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# Facial Comparison Overview and Methodology Guidelines



## 1. Scope

1.1 The purpose of this document is to provide guidelines and recommendations for conducting comparisons of faces unfamiliar to the practitioner.

1.2 Units—The values stated in Standard International (SI) units are to be regarded as standard. The values given in parentheses are mathematical conversions to non-SI units that are provided for information only.

1.3 *This standard* does *not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards*:

E2916 Terminology for Digital and Multimedia Evidence Examination

E3148 Standard Guide for Facial Image Comparison Feature List for Morphological Analysis

E3115 Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems

2.2 Other Standard *Documents*:

FISWG Recommendations for a Training Program in Facial Comparison

FISWG Guidelines and Recommendations for Facial Comparison Training to Competency

SWGDE Technical Overview for Forensic Image Comparison

## 2.3 Other Referenced Documents:

Biederman, I., & Kalocsai, P. (1997). Neurocomputational bases of object and face recognition. Philosophical Transactions of the Royal Society B: Biological Sciences 352(1358), 1203-1219.

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Moreton, R. and Morley, J., Investigation into the use of photoanthropometry in facial image comparison. Forensic Science International, 212, 231-237, 2011.

Penry, J., Looking at faces and remembering them: a guide to facial identification, Elek, 1971.

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Ritz-Timme, S., Gabriel, P., Obertovà, Z., Boguslawski, M., Mayer, F., Drabik, A., Poppa, P., De Angelis, D., Ciaffi, R., Zanotti, B., Gibelli, D., Cattaneo, C., A new atlas for the evaluation of facial features: advantages, limits, and applicability, International Journal of Legal Medicine, 125, 2, 301-306, 2010.

Towler, A., White, D., & Kemp, R. I. (in press). Evaluating the feature comparison strategy for forensic face identification. Journal of Experimental Psychology: Applied.

Vanezis, P., Lu, D., Cockburn, J., Gonzalez, A., McCombe, G., Trujillo, O., Vanezis M., Morphological classification of facial features in adult caucasian males based on an assessment of photographs of 50 subjects, Journal of Forensic Sciences, 41, 786-791, 1996.

## 3. Terminology

3.1 *Definitions:* See Terminology E2916 for digital and multimedia evidence examination terms.

3.2 Acronyms

## 4. Summary of Guide

4.1 This document reviews general types of facial comparisons, methods, human ability, and applications of facial comparison.

4.2 This document provides recommendations for general practices and methodologies to conduct facial comparisons.

## 5. Significance and Use

5.1 Facial comparison is a manual process undertaken by a human and used in different applications involving different levels of evaluation according to the purpose of the comparison.

5.1.1 A facial comparison in these applications generally involves faces that are unfamiliar to the person undertaking the comparison.

5.1.2 Most applications fall primarily into one of the following four categories, however crossover may exist.

5.1.2.1 **Intelligence Gathering for Identity Management** comparisons are a component of the compilation of information relating to what is believed to be a single subject, even if the identity of the subject is not known.

5.1.2.2 **Screening and Access Control** includes both image-to-image and image-to-person comparisons. Both occur in a high throughput environment and are thus limited in time (e.g., customs and immigration checkpoints).

5.1.2.3 **Investigative and Operational Leads** comparisons provide information, generally not intended for presentation in court, to assist operational personnel with meeting their objective (e.g., comparing an unknown subject featured in one or many images to images of known subjects to provide investigators with a potential name for a crime suspect).

5.1.2.4 **Forensic** comparisons provide information to assist a trier of fact (e.g., judge or jury).

5.2 There are three broad categories of facial comparison: assessment, review, and examination.

5.2.1 **Assessment** is a quick comparison of image-to-image or image-to-person typically carried out in screening and access control applications. Due to time constraints, assessment is the least rigorous of all of the facial comparison categories.

5.2.2 **Review** is a comparison of image-to-image often used in either investigative and operational leads or intelligence gathering applications. Review encompasses a broad range of purposes and levels of rigor involved in the analysis, though it is by nature more rigorous than the assessment process. In some cases, review may warrant a verification by a second reviewer.

5.2.3 **Examination** is a comparison of image(s)-to-image(s) often used in a forensic application. An independent technical review or verification by at least one additional examiner should be conducted.

5.3 There are three comparison methodologies (morphological analysis, superimposition, and photo-anthropometry) currently recognized in facial comparison. The method used for a facial comparison depends on the category and the application of the comparison.

## 6. Comparison Methodologies Guidelines

6.1 Depending on the application of the comparison, procedures may include some or all of the following steps: Analysis, Comparison, Evaluation, and Verification (referred to as ACE-V). As stated above, verification should be carried out in both facial review and facial examination.

6.2 **Morphological Analysis (in some form) should be the primary approach used for facial comparison in all categories: assessment, review, and examination.**

6.2.1 Morphological Analysis is the method of facial comparison in which the features and components of the face are compared. Conclusions in relation to similarity or difference are based on subjective assessment, evaluation, and interpretation of observations.

6.2.2 Morphological analysis is based on the evaluation of the correspondence among facial features, components and their respective component characteristics (presence, shape, appearance, symmetry, location, relative proportion, etc.). Features include those corresponding to the overall face, anatomical structures such as the nose or ear and their components (e.g.,

nose bridge, nostrils, ear lobes, helix), and discriminating characteristics, such as scars, marks and tattoos. The E3149 “Standard Guide for Facial Image Comparison Feature List for Morphological Analysis” provides a standard list of facial components and component characteristics to be assessed and evaluated during a morphological analysis. This methodology is used during the Analysis and Comparison steps in the ACE-V process.

6.2.3 The morphological analysis process does not rely on the classification or categorization of features (e.g., round face, Roman nose). Classification schemes have been proven to create inter-observer differences and are therefore not best practice (Iscan, 1993; Penry, 1971; Ritz-Timme et al., 2010; Vanezis et al., 1996).

6.2.4 Documentation of a morphological analysis will vary depending on the application of comparison undertaken. Screening and access control applications apply a more basic level of morphological analysis and at this level documentation of the decision-making process is generally not required. On the other hand, when using morphological analysis for facial examination as in a forensic application, the examination and decision-making process should be fully documented and include an independent technical review (verification or peer review).

6.2.5 Morphological analysis is highly dependent on the quality and quantity of the facial features and characteristics that can be compared, which is in turn dependent on the quality of the image. Image quality can be affected by factors such as image resolution, lighting, focus, pose, angle, orientation, obstructions of facial features, etc.

6.2.6 The Morphological analysis method requires training consistent with the category of comparison carried out.

6.2.7 Using a standardized checklist has been shown to be beneficial during an examination Towler, A., White, D., & Kemp, R. I.).

6.3 **Superimposition** is the process of creating an overlay of two aligned images and comparing them visually.

6.3.1 Superimposition should be used *only* as an aid to visual comparison and must be used in conjunction with morphological analysis and must never be used as a stand-alone approach for facial image comparison.

6.3.2 Superimposition can be applied only when two images are taken from the same viewpoint (images may be photographs, frames or images from video, or images synthesized from 3D face or head models). Images must be aligned (e.g., scaled, rotated, etc.) with each other. There should be a

concordance between images in all aspects of angle and perspective to avoid distortion of the spatial distribution of facial features and characteristics. Practitioners must only use tools which preserve shapes and may not use image processing techniques which may skew the images, facial proportions and shapes.

6.3.3 Since superimposition is sensitive to image quality, both images need to be captured under optimal conditions (as defined by E3115) or the use of the method may be misleading. Loss of image quality through blurring, compression artifacts, reduction in spatial resolution (e.g., number of pixels between the pupils), lens distortion, perspective distortion, etc. reduces the ability to determine the specific location of individual features, which subsequently reduces the ability to generate an accurate overlay/superimposition.

6.3.4 In cases where there are multiple copies of the same original image (e.g., forged identity documents), superimposition may be carried out on images displaying less than optimal quality.

6.4 **Photo-anthropometry** *must* not *be used* for facial comparison in any categories: assessment, review, and examination.

6.4.1 Photo-Anthropometry is the measurement of dimensions and angles of anthropological landmarks and other facial features visible in an image in order to quantify characteristics and proportions. The measurements taken from one image are compared to the measurements taken from a separate facial image. Conclusions are based on subjective thresholds for acceptable differences between measurements.

6.4.2 As in superimposition, photo-anthropometry is highly sensitive to image quality factors including but not limited to resolution, focus, distortion, obscuration, viewpoint, lighting, and pose. In addition, the following information should be known about the compared images prior to conducting the comparison: focal length, lens distortion and subject distance. Given the uncontrolled conditions under which many questioned images (e.g., CCTV images) are captured, it is often not possible to define a threshold boundary for similarity or dissimilarity.

6.4.3 Research on the use of anthropometric comparison has shown that photo-anthropometry has limited discriminating power and may be misleading (Evison et al., 2010; Kleinberg, 2007; Moreton and Morley, 2011).

6.4.4 The limitations described above regarding image requirements preclude the use of photo-anthropometry in any facial comparison. This technique should not be used as an independent comparison method or in conjunction with another method.

6.5 **Apart from the methods described above,** holistic comparison (i.e., the innate human ability to compare faces) will take place. It should be stressed that holistic comparison is not a method. Human ability for holistic comparison is highly variable and is dependent on a multitude of factors including, but not limited to, personal ability and familiarity with the subject. Studies have shown that human ability to compare unfamiliar faces is highly prone to error whereas comparison of familiar faces may be carried out accurately even when image conditions are poor. (Biederman & Kalocsai, 1997; Maurer, Le Grand, & Mondloch, 2002; Rossion, 2008).

## 7. Summary of Recommendations

7.1 Morphological analysis method is the best practice for facial comparison. When conducting morphological analysis for facial comparison, and the application warrants, the examination and decision-making process should be fully documented.

7.2 In the ACE-V process, morphological analysis is utilized during the analysis and comparison steps. Conclusions are based on the results of the morphological comparison. Additionally, an independent technical review or check (verification or peer review) should be conducted on all documented observations relating to facial examinations.

7.3 Superimposition should only be used in conjunction with morphological analysis.

7.4 Photo-anthropometry must not be used for facial image comparison.