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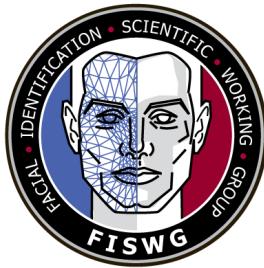
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Facial Comparison Overview and Methodology Guidelines

1. Scope

- 1.1 The purpose of this document is to provide guidelines and recommendations to the practitioner for conducting facial comparisons.
- 1.2 This standard does not purport to address all 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:¹
- E2916 Terminology for Digital and Multimedia Evidence Examination
 - E3149 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:^{2,3}
- 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

¹ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

² For referenced FISWG documents, visit www.fiswg.org.

³ Available from Scientific Working Group on Digital Evidence (SWGDE), www.swgde.org.

- 20 2.3 Other Referenced Documents:
- 21 Biederman, I., & Kalocsai, P. (1997). Neurocomputational bases of object and face
22 recognition. Philosophical Transactions of the Royal Society B: Biological Sciences
23 352(1358), 1203-1219.
- 24 Bruce, V., Henderson, Z., Greenwood, K., Hancock, P., Burton, A., Miller, P.,
25 Verification of face identities from images captured on video, Journal of Experimental
26 Psychology: Applied, 5, 339-360, 1999.
- 27 Bruce, V., Henderson, Z., Newman, C., Burton, A. M., Matching identities of familiar
28 and unfamiliar faces caught on CCTV images, Journal of Experimental Psychology:
29 Applied, 7, 207-218, 2001.
- 30 Burton, A. M., Wilson, S., Cowan, M., Bruce, V., Face recognition in poor-quality
31 video: evidence from security surveillance, Psychological Science, 10, 243-248, 1999.
- 32 Butavicius, M., Mount, C., MacLeod, V., Vast, R., Graves, I., Sunde, J., An experiment
33 on human face recognition performance for access control, Knowledge-Based Intelligent
34 Information and Engineering Systems, 12th International Conference KES, 141-148,
35 2008.
- 36 Edmond, G., Biber, K., Kemp, R., Porter, G., Law's looking glass: expert identification
37 evidence derived from photographic and video images, Current Issues in Criminal
38 Justice, 20, 337-377, 2009.
- 39 Henderson, Z., Bruce, V., & Burton, A. M., Matching the faces of robbers captured on
40 video, Applied Cognitive Psychology, 15, 445-464, 2001.
- 41 Hill, H. and Bruce, V, Effects of lighting on matching facial surfaces, Journal of
42 Experimental Psychology: Human Perception and Performance, 22, 986-1004, 1996.
- 43 Iscan, M.Y. and Helmer, R.P. (ed.), Forensic analysis of the skull: craniofacial
44 analysis, reconstruction, and identification, Wiley-Liss, 57-70, 1993.
- 45 Kemp, R., Towell, N., Pike, G., When seeing should not be believing: photographs,
46 credit cards and fraud, Applied Cognitive Psychology, 11, 211-222, 1997.
- 47 Lee, W.J., Wilkinson, C.M., Memon, A., Houston, K., Matching unfamiliar faces from
48 poor quality closed-circuit television (CCTV) footage: an evaluation of the effect of
49 training on facial identification ability, AXIS, 1, 1, 19-28, 2009.
- 50 Maurer, D., Le Grand, R., & Mondloch, C. J. (2002). The many faces of configural
51 processing. Trends in Cognitive Sciences, 6(6).
- 52 Megreya, A.M. and Burton, A.M., Unfamiliar faces are not faces: evidence from a
53 matching task, Memory & Cognition, 34, 865-876, 2006.
- 54 Penry, J., Looking at faces and remembering them: a guide to facial identification,
55 Elek, 1971.
- 56 Rossion, B. (2008). Picture-plane inversion leads to qualitative changes of face
57 perception. Acta Psychologica, 128(2), 274-289.

- 58 Ritz-Timme, S., Gabriel, P., Obertovà, Z., Boguslawski, M., Mayer, F., Drabik, A.,
59 Poppa, P., De Angelis, D., Ciaffi, R., Zanotti, B., Gibelli, D., Cattaneo, C., A new atlas for
60 the evaluation of facial features: advantages, limits, and applicability, International
61 Journal of Legal Medicine, 125, 2, 301-306, 2010.
- 62 Vanezis, P., Lu, D., Cockburn, J., Gonzalez, A., McCombe, G., Trujillo, O., Vanezis M.,
63 Morphological classification of facial features in adult caucasian males based on an
64 assessment of photographs of 50 subjects, Journal of Forensic Sciences, 41, 786-791,
65 1996.

66 **3. Terminology**

67 3.1 Definitions: See Terminology E2916 for digital and multimedia evidence
68 examination terms.

69 **4. Summary of Guide**

70 4.1 This document reviews general types of facial comparisons, methods, and
71 applications of facial comparison.

72 4.2 This document provides recommendations for general practices and
73 methodologies to conduct facial comparisons.

74 **5. Significance and Use**

75 5.1 Facial comparison is a manual process conducted by a human which entails
76 identifying similarities and differences between two images or an image and a live
77 subject to determine whether they represent the same person.

78 5.1.1 Practitioners conduct facial comparisons to support different applications for the
79 purpose of identity verification. The application, purpose, and resources available for a
80 facial comparison task determine which category of facial comparison should be
81 conducted.

82 5.1.2 Most applications fall primarily into one of the following four categories, however
83 crossover may exist.

84 **5.1.2.1 Intelligence Gathering for Identity Management** comparisons is a component
85 of the compilation of information relating to what is **believed** to be a single subject, even
86 if the identity of the subject is not known.

87 **5.1.2.2 Screening and Access Control** includes both image-to-image and image-to-
88 person comparisons. Both occur in a high throughput environment and are thus limited
89 in time (e.g., customs and immigration checkpoints).

90 **5.1.2.3 Investigative and Operational Leads** comparisons provide information,
91 generally not intended for presentation in court, to assist operational personnel with
92 meeting their objective (e.g., comparing an unknown subject featured in one or many

93 images to images of known subjects to provide investigators with a potential name for a
94 crime suspect).

95 **5.1.2.4 Forensic comparisons** provide information to assist a trier of fact (e.g., judge
96 or jury).

97 5.2 There are three broad categories of facial comparison: assessment, review, and
98 examination.

99 **5.2.1 Assessment** is a quick real time comparison of image-to-image or image-to-
100 person typically carried out in screening and access control applications. Due to time
101 constraints, assessment is often undocumented and is considered the least rigorous of
102 all the facial comparison categories.

103 **5.2.2 Review** is a comparison of image-to-image often used in either investigative
104 and operational leads or intelligence gathering applications. A broad range of purposes
105 and levels of rigor are involved in review, though it is by nature more rigorous than the
106 assessment process and may require some level of documentation. An independent
107 technical review should be conducted.

108 **5.2.3 Examination** is a comparison of image(s)-to-image(s) often used in a forensic
109 application. Examination is the most rigorous category of facial comparison and typically
110 requires more detailed documentation. An independent technical review should be
111 conducted.

112 5.3 There are three comparison methods (morphological analysis, superimposition,
113 and photo-anthropometry) currently recognized in facial comparison.

114 **6. Comparison Methodology Guidelines**

115 6.1 Depending on the application of the comparison, procedures may include some
116 or all of the following steps: Analysis, Comparison, Evaluation, and Verification (referred
117 to as ACE-V). As stated above, verification should be carried out in both facial review
118 and facial examination.

119 **6.2 Morphological analysis** is direct comparison of class and individual facial
120 characteristics without explicit measurement. The method of facial comparison in which
121 the features and components of the face are compared.

122 6.2.1 Morphological analysis (in some form) should be the primary approach used for
123 facial comparison in all categories: assessment, review, and examination. Opinions in
124 relation to similarity or difference are based on subjective assessment, evaluation, and
125 interpretation of observations.

126 6.2.2 Morphological analysis is based on the evaluation of the correspondence
127 among facial features, components and their respective component characteristics
128 (presence, shape, appearance, symmetry, location, relative proportion, etc.). Features
129 include those corresponding to the overall face, anatomical structures such as the nose
130 or ear and their components (e.g., nose bridge, nostrils, ear lobes, helix), and

131 discriminating characteristics, such as scars, marks and tattoos. The E3149 "Standard
132 Guide for Facial Image Comparison Feature List for Morphological Analysis" provides a
133 standard list of facial components and component characteristics to be assessed and
134 evaluated during a morphological analysis. This methodology is used during the
135 Analysis and Comparison steps in the ACE-V process.

136 6.2.3 The morphological analysis process should not rely on classification schemes
137 (e.g., round face, Roman nose) which result in interobserver differences and are,
138 therefore, not best practice (Iscan, 1993; Penry, 1971; Ritz-Timme et al., 2010; Vanezis
139 et al., 1996).

140 6.2.4 Documentation of a morphological analysis is required. Documentation
141 processes will depend on the agency guidelines and application of comparison
142 undertaken. Screening and access control applications apply a more basic level of
143 morphological analysis, therefore, documentation of the decision-making process is
144 generally not required. Alternatively, when using morphological analysis for facial
145 examination as in a forensic application, the examination and decision-making process
146 should be fully documented and include an independent technical review.

147 6.2.5 Morphological analysis is **highly dependent** on the quality and quantity of the
148 facial features and characteristics that can be compared. Image quality can be affected
149 by factors including, but not limited to, image resolution, lighting, focus, pose, angle,
150 orientation, and obstructions of facial features.

151 6.2.6 The morphological analysis method requires training consistent with the
152 category of the comparison carried out.

153 6.3 **Superimposition** is the process of creating an overlay of two aligned images and
154 comparing them visually.

155 6.3.1 Superimposition is *only* used in conjunction with morphological analysis. It shall
156 never be used as a stand-alone approach for facial image comparison.

157 6.3.2 Superimposition can be applied only when two images are taken from the same
158 viewpoint (images may be photographs, frames or images from video, or images
159 synthesized from 3D face or head models). Images are aligned (e.g., scaled, rotated)
160 with each other. There should be a concordance between images in all aspects of angle
161 and perspective to avoid distortion of the spatial distribution of facial features and
162 characteristics. Practitioners use tools which preserve shapes and shall not use image
163 processing techniques which may skew the images, facial proportions, or shapes.

164 6.3.3 Since superimposition is sensitive to image quality, both images should be
165 captured under optimal conditions (as defined by E3115) or the use of this method may
166 be misleading. Loss of image quality through blurring, compression artifacts, reduction
167 in spatial resolution (e.g., number of pixels between the pupils), lens distortion,
168 perspective distortion, etc. reduces the ability to determine the specific location of
169 individual features, which subsequently reduces the ability to generate an accurate
170 overlay/superimposition.

171 6.3.4 In cases where there are multiple copies of the same original image (e.g.,
172 forged identity documents), superimposition may be carried out on images displaying
173 less than optimal quality.

174 6.4 **Photo-anthropometry** is the measurement of dimensions and angles of
175 anthropological landmarks and other facial features visible in an image in order to
176 quantify characteristics and proportions. The measurements taken from one image are
177 compared to the measurements taken from a separate facial image.

178 6.4.1 Photo-anthropometry shall not be used for facial comparison in any categories:
179 assessment, review, or examination.

180 6.4.2 As in superimposition, photo-anthropometry is highly sensitive to image
181 capture and quality factors including but not limited to resolution, focus, distortion,
182 obscuration, viewpoint, lighting, and pose. In addition, the following information should
183 be known about the images prior to conducting the comparison: focal length, lens
184 distortion and subject distance. Photo-anthropometry should only be conducted when
185 the image capture and quality factors of the images being compared are controlled and
186 are the same. Given the uncontrolled conditions under which many questioned images
187 (e.g., security camera images) are captured, it is often not possible to conduct a
188 proper photo-anthropometric comparison.

189 6.4.3 The limitations described above regarding image requirements preclude the use
190 of photo-anthropometry in any facial comparison. This technique should not be used as
191 an independent comparison method or in conjunction with another method. (Evison et
192 al., 2010; Kleinberg, 2007; Moreton and Morley, 2011)

193 6.5 Apart from the methods described above, **holistic process** (i.e., the innate
194 human ability to compare faces) will take place. It should be stressed that holistic
195 process is not a method. Human ability for holistic face comparison is highly variable
196 and is dependent on a multitude of factors including, but not limited to, personal ability
197 and familiarity with the subject. Studies have shown that human ability to compare
198 unfamiliar faces is highly prone to error whereas comparison of familiar faces may be
199 carried out accurately even when image conditions are poor. (Biederman & Kalocsai,
200 1997; Maurer, Le Grand, & Mondloch, 2002; Rossion, 2008).

201 7. Summary of Recommendations

202 7.1 Morphological analysis method is considered to be the best practice by the Facial
203 Identification community for facial comparison. When conducting morphological analysis
204 for facial comparison, and the application warrants, the examination and decision-
205 making process should be fully documented.

206 7.2 In the ACE-V process, morphological analysis is utilized during the analysis and
207 comparison steps. Opinions are based on the results of the morphological comparison.
208 Additionally, an independent technical review or check (verification or peer review)
209 should be conducted on all documented observations relating to facial examinations.

210 7.3 Superimposition shall only be used in conjunction with morphological analysis.
211 Photo-anthropometry shall not be used for facial image comparison.

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