells to correct for skewness by applying a transformation of 'Ln(25-X_i)' (Field, 2013). Subsequently, outliers identified as any standardized residual of the newly transformed data with values greater than 2.30 or less than -2.30 were also removed from the dataset to further correct for skewness (*n*=16; Aguinis, Gottfredson, & Joo, 2013; Buzzi-Ferraris & Manenti, 2011). Following this, the resultant sample size was *N*=151. See Table 2 for a summary of the new sub-sample sizes across experimental conditions.

However, upon the removal of outliers, new outliers (*n*=14) were detected within the data as a consequence of unmasking effects from initial outliers (Rousseeuw, Bert, & Van

Zomeren, 1990). Although outliers increase the probability of a Type-I error, newly detected outliers were retained as further removal of outliers revealed additional outliers, producing a mass unmasking effect that resulted in a severe decrease in sample size (Halldestam, 2016). Finally, inspection of distributions of the new standardized residuals for 'Identification Accuracy' after transformation and removal of outliers indicated approximate normal distributions for the majority of experimental conditions. Further inferential statistics was performed on the transformed data.

Table 2
Condition Sample Sizes After Removal of Outliers (N=151)

Target A		Target B	
Memory (n= 33)	In-view (n= 39)	Memory (n= 45)	In-view (n= 34)

Analysis of the three independent variables was conducted via a 3X2X2 mixed-designs ANOVA ('Facial Identification Information Format' X 'Target' X 'Mode of Recall'). Levene's test for equality of variances indicated unequal variances for 'Identification Accuracy' on facial descriptions [$F(3,147) = 13.98$, $p<.001$]. Hence, violating the assumption of homogeneity of variances. However, as the ratio between the largest and smallest group sizes was determined to be 1.36, Levene's test can still be considered rather robust to this violation and further analysis can proceed[1] (Pituch & Stevens, 2015). Subsequently, Mauchly's test of sphericity indicated that the assumption of sphericity had been violated, $\chi^2(2) = 46.05$, $p<.001$. Thus, the Greenhouse-Geisser estimate was interpreted to correct degrees of freedom ($\varepsilon = .79$).

Results of the mixed-design ANOVA indicated a statistically significant main effect for 'Facial Identification Information Format' on 'Identification Accuracy', $F(1.57, 231.40) = 56.79$, $p<.001$, partial $\eta^2 = .28$, as shown in Figure 2. Moreover, a substantially large effect size was determined for 'Facial Identification Information Format', whereas no significant main effect was established for 'Target' or 'Mode of Recall' on 'Identification Accuracy' (see Figures 3,4). Similarly, the three-way interaction was found to be non-significant as well as the 'Facial Identification Information Format' X 'Mode of Recall' and 'Target' X 'Mode

[1] "[When] group sizes are equal or approximately equal (largest/smallest < 1.5), the ANOVA F test is often robust to violations of equal group variance." (Pitch & Stevens, 2015, p. 372).

of Recall'. No significant interaction was determined for 'Facial Identification Information Format' X 'Mode of Recall'. However, interpretation of 'Facial Identification Information Format' X 'Mode of Recall' found the memory condition performed significantly worse for composites than the in-view condition, $F(1,147)=8.99$, $p=.003$ (see Figure 5), whilst the memory and in-view conditions performed roughly the same on 'Identification Accuracy' with regards to facial descriptions and description-based synthetic faces.

A small, significant interaction effect was indicated for 'Facial Identification Information Format' X 'Target', $F(1.57, 231.40)= 7.06$, $p= .003$, partial $\eta^2 = .05$, as shown in Figure 6. Refer to Table 3 for a summary of results.

Table 3

Identification Accuracy: Summary of Tests of Between-subjects Effects and Within-subjects Effects (N=151)

Source	*df*	Sum of Squares	Mean Square	*F*	*p*	η_p^2
Between subjects	150	25.82				
Target	1	.47	.47	3.30	.071	.02
Mode of Recall	1	.35	.35	2.49	.117	.02
Target X Mode of Recall	1	.00	.00	.00	.958	.00
Error	147	20.77	.14			
Within subjects	237.68	157.80				
Facial Identification Information Format	1.57	41.98	26.67	56.79	<.001**	.28
Facial Identification Information Format X Target	1.57	5.22	3.32	7.06	.003*	.05
Facial Identification Information Format X Mode of Recall	1.57	1.77	1.13	2.40	.106	.02
Facial Identification Information Format X Target X Mode of Recall	1.57	.17	.11	.23	.741	.00
Error	231.40	108.66	.47			
Total	387.68	134.48				

Note. Significant at $*p < .05$, $**p < .001$. All listed *p*-values are two-tailed.
df = degrees of freedom.
η_p^2 = Partial Eta Squared.

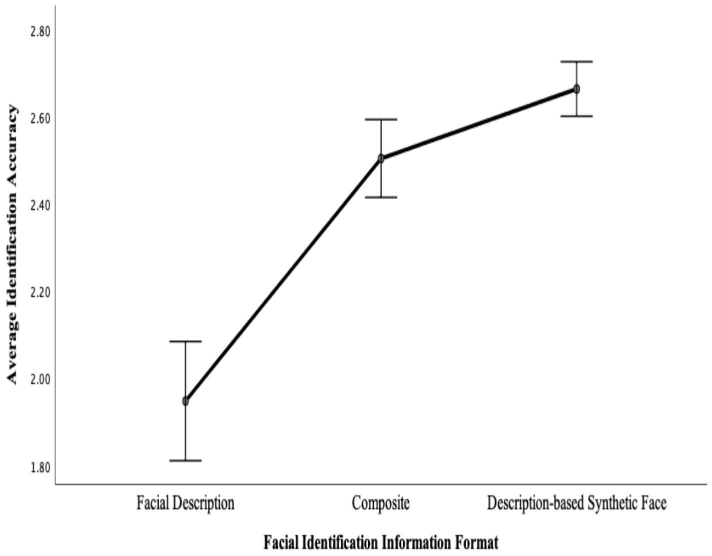

Figure2. Main Effect for Facial Identification Information Format on Identification Accuracy. Error bars represent 95% confidence intervals.

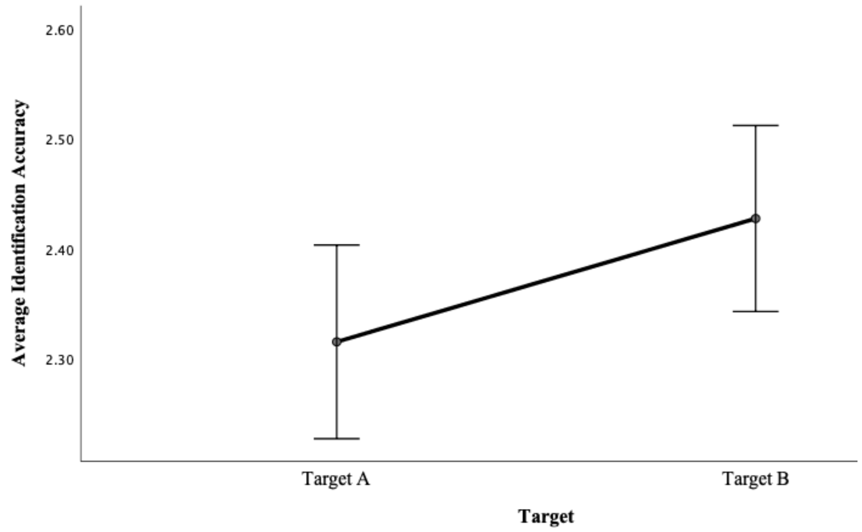

Figure 3. Non-significant Main Effect for Target on Identification Accuracy Error bars represent 95% confidence intervals.

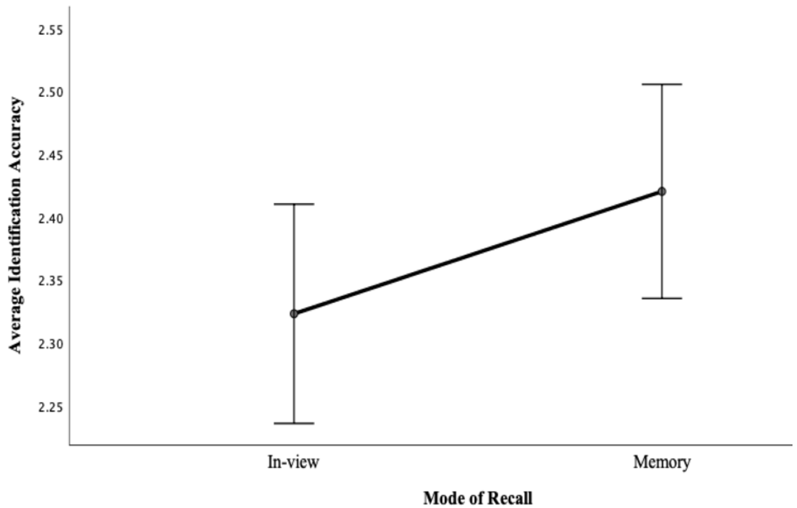

Figure 4. Non-significant Main Effect for Mode of Recall on Identification Accuracy. Error bars represent 95% confidence intervals.

Post-hoc analysis of the main effect for 'Facial Identification Information Format', adopting a Bonferroni adjustment, revealed a significant difference between facial descriptions (*M*= 1.95, *SE*=.07, 95% CI, 1.81 to 2.08) and composites (*M*= 2.50, *SE*=.05, 95% CI, 2.42 to 2.59), with 'Identification Accuracy' being noticeably better with facial descriptions than composites (*p*<.001). Moreover, a significant difference was indicated between facial descriptions and description-based synthetic faces (*M*= 2.66, *SE*=.03, 95% CI, 2.60 to 2.73), with description-based synthetic faces performing significantly worse on 'Identification Accuracy' (*p*<.001). No significant difference on 'Identification Accuracy' was determined between description-based synthetic faces and composites.

Finally, simple main effects and pairwise comparisons were conducted to determine where differences lied between the groups for the two-way interaction effect 'Facial Identification Information Format' X 'Target'. Statistically significant simple main effects were found between targets for composites [*F*(1,147)=11.19, *p*=.001] and description-based synthetic faces [*F*(1,147)=12.61, *p*=.001], with target B yielding a poorer 'Identification Accuracy' than target A for both composites (*M*=.30, *SE*=.09, *p*=.001, 95% CI, .12 to .48) and description-based synthetic faces (*M*=.22, *SE*=.06, *p*=.001, 95% CI, .10 to .35). Whilst, 'Identification Accuracy' remained roughly the same between targets on facial descriptions with a mean difference of .19 (*SE*= .14), 95% CI [-0.08, 0.46], *p* = .170; *F*(1,147)=1.90, *p*=.170.

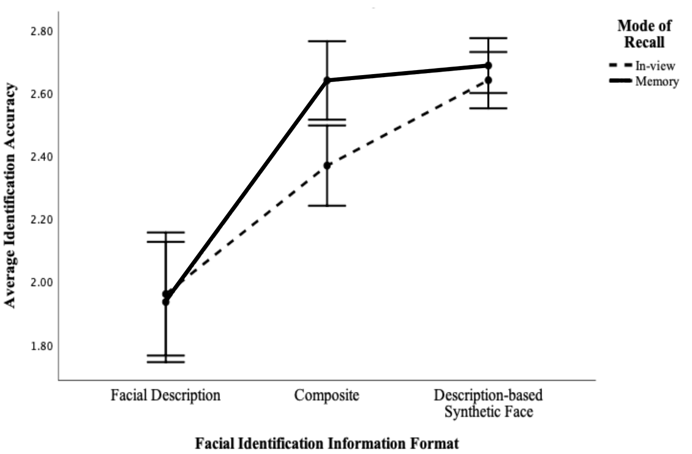

Figure 5. Interaction Effect for Facial Identification Information Format X Mode of Recall. Error bars represent 95% confidence intervals.

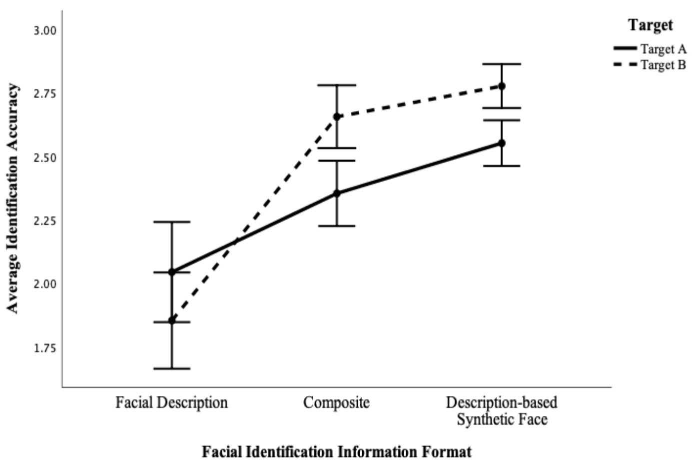

Figure 6. Interaction Effect for Facial Identification Information Format X Target. Error bars represent 95% confidence intervals.

Identification Precision

Preliminary examination of the descriptive statistics indicated that description-based synthetic faces resulted in the greatest number of faces being eliminated from the face-matrix, producing on average the greatest identification precision for the identification-reduction task (*M*=7.32, *SD*=6.07). This was followed closely by composites, which also achieved on average a relatively small reduced set-size indicating an identification precision score of 7.40 (*SD*=6.19). Whereas, facial descriptions (*M*=9.28, *SD*=7.47) resulted on average in the least eliminated faces within the face-matrix, yielding the worst identification precision between the different formats of facial identification information. Moreover, identification precision for facial descriptions were found to be on average 26.78% worse than for description-based synthetic faces as well as 25.41% worse than composite identification precision. See Table 4 for descriptive statistics for 'Identification Precision' across the different experimental conditions.

Table 4
Descriptive Statistics for Identification Precision (*N*=167)

	Target A		Target B		Total
	Memory (*n*= 37)	In-view (*n*= 39)	Memory (*n*= 51)	In-view (*n*= 40)	
Facial Description	9.22 (7.01)	9.79 (7.22)	7.71 (7.13)	10.85 (8.37)	9.28 (7.47)
Composite	6.46 (6.19)	7.64 (6.54)	7.39 (6.00)	8.02 (6.22)	7.40 (6.19)
Description-based Synthetic Face	7.43 (6.37)	6.23 (5.64)	7.57 (6.01)	7.98 (6.36)	7.32 (6.07)

Note. Standard deviations are reported in parentheses.
Means are presented without parentheses.

Visual assessment of distributions of the standardized residuals for 'Identification Precision' across each experimental cell found a strong, positive skewing. Hence, violating the assumption of normality. To correct for non-normality, a two-step transformation method was applied to the data (Templeton, 2011).

Initial analysis of the three independent variables via a mixed-designs ANOVA found no significant main effects or interactions involving 'Target'. Thus, 'Target' was attributed as a sampling factor to control for facial distinctiveness and collapsed. A 3X2 mixed-designs ANOVA was then performed with 'Facial Identification Information Format' as the within-subjects factor and ‘Mode of Recall’ as the between-subjects factor.

Mauchly’s test of sphericity indicated that the assumption of sphericity had been violated, $\chi^2(2) = 32.25$, $p<.001$. Thus, the Greenhouse-Geisser estimate was interpreted to correct for degrees of freedom (ε =.85).

A statistically significant main effect for ‘Facial Identification Information Format’ on ‘Identification Precision’ was found, $F(1.70, 427.18)= 9.48$, $p<.001$, partial $\eta^2 = .05$. Refer to Table 5 for a summary of results.

Further post-hoc testing of the main effect of ‘Facial Identification Information Format’ on ‘Identification Precision’, adopting a Sidak adjustment as all assumptions were met, indicated a significant difference for ‘Identification Precision’ between facial descriptions (*M*= 9.45, *SE*=.55, 95% CI, 8.36 to 10.53) and composites (*M*= 7.54, *SE*=.47, 95% CI, 6.61 to 8.46), with facial descriptions obtaining a significantly worse ‘Identification Precision’ than composites with a mean difference of 1.91 (*SE*=.57, 95% CI, .54 to 3.28, *p*=.003) . Similarly, a significant difference for ‘Identification Precision’ between description-based synthetic faces (*M*= 7.44, *SE*=.46, 95% CI, 6.53 to 8.34) and facial descriptions was also found, with description-based synthetic faces having a significantly better ‘Identification Precision’ than facial descriptions with a mean difference of 2.01 (*SE*=.58, 95% CI, .61 to 3.41, *p*=.002). Whilst, no significant difference in ‘Identification Precision’ was indicated between composites and description-based synthetic faces in relation to the overall number of uneliminated faces in the reduced set. This indicated that facial descriptions retained the most uneliminated faces after the identification-reduction task, yielding the worst ‘Identification Precision’ amongst the different types of facial identification information.

Table 5

Identification Precision: Summary of Tests of Between-subjects Effects and Within-subjects Effects (N=167)

Source	*df*	Sum of Squares	Mean Square	*F*	*p*	η_p^2
Between subjects	166	12742.06				
Mode of Recall	1	66.09	66.09	.86	.355	.01
Error	165	12675.97	76.82			
Within subjects	283.41	7958.47				
Facial Identification Information Format	1.70	427.18	251.72	9.48	<.001*	.05
Facial Identification Information Format X Mode of Recall	1.70	94.83	55.88	2.10	.132	.01
Error	280.01	7436.46	26.56			
Total	449.41	20700.53				

Note. Significant at $*p < .001$. All listed *p*-values are two-tailed.

df = degrees of freedom.

η_p^2 = Partial Eta Squared.

Discussion

The present research aimed to evaluate the effectiveness of facial identification information on identification accuracy. It was hypothesized that facial descriptions would facilitate the best identification accuracy of a target-face, whilst composites and description-based synthetic faces would result in a lower identification accuracy. This study also aimed to determine whether poor identification accuracy enabled by composites is provoked by potential limitations in current composite-construction software or human shortcomings in facial recall during composite-construction. Description-based synthetic faces, produced without human involvement, were created as an alternate visual form of facial identification information to composites to test this concept. It was theorized that description-based synthetic faces would enable a greater identification accuracy than composites, given that limitations in composite identification accuracy do not reside within the composite-construction software.

Although not included in the hypotheses, this research also investigated identification precision amongst the different types of facial identification information. Facial descriptions revealed a significantly poorer identification precision than composites and description-based synthetic faces, whereas composites and description-based synthetic faces performed roughly the same for identification precision. Given the lack of research into identification precision for facial identification information, it is only speculated that this difference between types of facial identification information could be the product of differing modalities (i.e., visual and written) for depicting a target-face. The higher level of identification precision obtained for composites and description-based synthetic faces could be a consequence of utilizing a visual modality for facial identification information to facilitate the search for a target-face, which is also a visual stimulus. Moreover, given this study utilized composites and description-based synthetic faces that were highly realistic, individuals may have perceived the composites and description-based synthetic faces to be exact, accurate representations of a target-face instead of an approximate, vague impression of a target (Lech & Johnston, 2011; Shepherd & Ellis, 1996). This could have caused individuals to search for higher levels of congruency between visual modalities of facial identification information and various faces, resulting in higher identification precision as more faces are eliminated based on not reaching an exact likeness to the composite or description-based synthetic faces. Whereas, facial descriptions may not enforce such high levels of congruency between potential target-faces and the provided facial description as it is more subjective to interpretation due to it being a written form of facial identification information. Thus, individuals are required to internally construct a mental image of the individual reported by the facial description, which could result in a less stringent comparison process between the facial description and potential target-faces due to more interpretation being allowed as a lack of having a more substantiate, visual form of facial identification information to compare faces against (Sporer, 1996).

Facial descriptions demonstrated significantly better identification accuracy than composites and description-based synthetic faces. This was consistent to the findings of previous studies, where facial descriptions were determined to perform better in identification accuracy than composites (Christie & Ellis, 1981; Lech & Johnston, 2011; McQuiston-Surrett & Topp, 2008). However, where previous studies attributed differences between facial descriptions and composites to shortcomings in the human construction of composites, the findings of this study potentially indicate otherwise. Modality-specific interference and high cognitive loading resulting from the transferring of an internalized, visual image of a target-face into an externalised visual image have been prominent theories for rationalizing poor identification accuracy for composites in comparison to facial descriptions (Lech & Johnston, 2011; Shepherd & Ellis, 1996). However, if this were the case then description-generated faces should have yielded a greater identification accuracy than composites, which was not found. It can be speculated that this is due to potential limitations within composite-construction software not being able to generate composites of a significant pictorial likeness to an intended target-face as both composites and description-based synthetic faces were produced using the same composite-construction software. Poor identification accuracy for composites and description-based synthetic faces may then be further impeded by individuals perceiving composites and description-based synthetic faces as exact depictions of a target-face due to the highly realistic nature of the depicted faces by the composite-construction software. Hence, further exploiting insufficiencies in the composite-construction software's ability to adequately capture the physical characteristics of target-faces, resulting in a poor identification accuracy.

Although an interaction was determined for identification accuracy between type of facial identification information and target-face, significant differences were only found composites and description-based synthetic faces. No differences in identification accuracy between target-faces for facial descriptions were observed. Hence, instead of indicating the presence of facial distinctiveness for a particular target-face, biasing participants towards higher identification accuracy for the more distinguishable target-face (Shapiro & Penrod, 1986), this result could demonstrate limitations in the composite-construction software. ID may have not been able to adequately capture the physical characteristics and likeness of the one target-face as the underlying face-database utilized by the software may not have incorporated faces with similar characteristics to the target-face.

In addition, composites produced in-view were found to perform significantly better in identification accuracy than composites constructed from memory. This finding was in-line with current literature as composites constructed from memory limit misleading information leaking in during composite-construction by controlling for memory-decay and other factors that negatively impact composite quality (Wogalter & Marwitz, 1991).

Limitations and Recommendations for Future Research

Although it has been shown that composites portray a poor pictorial likeness of an intended target-face (Wells & Hasel, 2007), target identification accuracy for the currently utilized composites in this study may have been further impeded by limitations in the composite-construction software itself. ID (Tredoux et al., 2006) employs PCA to produce composites of an appropriate facial likeness to a perpetrator. However, PCA has been established to poorly remodel and depict realistic hair texture (Davies & Valentine, 2006). Consequently, ID is restricted in accurately representing hair and as a result of this ID-composites are limited in correctly capturing the hairstyles of an intended target. This is unfortunate as witnesses tend to place emphasis upon describing the hair texture, hair colour and hairstyle of perpetrators (Davies & Valentine, 2006). Moreover, hair has also been proven to be a distinguishing feature for faces that is heavily relied upon for face recognition and accurate identification of individuals (Diamond & Carey, 1986). Hence, poor target identification accuracy for the composites as well as the description-based synthetic faces, which were also produced by ID, may have been substantially affected due to poor representations of the targets' hair. Future research could resolve this issue by constructing composites with an alternative composite-construction software that allows for better representations of an intended target's hair.

Additionally, ID (Tredoux et al., 2006) depends upon an underlying face-database that must be loaded into the system to initiate composite construction. However, the filler faces chosen to populate the face-matrices were also selected from the same face-database that ID used to produce the composites and description-based synthetic faces utilized in this study. Hence, filler faces may have borne a closer resemblance to the provided composites and description-based synthetic faces than the target-faces, as such filler faces were incorporated into the underlying facial generation of the composites and description-based synthetic faces by ID. This could have further worsened target identification accuracy for composites and description-based synthetic faces as participants were potentially biased towards selecting the filler faces over the target-faces. In future, the face-matrices should be populated with filler faces independent from the face-databased used by ID to control for composites and description-based synthetic faces that may obtain a higher visual congruency to a filler face than the target-face. Hence, allowing for better target identification accuracy for both composites and description-based synthetic faces.

The online study was originally estimated to take between 30 to 45 minutes to complete. However, inspection of recorded participant response times found it took just over an hour for participants to finish all identification tasks. This unanticipated long duration of the study coupled with the repetition of identification tasks may have induced potential respondent fatigue. Thus, possibly resulting in poorer target identification accuracy as a function of declining response quality as participants became increasingly fatigued towards the end of the study. The repeated measurement of identification accuracy as a consequence of the mixed-design employed in this research promoted subject attrition and increased respondent fatigue, which was further exasperated by the study being conducted online as a single survey. Future consideration should be taken into the design and implementation of similar, future studies with perhaps the study being divided into three testing sessions (one session per each type of facial identification information) conducted over a longer period of three days to control for potential respondent fatigue and subject attrition ensuing from a single testing session.

Furthermore, the impact of own-race bias on target identification accuracy was not examined. Research indicates people are worse at distinguishing between individuals of a different race to themselves, whilst they are significantly better at identifying individuals who are of the same race as themselves (Sporer et al., 2007). Hence, given only a small portion of the sample identified themselves as being of the same race as all the faces used in this study (i.e., coloured), own-race bias may have confounded target identification accuracy. Future research should take into account this phenomenon to assess and control for the potential impact own-race bias has on target identification accuracy across different types of facial identifying information.

In addition, future research should evaluate the quality of description-based synthetic faces generated by the techniques utilized in this study. Individuals who helped to construct the facial identification information could be asked to judge the quality of their description-based synthetic faces and resemblance towards the target-faces they described. This would assess how effective description-based synthetic faces are in accurately portraying a witness's elicited facial description. Moreover, further techniques for developing description-based synthetic faces should also be explored in future research. Given recent technological advancements, techniques such as natural language processing and neural network models could be utilized to generate description-based synthetic faces based upon a free-recall facial description instead of a facial checklist, which may prove to be better for target identification accuracy.

Conclusion

In conclusion, the findings from this study are congruent with previous literature. It was found that facial descriptions yielded the best target identification accuracy, whilst no significant difference for identification accuracy was established between composites and description-based synthetic faces. However, even though description-based synthetic faces were not found to facilitate better identification accuracy than composites, further research should still be conducted into this area to explore alternative techniques for producing description-based synthetic faces. Despite facial descriptions obtaining the highest identification accuracy, findings also showed that facial descriptions performed the worst on identification precision. Results revealed that individuals tended to eliminate more faces when provided composites or description-based synthetic faces in comparison to facial descriptions. Future research should seek to further investigate the relationship between identification accuracy and identification precision for facial identification information.

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Appendix A

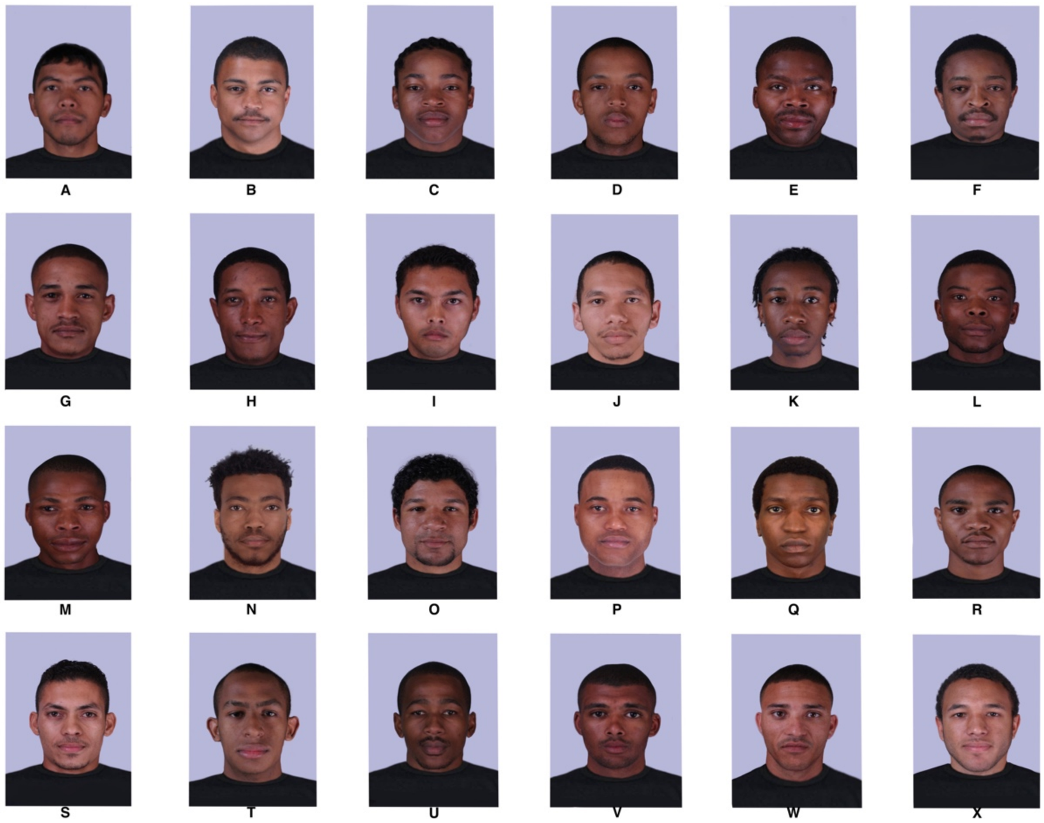
Photographs of Target Faces

Target A

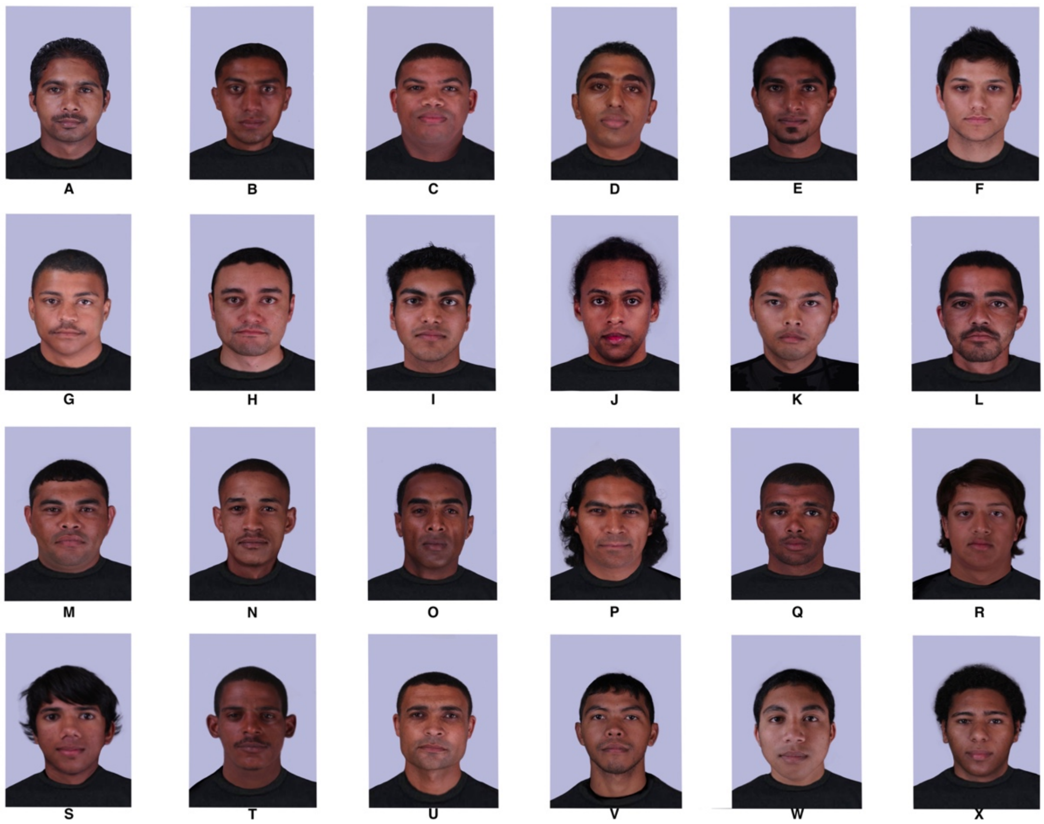
Target B

Appendix B

Face Matrices



(*Right*) Face matrix for target A, with target A placed at position N.



(*Right*) Face matrix for target B, with target B placed at position J.

Appendix C
SRPP Recruitment Advert: Phase One

Subject: Earn 4 SRPP points: Tarot Reading Study
From: Kyra Scott

Hi All

I am conducting a study on the Barnum Effect and the level of acceptance for Tarot card readings. For this study you will have to take part in a **Tarot card reading** followed by completing various activities concerning the Tarot reading. Sessions will be carried out individually in one of the rooms in the **Department of Psychology**.

To participate in this study you must be:
1. 18 years or older
2. South African OR from a bordering South African country (Namibia, Botswana, Zimbabwe, Mozambique, Eswatini, or Lesotho) OR have lived in South Africa for at least the past 5 years

The experiment will take approximately **1hour 30min - 2 hours** to complete and you will be awarded **4 SRPP points** for your participation.
Please note SRPP points will only be received if all tasks in the study are completed.

Places are limited so if you are interested in participating in this study, please email me as soon as possible at kyra.em.scott@gmail.com and I will provide you with more information.

Kind regards
Kyra Scott
Psychology Honours Student

Appendix D

Facial Checklist

Participant Number:

DESCRIPTION OF TARGET

Please circle one number or fill in the blank in response to each item. Leave no blanks. If you do not remember a feature circle DK (Do Not Know). If a feature is not relevant, circle DA (Does Not Reply).

Race

1. White/Caucasian _______ Black/African___________ Coloured______

Shape of Face

2. Short	1	2	3	4	5	Long	DK	DA
3. Narrow	1	2	3	4	5	Broad	DK	DA
4. Bony	1	2	3	4	5	Chubby	DK	DA
5. High Cheekbones	1	2	3	4	5	Low Cheekbones	DK	DA

Complexion

6. Fair	1	2	3	4	5	Dark	DK	DA
7. Clear	1	2	3	4	5	Blemished	DK	DA

Hair

8. Short	1	2	3	4	5	Long	DK	DA
9. Tidy	1	2	3	4	5	Untidy	DK	DA
10. Straight	1	2	3	4	5	Curly	DK	DA
11. Bald	1	2	3	4	5	Full Head	DK	DA
12. No Gray	1	2	3	4	5	All Gray	DK	DA
13. Black/Very Dark Brown	1	2	3	4	5	Light Brown	DK	DA

14. Parted Right 1 Parted Center 2 Parted Left 3 No Part 4 DK DA

Forehead

15. Low	1	2	3	4	5	High	DK	DA
16. Narrow	1	2	3	4	5	Broad	DK	DA

Eyebrows

17. Thin	1	2	3	4	5	Thick	DK	DA
18. Straight	1	2	3	4	5	Bent	DK	DA
19. Meet in Middle	1	2	3	4	5	Set far Apart	DK	DA
20. Low	1	2	3	4	5	High	DK	DA

Eyes

21. Small	1	2	3	4	5	Large	DK	DA
22. Narrowed								

23. Close Set	1	2	3	4	5	Wide Space	DK	DA
24. Deep Set	1	2	3	4	5	Protruding	DK	DA

Ears

25. Small	1	2	3	4	5	Large	DK	DA
26. Protruding	1	2	3	4	5	Close to head	DK	DA

Nose

27. Small	1	2	3	4	5	Large	DK	DA
28. Short	1	2	3	4	5	Long	DK	DA
29. Narrow	1	2	3	4	5	Broad	DK	DA

Mouth

30. Small	1	2	3	4	5	Large	DK	DA
31. Dark Lips	1	2	3	4	5.	Pink Lips	DK	DA

Chin

32. Small	1	2	3	4	5	Large	DK	DA

Facial Hair

33. None	1	2	3	4	5	Some	DK	DA

General Description

34. Age _____

Build

35. Thin	1	2	3	4	5	Obese	DK	DA
36. Skinny	1	2	3	4	4	Muscular	DK	DA

General Appearance

37. Unattractive	1	2	3	4	5	Attractive	DK	DA
38. Average	1	2	3	4	5	Distinctive	DK	DA
39. Honest	1	2	3	4	5	Dishonest	DK	DA
40. Unmasculine	1	2	3	4	5	Masculine	DK	DA
41. Not Criminal	1	2	3	4	5	Criminal	DK	DA

Appendix E

Number of Facial Identification Information Items Produced for Each Experimental Condition

Table 6

Number of Facial Identification Information Items Produced for Each Experimental Condition

Group	Target-Present		Target-Absent		Total
	Target A	Target B	Target A	Target B	
Facial Descriptions	8	8	8	8	32
Facial Composites	8	8	8	8	32
Synthetic Faces	8	8	8	8	32
Total	24	24	24	24	96

Note. A total of 16 participants and 2 targets (A and B) were used to produce facial identification information.

Appendix F

Illustration of Procedure Used to Gather Facial Identification Information

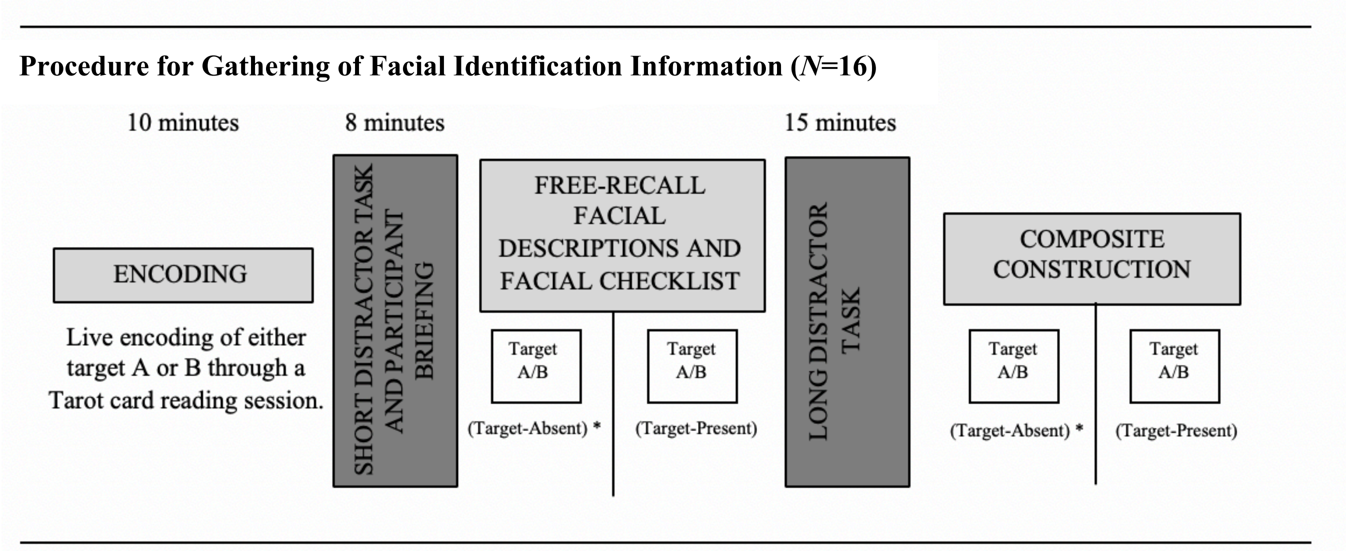


Figure 7. Illustration of the procedure used for gathering facial identification information to be used in the study. Two targets (A and B) were present during the entire study. Individuals were required to produce two free-recall facial descriptions, complete two facial checklists and construct two composites, one for each target.
Note. Target encoding was counterbalanced between individuals
*Target-absent condition was used for the target encoded during the Tarot card reading session. Whilst, the target-present condition was used as a control.

Appendix G

Participant Consent Form: Gathering of Facial Identification Information

Thank you for showing an interest in this study!

This study investigates the Barnum Effect (defined as the psychological phenomenon whereby people accept general personality interpretations as accurate descriptions of their own unique personalities) on the level of acceptance of Tarot card readings conducted by strangers. This study is being conducted as part of my Psychology Honours degree at the University of Cape Town. Before participating in the study please carefully read the text below.

PROCEDURE

You will be required to take part in an individual Tarot card reading session with a Tarot card reader followed by completing a short questionnaire relating to the Tarot card reading. This entire process will take approximately 1 hour 30 min to 2 hours and you will be provided with refreshments and snacks during the time.

RISKS AND INCONVIENCES

There are no foreseen physical or psychological risks to this study.

BENEFITS

In exchange for participating in the above outlined study you will receive 4 SRPP points for completing all the tasks.

CONFIDENTIALITY

All acquired information will be kept strictly confidential. Only the researcher will know your personal information and responses but will not disclose any personal information to the public. Participant information (i.e. names and student numbers) will be kept separate from the study data to ensure anonymity. Additionally, to ensure no association with the participant, any published data will be coded by a unique and independent participant number. Reports will only report aggregated (general) information, and you will not be identifiable in any report.

VOLUNTARY PARTICIPATION

Participation in this study is completely voluntary and you may withdraw from the study at any point in time. Withdrawing from the study will have no negative consequences for you and should you feel the desire to withdraw from the study you may do so without giving a reason. However, withdrawing from the study means you will not receive any SRPP points.

QUESTIONS AND FURTHER INFORMATION

Should you have any further questions with regards to this study, please feel free to contact me via email.
Primary Researcher: Kyra Scott (kyra.em.scott@gmail.com)

FURTHER CONTACT INFORMATION

SUPERVISOR	CO-SUPERVISOR	INDEPENDENT ETHICS COMMITTEE CONTACT
Colin Tredoux, Ph. D	Alicia Nortje, Ph. D	Rosalind Adams
Department of Psychology (UCT)	Department of Psychology (UCT)	Department of Psychology (UCT)
Colin.tredoux@uct.ac.za	Alicia.nortje@gmail.com	Rosalind.adams@uct.ac.za

By signing this form I acknowledge that I have read and understood the above information and hereby give consent to participate in the study described above.

NAME: ________________________ **COURSE FOR SRPP POINTS:** __________

SIGNATURE: ____________________

DATE: _________________________

Appendix H
Tarot-Card Reading: Script

TAROT READER: Hi, I'm **[Name]** and I'll be doing a Tarot reading for you today. Is this your first time having a Tarot reading?

PARTICIPANT: ** *Replies***

TAROT READER: [*Tarot reader starts arranging the Tarot deck into five piles placed in a pentagon shape on the* table] Well… Tarot helps you connect to your higher self, giving you divine insights to help you make sense of your reality. Tarot does not predict a definite future but may help with self-discovery and guidance. We will be doing a very general 5-card spread reading.

Before we start, let's center ourselves by closing our eyes and taking a deep breathe in and holding it for 3..2..1 and breath out. Open your eyes when you're feeling calm and are ready to begin.
Soo… let's see. How are you feeling at this moment?

PARTICIPANT: ***Replies***

TAROT READER: Okay, I see. Hopefully the reading today will give you some more insight into your spirit.

TAROT READER: [*Takes pile 1, shuffling pile and spreading pile out on the table*] This is the Major Arcana which represents the human spirit. It symbolizes important life events, lessons, or milestones. Now, from the cards spread out, please point to the card that speaks to you the most. [*Tarot Reader waves hands in front of the cards*]. ***After the participant indicates a card, the Tarot Reader gathers the spread cards into a pile again, placing the chosen card face up on the pile. The Tarot Reader then offers a brief explanation of the card***

TAROT READER: [*Takes pile 2, shuffling pile and spreading pile out on the table*] The Suit of Cups represents your feelings, emotions, intuition, and creativity. In particular, relating to your relationships and emotional connections with others. Now, from this spread, please point to the card that speaks to you the most. [*Tarot Reader waves hands in front of the cards*]. ***After the participant indicates a card, the Tarot Reader gathers the spread cards into a pile again, placing the chosen card face up on the pile. The Tarot Reader then offers a brief explanation of the card***

TAROT READER: [*Takes pile 3, shuffling pile and spreading pile out on the table*] The Suit of Wands represents your energy, motivation, and passion. In particular it refers to your creativity, will, and drive with regards to your life purpose and spirituality. Now, from this spread, please point to the card that speaks to you the most. [*Tarot Reader waves hands in front of the cards*]. ***After the participant indicates a card, the Tarot Reader gathers the spread cards into a pile again, placing the chosen card face up on the pile. The Tarot Reader then offers a brief explanation of the card***

TAROT READER: [*Takes pile 4, shuffling pile and spreading pile out on the table*] The Suit of Pentacles represents your career, finances, and work. This is usually the most rounded part of the reading. Now, from this spread, please point to the card that speaks to you the most. [*Tarot Reader waves hands in front of the cards*]. ***After the participant indicates a card, the Tarot Reader gathers the spread cards into a pile again, placing the chosen card face up on the pile. The Tarot Reader then offers a brief explanation of the card***

TAROT READER: [*Takes pile 5, shuffling pile and spreading pile out on the table*] The Suit of Swords represents your thoughts, words, and actions. It also symbolizes ideas and can be the most interesting part of a Tarot reading. Now, from this spread, please point to the card that speaks to you the most. [*Tarot Reader waves hands in front of the cards*]. ***After the participant indicates a card, the Tarot Reader gathers the spread cards into a pile again, placing the chosen card face up on the pile. The Tarot Reader then offers a brief explanation of the card***

TAROT READER: This concludes our Tarot card reading. I hope you found it thought provoking and inspiring.

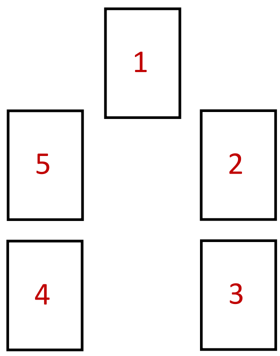


Diagram of deck layout for Tarot Reading.

Appendix I

Tarot-card Reading Survey

Please answer the following questions regarding the Tarot card reading:

1. On a scale of 1-10 how superstitious do you consider yourself ?
   Please indicate your rating by circling one of the numbers on the scale below:
   (1= not at all superstitious,5=moderately superstitious,10=highly superstitious)

1	2	3	4	5	6	7	8	9	10

2. Did you feel that the Tarot card reading was very personal ?
   Please indicate your answer by circling one of the numbers on the scale below.
   (1= not very personal at all, 5= averagely personal, 10= very personal)

1	2	3	4	5	6	7	8	9	10

3. Do you view yourself as a spiritual person?
   On the scale below, please indicate how spiritual you rate yourself as:
   (1=not at all spiritual, 5=averagely spiritual, 10=highly spiritual)

1	2	3	4	5	6	7	8	9	10

4. Did you feel that the Tarot card reading was a highly accurate portrayal of your life?
   Please indicate your answer by circling one of the numbers on the scale below.
   (1= not very accurate at all, 5=averagely accurate, 10= very accurate)

1	2	3	4	5	6	7	8	9	10

5. Did you find the Tarot card reading to be vague/ambiguous in any way ?
   Yes ☐ No ☐

5.1 If you indicated 'Yes' to the above question, please briefly describe which aspects of the reading you found to be vague/ambiguous.

………
………

6. Were there any aspects of the Tarot card reading that you felt were not very relevant to you as a person?
   Yes ☐ No ☐

6.1 If you indicated 'Yes' to the above question, please briefly describe which aspects of the reading you found to be non-relevant.

………
………

7. Please briefly describe what feelings you felt whilst participating in the Tarot card reading.

……
……
……

THANK YOU ☺

Appendix J

Debriefing Form: Gathering of Facial Identification Information

The Relationship between Format of Identification Information and Facial Identification Accuracy

Dear Participant

Thank you for participating in my study!

This study investigates how accurate facial identification information (such as facial descriptions, facial composites, and synthetic faces generated by a neural network) is in identifying the correct perpetrator of a crime. The following form will provide you with all relevant information concerning the study you have just participated in. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also verbally explain this study to you and answer any questions you may have.

The purpose of this study is to investigate whether the format of facial identification information (i.e. facial descriptions, facial composites, or synthetic faces) has an effect on facial identification accuracy. In other words, are some formats of identification information (i.e. descriptions, facial composites, or synthetic) more accurate in portraying the facial details of a perpetrator than other formats? If so, this would then allow for a greater level of accuracy in identifying the perpetrator of a crime.

During this study, you would have been required to engage in an individual Tarot card reading session with a 'Tarot Reader'. The Tarot session acted as an encoding period, allowing you to commit to memory the face of the 'Tarot Reader'. Following this, you would have had to provide two verbal facial descriptions and two facial composites (one for the 'Tarot Reader' and one for a second individual who would have been present for both the generation of the verbal description and composite construction). The questionnaire you completed after the Tarot reading as well as the computer game you played at intervals during the study acted as a distractor task to reduce practice effects and interference between the two target faces ('Tarot Reader' and second individual). This whole procedure should have taken 1 hour 30 min – 2 hours and you will receive 4 SRPP points for your participation.

Please take note, deception was used in this study as initially you would not have been aware that this is a facial recognition study but have thought you were having a Tarot card reading as part of a study exploring the Barnum Effect. This was done to ensure that you were not prompted to consciously memorize the Tarot Reader's face for later recognition as most crimes tend to be unexpected and witnesses do not make a conscious effort to memorize the perpetrator's face.

Please further note that all participant information will remain confidential and anonymous. Additionally, please refrain from disclosing any details of this study to anyone else, as this may bias future participants and their performance.

Should you have any further questions regarding this study or be interested in this research please feel free to contact me (the principal researcher) on my email given below.

PRINCIPAL RESEARCHER, SUPERVISORS AND ETHICS COMMITTEE CONTACT INFORMATION

PRINCIPAL RESEARCHER	SUPERVISOR	CO-SUPERVISOR
Kyra Scott, Honours Department of Psychology (UCT) Kyra.em.scott@gmail.com	Colin Tredoux, Ph. D Department of Psychology (UCT) Colin.tredoux@uct.ac.za	Alicia Nortje, Ph. D Department of Psychology (UCT) Alicia.nortje@gmail.com

INDEPENDENT ETHICS COMMITTEE CONTACT

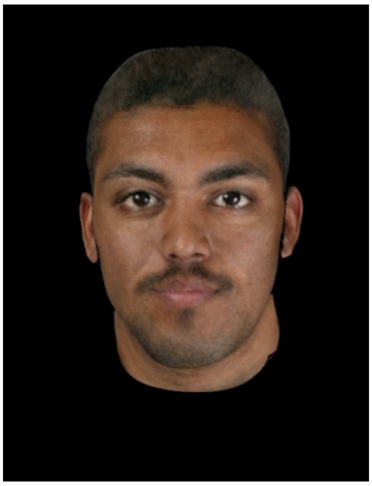
Rosalind Adams
Department of Psychology (UCT)
Rosalind.adams@uct.ac.za

Appendix K

Facial Identification Information Samples

Photograph of Target B

Computer generated description-based synthetic face of target B



Human constructed ID-composite of target B

<u>Example of transcribed facial description for target B:</u>

"Dark skin. Dark eyes. Facial hair but not prominent facial hair, more like a shadow. Dark hair in a bun. Maybe a square shaped face."

Appendix L
Ethical Considerations

Consent and Confidentiality

Participation in the study was voluntary and informed consent was given before engaging in the study via reading and signing a consent form.
Participants were briefed on their right to withdraw from the study at any stage, without justification or penalty, and all participant information will remain confidential. Additionally, data was organized according to a participant number and encrypted to ensure further confidentiality and anonymity.

Risks and Benefits

No foreseeable risks was associated with the study. During the gathering of facial identification information individuals may have felt cheated as deception concerning the nature of the study was initially present to control for subject-expectancy effects and priming, which could negatively impact results. However, the nature of the study and reason for deceit was explained immediately after the Tarot-card reading.

Individuals who participated in the gathering of facial identification information received 4 SRPP points.

Debriefing

All participants were emailed a debriefing form with the researcher's contact information after completing the study. Participants were also encouraged to contact the researcher should they have further questions regarding the study.

Appendix M

Ethical Approval Letter

UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3417
Fax No. (021) 650 4104

13 September 2019

Kyra Scott
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Kyra

I am pleased to inform you that ethical clearance has been given by an Ethics Review Committee of the Faculty of Humanities for your study, *The Relationship between Format of Facial-Identification Information and Identification Accuracy*. The reference number is PSY2019-051.

I wish you all the best for your study.

Yours sincerely

Lauren Wild (PhD)
Associate Professor
Chair: Ethics Review Committee

University of Cape Town
ΨPSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch

Appendix N

Participant Consent Form: Online Study

Thank you for showing an interest in this study!
This study investigates the relationship between facial identification information and subsequent identification accuracy, to evaluate how effective facial descriptions, facial composites and synthetic faces are in correctly identifying the perpetrators of crimes. This study is being conducted as part of my Psychology Honours degree at the University of Cape Town. Before participating in the study please carefully read the text below.

PROCEDURE

You will have to complete three facial identification tasks. This will take approximately 30-45 minutes to finish. You will be presented with a set of 24 faces and facial identification information (either a facial description or facial composite or synthetic face generated by a neural network), where you will first be asked to eliminate all faces from the face set that you believe do not resemble to facial identification information. Secondly, you will be required to rank the faces in the face set from least likely to best likely to match the provided facial identification information. You will complete both of these tasks three times, once for each type of facial identification information (i.e., facial description, composite, and description-generated synthetic face) along with answering a few questions relating to the facial identification task.

RISKS AND INCONVIENCES

There are no foreseen physical or psychological risks to this study.

CONFIDENTIALITY

All acquired information will be kept strictly confidential. Only the researcher will know your personal information and responses but will not disclose any personal information to the public. Participant information (e.g., names and date of birth) will be kept separate from the study data to ensure anonymity. Additionally, to ensure no association with the participant, any published data will be coded by a unique and independent participant number. Reports will only report aggregated (general) information, and you will not be identifiable in any report.

VOLUNTARY PARTICIPATION

Participation in this study is completely voluntary and you may withdraw from the study at any point in time. Withdrawing from the study will have no negative consequences for you and should you feel the desire to withdraw from the study you may do so without giving a reason.

QUESTIONS AND FURTHER INFORMATION

Should you have any further questions with regards to this study, please feel free to contact me via email.
Researcher: Kyra Scott (kyra.em.scott@gmail.com)

FURTHER CONTACT INFORMATION

SUPERVISOR	CO-SUPERVISOR	INDEPENDENT ETHICS COMMITTEE CONTACT
Colin Tredoux, Ph. D	Alicia Nortje, Ph. D	Rosalind Adams
Department of Psychology (UCT)	Department of Psychology (UCT)	Department of Psychology (UCT)
Colin.tredoux@uct.ac.za	Alicia.nortje@gmail.com	Rosalind.adams@uct.ac.za

By clicking the 'next button' below I acknowledge that I have read and understood the above information and hereby give consent to participate in the study described above.

Name: ________________
*Date:*________________

Appendix O

Participant Demographic Form

PARTICIPANT DEMOGRAPHIC INFORMATION

Please fill out the following details:

Age: ______________

Gender:
☐ Male
☐ Female

Nationality: ____________________

*if you're not South African, how long have you lived in South Africa for? ____________________

Race:
☐ Asian
☐ Black
☐ Caucasian
☐ Coloured
☐ Other ______________________

Appendix P

Debriefing Form: Online Study

The Relationship between Format of Identification Information and Facial Identification Accuracy

Dear Participant

Thank you for participating in my study!

This study investigates how accurate facial identification information (such as facial descriptions, facial composites, and synthetic faces generated by a neural network) is in identifying the correct perpetrator of a crime. The following form will provide you with all relevant information concerning the study you have just participated in.

The purpose of this study is to investigate whether the format of facial identification information (i.e. facial descriptions, facial composites, or synthetic faces) has an effect on facial identification accuracy. In other words, are some formats of identification information (i.e. descriptions, facial composites, or synthetic) more accurate in portraying the facial details of a perpetrator than other formats? If so, this would then allow for a greater level of accuracy in identifying the perpetrator of a crime.

During this study, you would have been required to complete three online facial identification tasks, where you would have been presented with a set of 24 faces alongside a facial description/facial composite/description-based synthetic face and were instructed to eliminate faces from that you thought were unlikely to match the given facial identification information. Additionally, you would have also been requested to rank the set of 24 faces from least likely to most likely to match the provided facial identification information, where the last remaining face would have been the face that you believed held the most likely resemblance to the identification information. This should have taken approximately 30-45 minutes.

Please take note that no deception was used in this study and that all participant information will remain confidential and anonymous. Additionally, please refrain from disclosing any details of this study to anyone else, as this may bias future participants and their performance.

Should you have any further questions regarding this study or be interested in this research please feel free to contact me (the principal researcher) on my email given below.

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Appendix Q

Illustration of the Online Study Procedure

Online Study Procedure (*N*=140)

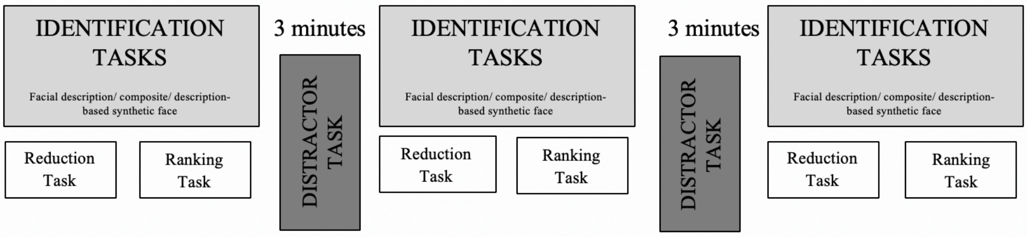

Figure 8. Illustration of the study procedure for the online study. Participants were randomly exposed to only one of the two targets and assigned to either facial identification information that had been produced in-view of a target or facial identification information that had been produced from memory (in absence of the target). Participants were exposed to all three types of facial identification information (i.e., facial descriptions, composites, description-based synthetic faces) and randomly assigned a one piece of facial identification information per type. Participants were presented with a 6x4 face matrix that had the target's face present alongside one facial identification information piece (facial description, facial composite, or synthetic face) relating to the respective target, and required to complete two identification tasks three times, once per each type of facial identification information. The identification tasks consisted of a reduction task, where participants had to eliminate faces unlikely to match the given facial identification information, and a ranking task where participants had to rank faces from least likely to most likely to match the provided facial identification information.

Note. Order of presentation of the identification-task for each type of facial identification information format were counterbalanced according on facial identification information format type (i.e., facial description, composite, description-based synthetic face).