

OSAC 2022-S-0007 Standard Guide for Facial Comparison Overview and Methodology Guidelines

*Facial Identification Subcommittee
Digital/Multimedia Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science*





Draft OSAC Proposed Standard

OSAC 2022-S-0007 *Standard Guide for Facial Comparison Overview and Methodology Guidelines*

Prepared by
Facial Identification Subcommittee
Version: 1.0
December 2021

Disclaimer:

This OSAC Proposed Standard was written by the Facial Identification Subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science following a process that includes an [open comment period](#). This Proposed Standard will be submitted to a standards developing organization and is subject to change.

There may be references in an OSAC Proposed Standard to other publications under development by OSAC. The information in the Proposed Standard, and underlying concepts and methodologies, may be used by the forensic-science community before the completion of such companion publications.

Any identification of commercial equipment, instruments, or materials in the Proposed Standard is not a recommendation or endorsement by the U.S. Government and does not imply that the equipment, instruments, or materials are necessarily the best available for the purpose.

To be placed on the OSAC Registry, certain types of standards first must be reviewed by a Scientific and Technical Review Panel (STRP). The STRP process is vital to OSAC's mission of generating and recognizing scientifically sound standards for producing and interpreting forensic science results. The STRP shall provide critical and knowledgeable reviews of draft standards or of proposed revisions of standards previously published by standards developing organizations (SDOs) to ensure that the published methods that practitioners employ are scientifically valid, and the resulting claims are trustworthy.

The STRP panel will consist of an independent and diverse panel, including subject matter experts, human factors scientists, quality assurance personnel, and legal experts, which will be tasked with evaluating the proposed standard based on a comprehensive list of science-based criteria.

For more information about this important process, please visit our website at: <https://www.nist.gov/topics/organization-scientific-area-committees-forensic-science/scientific-technical-review-panels>.

Standard Guide for 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 This document reviews general types of facial comparisons, methods, human ability, and applications of facial comparison and provides recommendations for general practices and methodologies to conduct facial comparisons.

1.3 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.

1.4 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

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

[OSAC Overview of ACE-V Document Placeholder]

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.

Bruce, V., Henderson, Z., Greenwood, K., Hancock, P., Burton, A., Miller, P., Verification of face identities from images captured on video, *Journal of Experimental Psychology: Applied*, 5, 339-360, 1999.

- 40 Bruce, V., Henderson, Z., Newman, C., Burton, A. M., Matching identities of familiar and
41 unfamiliar faces caught on CCTV images, *Journal of Experimental Psychology: Applied*,
42 7, 207-218, 2001.
- 43 Burton, A. M., Wilson, S., Cowan, M., Bruce, V., Face recognition in poor-quality video:
44 evidence from security surveillance, *Psychological Science*, 10, 243-248, 1999.
- 45 Butavicius, M., Mount, C., MacLeod, V., Vast, R., Graves, I., Sunde, J., An experiment on
46 human face recognition performance for access control, *Knowledge-Based Intelligent
47 Information and Engineering Systems*, 12th International Conference KES, 141-148,
48 2008.
- 49 Edmond, G., Biber, K., Kemp, R., Porter, G., Law's looking glass: expert identification
50 evidence derived from photographic and video images, *Current Issues in Criminal Justice*,
51 20, 337-377, 2009.
- 52 Evison, M., Dryden, I., Fieller, N., Mallett, X., Morecroft, L., Schofield, D., Vorder
53 Bruegge, R., Key parameters of face shape variation in 3D in a large sample, *Journal of
54 Forensic Science*, 55, 159-162, 2010.
- 55 Henderson, Z., Bruce, V., & Burton, A. M., Matching the faces of robbers captured on
56 video, *Applied Cognitive Psychology*, 15, 445-464, 2001.
- 57 Hill, H. and Bruce, V., Effects of lighting on matching facial surfaces, *Journal of
58 Experimental Psychology: Human Perception and Performance*, 22, 986-1004, 1996.
- 59 Iscan, M.Y. and Helmer, R.P. (ed.), *Forensic analysis of the skull: craniofacial analysis,
60 reconstruction, and identification*, Wiley-Liss, 57-70, 1993.
- 61 Kemp, R., Towell, N., Pike, G., When seeing should not be believing: photographs, credit
62 cards and fraud, *Applied Cognitive Psychology*, 11, 211-222, 1997.
- 63 Kleinberg, K.F., Vanezis, P., Burton, A.M., Failure of anthropometry as a facial
64 identification technique using high-quality photographs, *Journal of Forensic Science*, 52,
65 779-783, 2007.
- 66 Lee, W.J., Wilkinson, C.M., Memon, A., Houston, K., Matching unfamiliar faces from
67 poor quality closed-circuit television (CCTV) footage: an evaluation of the effect of
68 training on facial identification ability, *AXIS*, 1, 1, 19-28, 2009.
- 69 Maurer, D., Le Grand, R., & Mondloch, C. J. (2002). The many faces of configural
70 processing. *Trends in Cognitive Sciences*, 6(6).
- 71 Megreya, A.M. and Burton, A.M., Unfamiliar faces are not faces: evidence from a
72 matching task, *Memory & Cognition*, 34, 865-876, 2006.
- 73 Moreton, R. and Morley, J., Investigation into the use of photoanthropometry in facial
74 image comparison. *Forensic Science International*, 212, 231-237, 2011.
- 75 Penry, J., *Looking at faces and remembering them: a guide to facial identification*, Elek,
76 1971.
- 77 Rossion, B. (2008). Picture-plane inversion leads to qualitative changes of face perception.
78 *Acta Psychologica*, 128(2), 274-289.

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

83 Towler, A., White, D., & Kemp, R. I. (2017). Evaluating the feature comparison strategy
84 for forensic face identification. *Journal of Experimental Psychology: Applied*, 23(1), 47-
85 58. doi:<http://dx.doi.org/10.1037/xap0000108>.

86

87 Vanezis, P., Lu, D., Cockburn, J., Gonzalez, A., McCombe, G., Trujillo, O., Vanezis M.,
88 Morphological classification of facial features in adult caucasian males based on an
89 assessment of photographs of 50 subjects, *Journal of Forensic Sciences*, 41, 786-791,
90 1996.

91

92 **3. Terminology**

93

94 3.1 *Definitions:*

95 3.1.1 See Terminology E2916 for digital and multimedia evidence examination terms.

96 3.1.2 OSAC Preferred Terms

97 3.1.2.1 Interpretations: Explanations for the observations, data and calculations

98 3.1.2.2 Observations: Recognizing and noting an occurrence

99 3.1.2.3 Opinions: View, judgment, belief –takes into consideration other information in

100 addition to observations, data, calculations and interpretations

101

102 3.2 *Acronyms:*

103 3.2.1 OSAC – Organization of Scientific Area Committees for Forensic Science

104 3.2.2 ACE-V – Analysis, Comparison, Evaluation, and Verification

105

106 **4. Summary of Guide**

107

108 4.1 This guide discusses the four main applications of facial comparison, the three
109 categories of facial comparison, and the three recognized methodologies of conducting facial
110 comparisons. This guide identifies Morphological Analysis as the preferred primary facial
111 comparison methodology for all applications and categories of facial comparison.

112

113 **5. Significance and Use**

114

115 5.1 Facial comparison is a manual process undertaken by a human and used in different
116 applications involving different levels of evaluation according to the purpose of the comparison.

117 5.1.1 A facial comparison in these applications generally involves faces that are
118 unfamiliar to the person undertaking the comparison.

119 5.1.2 Most applications fall primarily into one of the following four categories, however
120 crossover may exist.

121 5.1.2.1 Intelligence Gathering for Identity Management comparisons are a component of
122 the compilation of information relating to what is believed to be a single subject, even if the identity
123 of the subject is not known.

124 5.1.2.2 Screening and Access Control includes both image-to-image and image-to-person
125 comparisons. Both occur in a high throughput environment and are thus limited in time (e.g.,
126 customs and immigration checkpoints).

127 5.1.2.3 Investigative and Operational Leads comparisons provide information, generally
128 not intended for presentation in court, to assist operational personnel with meeting their objective
129 (e.g., comparing an unknown subject featured in one or many images to images of known subjects
130 to provide investigators with a potential name for a crime suspect).

131 5.1.2.4 Forensic comparisons provide information to assist a trier of fact (e.g., judge or
132 jury).

133

134 5.2 There are three broad categories of facial comparison: assessment, review, and
135 examination.

136 5.2.1 Assessment is a quick comparison of image-to-image or image-to-person typically
137 carried out in screening and access control applications. Due to time constraints, assessment is the
138 least rigorous of all of the facial comparison categories.

139 5.2.2 Review is a comparison of image-to-image often used in either investigative and
140 operational leads or intelligence gathering applications. Review encompasses a broad range of
141 purposes and levels of rigor involved in the analysis, though it is by nature more rigorous than the
142 assessment process. In some cases, review may warrant a verification by another practitioner.

143 5.2.3 Examination is a comparison of image(s)-to-image(s) often used in a forensic
144 application. An independent technical review or verification by at least one additional examiner
145 should be conducted.

146

147 5.3 There are three comparison methodologies (morphological analysis,
148 superimposition, and photo-anthropometry) currently recognized in facial comparison. The
149 method used for a facial comparison depends on the category and the application of the
150 comparison.

151

152 **6. Comparison Methodologies Guidelines**

153

154 6.1 Depending on the application of the comparison, procedures may include some or
155 all of the following steps: Analysis, Comparison, Evaluation, and Verification (referred to as
156 ACE-V). As stated above, verification should be carried out in both facial review and facial
157 examination.

158

159 6.2 Morphological Analysis (in some form) should be the primary approach used for
160 facial comparison in all categories: assessment, review, and examination.

161 6.2.1 Morphological Analysis is the method of facial comparison in which the features
162 and components of the face are compared. Morphological analysis is based on the evaluation of
163 the correspondence among facial features, components and their respective component

164 characteristics (presence, shape, appearance, symmetry, location, relative proportion, etc.).
165 Features include those corresponding to the overall face, anatomical structures such as the nose or
166 ear and their components (e.g., nose bridge, nostrils, ear lobes, helix), and discriminating
167 characteristics, such as scars, marks and tattoos. The E3149 “Standard Guide for Facial Image
168 Comparison Feature List for Morphological Analysis” provides a standard list of facial
169 components and component characteristics to be assessed and evaluated during a morphological
170 analysis. This methodology is used during the Analysis and Comparison steps in the ACE-V
171 process.

172 6.2.2 The morphological analysis process does not rely on the classification or
173 categorization of features (e.g., round face, Roman nose). Classification schemes have been proven
174 to create interobserver differences and are therefore not best practice (Iskan, 1993; Penry, 1971;
175 Ritz-Timme et al., 2010; Vanezis et al., 1996).

176 6.2.3 Documentation of a morphological analysis will vary depending on the application
177 of comparison undertaken. Screening and access control applications apply a more basic level of
178 morphological analysis and at this level documentation of the decision-making process is generally
179 not required. On the other hand, when using morphological analysis for facial examination as in a
180 forensic application, the examination and decision-making process should be fully documented
181 and include an independent review by a second competent examiner (verification or technical
182 review).

183 6.2.4 Morphological analysis is highly dependent on the quality and quantity of the facial
184 features and characteristics that can be compared, which is in turn dependent on the quality of the
185 image. Image quality can be affected by factors such as image resolution, lighting, focus, pose,
186 angle, orientation, obstructions of facial features, etc.

187 6.2.5 The Morphological analysis method requires training consistent with the category
188 of comparison carried out.

189 6.2.6 Using a standardized checklist has been shown to be beneficial during an
190 examination (Towler, A., White, D., & Kemp, R. I.).

191
192 6.3 Superimposition is the process of creating an overlay of two aligned images and
193 comparing them visually.

194 6.3.1 Superimposition should be used *only* as an aid to visual comparison and must be
195 used in conjunction with morphological analysis and must never be used as a stand-alone approach
196 for facial image comparison.

197 6.3.2 Superimposition can be applied only when two images are taken from the same
198 viewpoint (images may be photographs, frames or images from video, or images synthesized from
199 3D face or head models). Images must be aligned (e.g., scaled, rotated, etc.) with each other. There
200 should be a concordance between images in all aspects of angle and perspective to avoid distortion
201 of the spatial distribution of facial features and characteristics. Practitioners must only use tools
202 which preserve shapes and may not use image processing techniques which may skew the images,
203 facial proportions and shapes.

204 6.3.3 Since superimposition is sensitive to image quality, both images need to be captured
205 under optimal conditions (as defined by E3115) or the use of the method may be misleading. Loss
206 of image quality through blurring, compression artifacts, reduction in spatial resolution (e.g.,
207 number of pixels between the pupils), lens distortion, perspective distortion, etc. reduces the ability

208 to determine the specific location of individual features, which subsequently reduces the ability to
209 generate an accurate overlay/superimposition.

210 6.3.4 In cases where there are multiple copies of the same original image (e.g., forged
211 identity documents), superimposition may be carried out on images displaying less than
212 optimal quality.

213

214 6.4 Photo-anthropometry *must not be used* for facial comparison in any categories:
215 assessment, review, and examination.

216 6.4.1 Photo-Anthropometry is the measurement of dimensions and angles of
217 anthropological landmarks and other facial features visible in an image in order to quantify
218 characteristics and proportions. The measurements taken from one image are compared to the
219 measurements taken from a separate facial image. A practitioner's opinion is based on subjective
220 thresholds for acceptable differences between measurements.

221 6.4.2 As in superimposition, photo-anthropometry is highly sensitive to image quality
222 factors including but not limited to resolution, focus, distortion, obscuration, viewpoint, lighting,
223 and pose. In addition, the following information should be known about the compared images prior
224 to conducting the comparison: focal length, lens distortion and subject distance. Given the
225 uncontrolled conditions under which many questioned images (e.g., security camera images) are
226 captured, it is often not possible to define a threshold boundary for similarity or dissimilarity.

227 6.4.3 Research on the use of anthropometric comparison has shown that photo-
228 anthropometry has limited discriminating power and may be misleading (Evison et al., 2010;
229 Kleinberg, 2007; Moreton and Morley, 2011).

230 6.4.4 The limitations described above regarding image requirements preclude the use of
231 photo-anthropometry in any facial comparison. This technique should not be used as an
232 independent comparison method or in conjunction with another method.

233

234 6.5 Apart from the methods described above, holistic comparison (i.e., the innate
235 human ability to compare faces) will take place. It should be stressed that holistic comparison
236 is not a method. Human ability for holistic comparison is highly variable and is dependent on a
237 multitude of factors including, but not limited to, personal ability and familiarity with the
238 subject. Studies have shown that human ability to compare unfamiliar faces is highly prone to
239 error whereas comparison of familiar faces may be carried out accurately even when image
240 conditions are poor. (Biederman & Kalocsai, 1997; Maurer, Le Grand, & Mondloch, 2002;
241 Rossion, 2008).

242

243 **7. Summary of Recommendations**

244 7.1 Morphological analysis method is the best practice for facial comparison. When
245 conducting morphological analysis for facial comparison, and the application warrants, the
246 examination and decision-making process should be fully documented.

247 7.2 Superimposition should only be used in conjunction with morphological analysis.

248 7.3 Photo-anthropometry must not be used for facial image comparison.