This document has been accepted by the Academy Standards Board (ASB) for development as an American National Standard (ANS). For information about ASB and their process please refer to asb.aafs.org. This document is being made available at this stage of the process so that the forensic science community and interested stakeholders can be more fully aware of the efforts and work products of the Organization of Scientific Area Committees for Forensic Science (OSAC). The documents were prepared with input from OSAC Legal Resource Committee, Quality Infrastructure Committee, and Human Factors Committees, as well as the relevant Scientific Area Committee. The content of the documents listed below is subject to change during the standards development process within ASB, and may not represent the contents of the final published standard. All stakeholder groups or individuals, are strongly encouraged to submit technical comments on this draft document during the ASB's open comment period. Technical comments will not be accepted if submitted to the OSAC Scientific Area Committee or Subcommittees.

Guideline for the Articulation of the Decision-Making Process Leading to an Expert Opinion of Source Identification in Friction Ridge Examinations
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Guideline for the Articulation of the Decision-Making Process Leading to an Expert Opinion of Source Identification in Friction Ridge Examinations

Keywords: friction ridge, fingerprints, comparison, conclusions, decisions, testimony, strength of evidence, source identification, competing propositions, expert opinion

Abstract: The friction ridge comparison discipline has experienced a shift from expressing the identification decision in absolute terms to expressing its findings as an expert opinion, based upon consideration of the evidence in terms of the support it offers to one of two competing propositions. This document explains the process leading to the expert opinion of source identification and provides guidance on articulating the process, the conclusion, and the limitations of that conclusion in testimony or discussion with relevant stakeholders.

Foreword

The "Articulation document", as it has come to be known by those drafting and debating it, originated in the Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) shortly after the release of the National Research Council's (NRC) 2009 report, *Strengthening Forensic Science in the United States: A Path Forward*.

The NRC report was critical of, among other things, the way friction ridge examiners expressed the results of their comparisons. The report particularly disapproved of examiners' tendency to present those results as facts, rather than expert opinions, and to describe them in absolute terms such as "individualization", "100% certain", "exclusion of all others", and "zero error rate" that the NRC and other critics noted overstated the strength of both the evidence and the foundational basis of the science to support it.

Very shortly after the release of the NRC report, the discipline responded with strong recommendations that these terms not be used in expressing friction ridge conclusions and that absolute certainty in conclusions should be neither expressed nor implied; however, they offered no guidance on what should be communicated instead.

SWGFAST undertook the writing of the Articulation document in an effort to fill that void. Its goal was to offer guidance on how a friction ridge examiner could describe the examination process and report the findings without overstating them and while operating within a logically consistent framework. SWGFAST completed two drafts of the Articulation document, which were put out for public comment. Before the document was finalized, SWGFAST was dissolved in favor of the newly formed Organization of Scientific Area Committees (OSAC).

In 2015, the Friction Ridge Subcommittee (FRS) of the OSAC took up the legacy SWGFAST document and began the work of updating the references, clarifying some of the explanations, strengthening some of the recommendations and prohibitions, and putting the document through a full Standards Developing Organization (SDO) process, to result in a Best Practice Recommendations document that could be submitted to the OSAC Registry of Standards and Guidelines for adoption. The document you are reading is the result of that effort.

Table of Contents

1 Scope

This document offers guidance for articulating the decision-making process leading to the source identification conclusion resulting from the examination of friction ridge evidence. This document takes into consideration the current status of professional practices, legal decisions, and scientific research. The scope of this document is limited to the process leading to a source identification conclusion and does not address or consider other possible conclusions, such as inconclusive or exclusion decisions.

2 Terms and Definitions

For purposes of this document, the following definitions apply.

2.1
discriminability
The degree to which information in an impression can be used to reliably distinguish between impressions made by different sources. The discriminability of an impression encompasses its features' quantity, spatial arrangement, clarity, and rarity.

2.2
pattern force area
A region of friction ridge skin in which minutiae of a particular type are forced to form due to the flow of the ridges. For example, in the outflow of a loop, many ridges are converging, which necessarily forces many ridge endings as space runs out. Because the pattern forces these minutiae to form predictably and their configurations are more common and less random, they are properly assigned less weight than more randomly distributed minutiae toward an association between two impressions.

2.3
rarity (of a feature type)
2.4.1 Rarity of a type of feature of friction ridge skin refers to how frequently that type of feature is encountered in a group of people (its prevalence), either in isolation or in conjunction with other information about its local context. For instance, the prevalence of a type of feature could be affected by its proximity to a pattern force area, the finger number or palmar region on which it is located, or the pattern type in which it is located.

2.4
strength of the evidence
2.5.1 A means of describing the weight of support the evidence lends to one source proposition over the other. The strength of the evidence is often represented as a Bayes Factor (also known as a likelihood ratio), and may be described verbally or numerically.

2.5
Tolerance
2.6.1 A means of expressing the variation that is allowable in two impressions originating from the same source due to the elasticity of the skin and differences in deposition and lateral pressure, twist, substrate, matrix, development medium, environmental factors, or post deposition damage. Two impressions within the expected variability are said to be "within tolerance" while two impressions that are outside are said to be "out of tolerance".

3 Recommendations

This document presents a series of statements, in sequence, that build upon one another. Together these provide a recommended explanation and articulation of the foundation and decision-making process for current friction ridge source identification practice. They are not meant to stand alone. An expanded section giving further explanation follows each statement. Supporting references are provided in each section, and practicing examiners should be aware of this material. The references cited are meant to be representative, not all-inclusive. An overview of these statements is included in Annex A.

3.1 Discriminating and Persistent Nature of Friction Ridge Skin

3.1.1 Statement

Friction ridge skin is a complex, highly discriminating, and persistent morphological structure.

3.1.2 Further explanation

3.1.2.1 Research and practical application have shown that the combination of the details present in friction ridge skin are highly variable between different sources. Research and practice have also shown that, barring injury or disease, the essential structure and ridge arrangements of this detail remain unchanged (except for growth) over the life of an individual. These aspects of friction ridge skin (discriminability and persistence) help make friction ridge impressions an effective means of identification.

3.1.2.2 An entire complement of a particular anatomical source of friction ridge *skin* is highly discriminating. However, it is less certain at what point a subset of the skin's features, imperfectly reproduced as an *impression,* are no longer discriminating enough to distinguish between similar sources. Furthermore, while research has demonstrated that some configurations of friction ridge details are highly discriminating, others, particularly in pattern force areas, are less so. Since impressions are often incomplete or indiscernible in part, their degree of discriminability must be considered at all stages of the examination.

3.1.2.3 While the highly discriminating nature of friction ridge skin is often expressed as "uniqueness", this claim has not been empirically proven. Additionally, it has been suggested that the concept of uniqueness is neither a guarantee of an examiner's ability to make an accurate source identification, nor a necessary precondition to reaching a reliable forensic conclusion.

3.1.3 References supporting statement and explanation

3.1.3.1 Studies of discriminability, persistence, and morphology: Wilder and Wentworth (1932), Cummins and Midlo (1943), Hale (1952), Babler (1979), Maceo (2011), Wertheim (2011), Kücken and Champod (2013), Yoon and Jain (2015)

3.1.3.2 Historical use of friction ridge skin for personal identification: Barnes (2011)

3.1.3.3 Recent scientific studies of friction ridge discriminability: Neumann, Champod et al. (2007), Neumann, Evett et al. (2012)

3.1.3.4 Features in pattern force areas (e.g., deltas, outflows of a loop) tend to be more common: Champod and Margot (1997)

3.1.3.5 Uniqueness is unproven and unnecessary: Cole (2009), National Research Council (2009), Page et al. (2011)

3.2 Transfer of Friction Ridge Features to Impressions

3.2.1 Statement

An impression, or recording, of the features of friction ridge skin can result when contact is made with a receptive surface.

3.2.2 Further explanation

Contact with a surface can result in an impression, or recording, of the friction ridge skin. The resulting impression is not a perfect recording of the skin, as it is subject to distortions and environmental effects. Each impression from the same area of friction ridge skin will reproduce a subset of that skin's features that will vary in appearance from other impressions of the same source skin. This is true of both questioned and known impressions.

3.2.3 References supporting statement and explanation

Ashbaugh (1999), Maceo (2009)

3.3 Analysis of Impression to Detect Discriminating Features for Comparison

3.3.1 Statement

During analysis of a friction ridge skin impression, an examiner detects features that would be expected to be present in another impression, generally a known exemplar, from the same area of friction ridge skin.

3.3.2 Further explanation

Examiners trained to competency have demonstrated an ability to accurately detect discriminating features such as ridge events, creases, and scars in friction ridge impressions. Their ability surpasses that of untrained novices. Examiners are capable of accurately detecting discriminating features even in highly distorted impressions. Examiner confidence in the reliability of observed features increases with their clarity in an impression. Before comparing two impressions, an examiner decides that both contain sufficient clear, discriminating features.

3.3.3 References supporting statement and explanation

Busey and Parada (2010), Busey and Vanderkolk (2005), Hicklin et al. (2013), Langenburg (2012), Maceo (2009)

3.4 Comparison of Features to Judge Correspondence

3.4.1 Statement

The observed features are then compared between two impressions. An examiner considers whether there is correspondence within tolerance between these features or differences beyond tolerance.

3.4.2 Further explanation

A ridge-to-ridge comparison between two side-by-side impressions determines whether or not there are corresponding features within tolerance. Correspondence is judged with respect to the features and their spatial relationships. Because every recording of friction ridge skin is different, the ground truth of whether a particular feature actually exists and its true appearance can only be known by examining the source skin. Thus, when comparing any two impressions, correspondence is not exact, but takes into account tolerances that are influenced by distortion factors and other environmental effects.

3.4.3 References supporting statement and explanation

Ashbaugh (1999), Fagert and Morris (2015), Ulery et al. (2014)

3.5 Accumulated Correspondence Decreases Probability of Repetition in a Different Source

3.5.1 Statement

As an examiner finds more corresponding features between two impressions, it becomes less likely that the corresponding set of features would also be present in an impression from a different source.

3.5.2 Further explanation

3.5.2.1 As the number of corresponding features increases, the probability of observing these same features (due to random chance or coincidence) in a friction ridge skin impression from a different source decreases. With sufficient corresponding features, this probability becomes extremely low.

3.5.2.2 The quantity of corresponding features is important; however, so are their clarity and rarity. Not all features carry the same weight. Features that are clearer allow the examiner to have more confidence that they are accurate representations of the friction ridge skin. Features that are rarer allow the examiner to better discriminate between two sources.

3.5.2.3 Quantity, clarity, and rarity combined make up the discriminability of the impression. A more discriminating impression is less likely to have its features repeated in impressions

made by different sources. The interpretation of the discriminability of the observed features is based upon an examiner's training and experience.

3.5.3 References supporting statement and explanation

Egli, Champod et al. (2007), Gutièrrez, Galera et al. (2007), Neumann, Champod et al. (2007), Neumann, Evett et al. (2012), Stoney and Thornton (1986)

3.6 Evaluation of the Observations Under Two Competing Propositions

3.6.1 Statement

An examiner considers, based upon knowledge and experience, the probability of encountering the observed corresponding features in two impressions made by the same source against the probability of observing the same correspondence between the unknown impression and an impression from a different source. In order to support the proposition that the two impressions were made by the same source, an examiner must find discriminability in the corresponding features to outweigh any support for the proposition that the two impressions were made by different sources. The degree to which support for a proposition of same source outweighs support for a proposition of different source is the strength of the evidence.

3.6.2 Further explanation

3.6.2.1 Because no two recordings of friction ridge skin are identical to one another or to the source skin, comparisons of any two friction ridge skin impressions will exhibit differences. The examiner must determine whether or not the differences observed are normal variations within tolerance expected from multiple recordings of the same source skin. Differences beyond these normal variations give support to the proposition that the two impressions are from different sources.

3.6.2.2 A formal way to consider these two possibilities is by framing them as two competing propositions. One proposition is: the observed features in the questioned impression came from the same source as the known impression; the other proposition is: the observed features in the questioned impression came from a different source than the known impression. The extent of the correspondence of features (including both similarities and dissimilarities) between two impressions allows the examiner to evaluate the degree to which one would expect to observe these data under the same source proposition. The discriminability of the corresponding features in two impressions allows the examiner to evaluate the degree to which one would expect to observe these data under the different source proposition.

3.6.2.3 Discriminability allows the examiner to evaluate the degree of support for the different source proposition. The different source proposition considers the probability that the observed features would also be observed in an impression from a different source. If the corresponding features are highly discriminating, the probability that they would also be found in an impression from a different source is very low.

3.6.2.4 Examiners express an opinion regarding their evaluation of the evidence. This opinion is either offered as an expression of the strength of the evidence (thereby skipping section 3.7, below), or it is carried forward into a source identification decision (section 3.7).

NOTE Historically, when the examiner has believed support for the proposition of same source has outweighed support for the proposition of different source to a high enough degree, the friction ridge examiner has offered a decision of source identification in reports and testimony. However, since the ultimate decision regarding source requires consideration of information in addition to the strength of the evidence itself, some of which has been argued to be task-irrelevant to the friction ridge examiner and more appropriately considered by the fact finder, the ultimate responsibility for making a decision regarding source lies with the fact finder. In recognition of this, some laboratories express the conclusion as an opinion of the weight of the evidence instead of a decision of source identification and some relevant authorities choose to limit the opinion of the friction ridge examiner to the strength of the evidence alone.

3.6.3 References supporting statement and explanation

3.6.3.1 Two competing propositions are considered: Finkelstein and Fairley (1970), Aitken et al (2010), Neumann et al. (2012)

3.6.3.2 The strength of the evidence may be reported without making a source identification decision: Champod (2015), Cole (2009), Cole (2014), Swofford (2015)

3.6.3.3 Examiners should not rely on task-irrelevant information in their evaluation of evidence: National Commission on Forensic Science (2016)

3.7 Source Identification Decision

3.7.1 Statement

The examiner makes a decision to render a source identification conclusion.

3.7.2 Further explanation

Source identification is the opinion by an examiner that two friction ridge skin impressions originated from the same source. This opinion is the decision that the features are in sufficient correspondence and that the probability the questioned impression was made by a different source is so small that it is negligible.

3.7.3 References supporting statement and explanation

Decision-making in forensic identification: Biedermann, Bozza et al. (2008)

3.8 Communication of Findings

3.8.1 Statement

The examiner shall communicate the findings in writing. These findings can be communicated again through oral testimony. The target audiences for these communications vary by agency or situation.

3.8.2 Further explanation

3.8.2.1 Reported conclusions shall be expressed as the opinion of the examiner. The examiner has a level of personal confidence associated with the accuracy and reliability of this conclusion; however, this personal level of confidence cannot be objectively measured. For this reason, certainty shall not be reported in absolute terms and should not be reported numerically.

3.8.2.2 Specific words and phrases conveying absolute certainty are inappropriate or misleading and shall not be used, or implied, to express conclusions in an open population. Specific problematic phrases include:

a) Exclusion of all others

In order to reach an identification decision "to the exclusion of all others", there would need to be an assumption of uniqueness, and the entire world's population would need to be considered, and rejected, as a potential source of the unknown impression. These two claims are neither supportable, nor necessary, to form an opinion of source identification within a relevant population.

Additionally, a "source exclusion" decision is made after comparing two impressions and finding sufficient differences to conclude that they were not made by the same source; therefore, unless a comparison has actually been conducted, no exclusion decision can be made.

b) Individualization

Use of the term "individualization" implies the global exclusion of all others. To individualize is to attribute a friction ridge skin impression to a single source. This determination *de facto* excludes all other possibilities.

c) 100% certainty

The concept of 100% certainty is incompatible with the practice of science. Arguments such as "I would not have signed it unless I was 100% certain" are not sufficient support for a claim of 100% certainty.

d) Zero error rate / infallible method

A claim of a zero error rate for the method is demonstrably false; errors have occurred. Because the friction ridge comparison process takes place within the mind of the examiner, there is no way to separate a method error rate from a practitioner error rate. Furthermore, as with 100% certainty, the concept of a zero error rate is incompatible with the practice of science.

3.8.3 References supporting statement and explanation

3.8.3.1 Use of these phrases is inappropriate and unsupported: Campbell (2011), Champod (2013), Cole (2014), Garrett (2009), National Research Council (2009), NIST (2012)

3.8.3.2 When reaching a source identification decision, experienced friction ridge examiners tend to be highly accurate: Langenburg (2009), Ulery, Hicklin et al. (2011), Tangen, Thompson et al. (2011)

Annex A
(informative)

Foundational Principles

A.1 Shifting Emphasis in Friction Ridge Examination Decisions

Rather than expressing a source identification as an incontrovertible fact, the friction ridge discipline is now articulating the source identification conclusion as a *decision* that is expressed as an expert opinion. This decision must derive from supporting data and only be reached after the two competing propositions of same source and different source have been assessed and considered.

As this approach to reporting conclusions represents a shift in the discipline from the traditional way of representing an identification, a gap was left in examiners' understanding of how to articulate the decision-making process that leads to the decision, as well as the limits of the claims they are making when reporting on the strength of the evidence, or providing an opinion of source identification.

This document seeks to fill that gap by providing a structured framework that builds through the steps of the process using unified logic and terminology to culminate in one of two possible ways to report findings. It should be emphasized that this document does not represent a shift in how the comparison process is conducted; it is only a means of articulating that process and its results as pertains specifically to a strong association between a questioned and known impression, and in light of good scientific practice and valid concerns about some of the ways findings were presented in the past.

A.2 Overview of Statements

To provide a summary of the structure of the document, and to serve as a quick reference to its sections, each of the progression of statements that are explained within the document are presented here, using the same numbering system under which they appear in the document body.

3.1.1 Friction ridge skin is a complex, highly discriminating, and persistent morphological structure.

3.2.1 An impression, or recording, of the features of friction ridge skin can result when contact is made with a receptive surface.

3.3.1 During analysis of a friction ridge skin impression, an examiner detects features that would be expected to be present in another impression, generally a known exemplar, from the same area of friction ridge skin.

3.4.1 The observed features are then compared between two impressions. An examiner considers whether there is correspondence within tolerance between these features or differences beyond tolerance.

3.5.1 As an examiner finds more corresponding features between two impressions, it becomes less likely that the corresponding set of features would also be present in an impression from a different source.

3.6.1 An examiner considers, based upon knowledge and experience, the probability of encountering the observed corresponding features in two impressions made by the same source against the probability of observing the same correspondence between the unknown impression and an impression from a different source. In order to support the proposition that the two impressions were made by the same source, an examiner must find discriminability in the corresponding features to outweigh any support for the proposition that the two impressions were made by different sources. The degree to which support for a proposition of same source outweighs support for a proposition of different source is the strength of the evidence.

3.7.1 The examiner makes a decision to render a source identification conclusion.

3.8.1 The examiner shall communicate the findings in writing. These findings can be communicated again through oral testimony. The target audiences for these communications vary by agency or situation.

Annex B
(informative)

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