Friction Ridge Examination: ACE-V Documentation

Introduction

The need for additional transparency in the use of ACE-V in processing fingerprints discovered at crime scenes has been building with increased urgency in the United States over the last decade. David Ashbaugh was one of the early champions from within the latent print community to push for increased documentation of the examination process [1]. From outside the fingerprint community, critical assessments by legal and academic commentators [2–6] have also discussed the need for greater documentation of ACE-V.

The ability to provide increased documentation has been challenging for many law enforcement agencies because of casework demands, technological capabilities, and competing philosophies on documentation. It is important to place the need for increased documentation in the context of an operational latent print unit. One case involving friction skin evidence can encompass anywhere from one latent print to hundreds. Analysts may have to compare each of those latent prints to one subject or to dozens. A case can take an hour, weeks, or months. Given the volume of evidence and number of incoming cases, the analyst or agency may struggle with the inevitable slowdown of productivity associated with providing additional documentation of the work flow followed in examining evidence. There must be a cultural shift within the system to support the additional time needed to accommodate the documentation process.

In today's latent print unit, it should be standard that the analysts have the computer technology (hardware and software) and associated training to facilitate documentation of ACE-V. Imaging software, like Adobe Photoshop®, has been commercially available for years. Newer commercial forensic casework applications like Mideo Systems Caseworks® and Foray Technologies Digital Workplace® are also available. In addition, the Committee to Define an Extended Fingerprint Feature Set (CDEFFS), chartered by the National Institute of Standards and Technology (NIST), is making efforts toward developing a standard method for documenting the data present in friction ridge impressions for both electronic data exchange and casework applications [7]. Researchers at the University of Lausanne developed an open-source documentation software called *PiAnoS* (a Picture Annotation System) that facilitates the documentation of the analysis and comparison of prints [8]. It has been the author's experience that despite the availability of digital imaging technology and associated training, a number of agencies are not providing them to their analysts. This could be due to several factors; however, often-cited reasons include the cost, a lack of perceived benefit of the documentation process, or the inability to document all the data that the analyst uses during the examination.

The perceived benefit of documentation points toward the different philosophies within the latent print community. The author has noted a range of philosophies during training classes taught throughout the United States. At one extreme, analysts are focused on the conclusions and not on the examination process. The argument for limited documentation is that the latent print is not "consumed" during the examination; therefore, another qualified analyst can reexamine the evidence at any time to confirm or refute the conclusions.

At the other extreme, some analysts use extensive note taking and image markups to document their interpretation of the evidence. The argument for extensive documentation is that it provides transparency to the decision-making process and permits the evaluation of the analyst's interpretation of the evidence. The Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST) took the middle ground in the 2010 *Standard for the Documentation of Analysis, Comparison, Evaluation, and Verification (ACE-V)* [9] by stating

> "Although all examinations require documentation, the extent of documentation is related to the complexity of the examination. The friction ridge impression alone is not sufficient documentation. The impression, or a legible copy shall be annotated or have accompanying notes." [p. 1]

The SWGFAST *Standard for the Documentation of Analysis, Comparison, Evaluation, and Verification (ACE-V)* [9] offers significant discussion and numerous methods through which documentation can be

accomplished. Other sources addressing documentation include Chapter 10, "Documentation of Friction Ridge Impressions: From the Scene to Conclusions," of the Friction Ridge Sourcebook [10] and an upcoming article in the *Journal of Forensic Identification* by Glenn Langenburg and Christophe Champod, "The GYRO System – A Recommended Approach to More Transparent Documentation" [8].

The purpose of this article is to discuss the benefits of increased documentation of ACE-V to the quality system of a latent print unit. It also provides some examples of how documentation could be accomplished on some challenging prints. This article is, however, not concerned with all aspects of putting together a proper case file.

Analysis

The analysis stage of ACE-V is, essentially, the determination of whether or not the data in a friction ridge impression is sufficient to warrant a comparison. In other words, does the analyst have sufficient information to identify or exclude a subject from the unknown (latent) prints? The latent print community lacks general, defined criteria for making this decision because of the tremendous variability of the data encountered in friction ridge impressions and the inherent variability of the analysts (it must be noted that several countries do have quantitative thresholds based on minutiae counts [11]). Because of the variability of the impressions and the analysts, a minutiae threshold alone can prove to be a false idol [12, 13].

Owing to a lack of general criteria, each latent print unit tends to develop internal criteria (often unwritten) for determining which latent prints move to the comparison process. This frequently depends on the expertise of the analysts within a particular unit. Despite the development of an internal standard within a unit, many agencies continue to struggle with occasional conflict between analysts over whether an evidential latent impression contains sufficient data. From an administrative standpoint, these diverging approaches can be very difficult to resolve because they depend on the expertise of the analysts.

Expertise of the analysts is the critical issue because each analyst has his own strengths and weaknesses. For instance, one analyst may have excellent contrast sensitivity (ability to see shades of gray), and, consequently, can see more data in the print. This analyst may mark latent prints of value for comparison, which another analyst determines to be insufficient because the second analyst does not see the same amount of data. In another example, an analyst may have a tendency to *not* mark small latent palm prints of value for comparison if there is no clear distal orientation or a focal point because he, historically, has been unable to render conclusions (particularly exclusions) when he compares these types of latent palm prints to known palm prints.

Another analyst may be much more confident (or patient) at searching small palm fragments and reaching conclusions; so, this analyst routinely marks these kinds of latent prints as being of value for comparison. These examples illustrate how expert variability can impact the "suitable for comparison" decision process. This variability has ramifications not only within one latent print unit but also between latent print units across national and international boundaries.

Latent print units are encouraged, first and foremost, to establish documented consensus minimum criteria for determining whether a latent print is suitable for comparison. These standards need to be flexible, but should provide a baseline from which to start a discussion when there is conflict. These are management and quality assurance criteria based on the experience of the analysts and the operations of the unit.

The following is a *sample* of one such administrative guideline to provide analysts and latent print units a place to begin discussing this very complex issue. There are many ways to approach this challenge; this is just *one* method that may be operationally successful [14]. It should be noted that this criterion was established on the basis of what the analysts determined could be excluded and *not* on the basis of what they determined could be identified. In other words, a print could meet these criteria and still not be sufficient for identification.

Suitability for Comparison Guideline

> *At a minimum, a latent print will be determined to be suitable for comparison if it contains at least eight (8) discernable minutiae in a distal phalanx impression, ten (10) discernable minutiae in a proximal or medial phalanx impression, and twelve (12) discernable minutiae in a palm or foot impression (these are minutiae that are located during the analysis –*

prior to comparison). In addition, the latent print must meet one or more of the following criteria:

- *Discernable distal orientation*
- *At least one focal point (e.g. core, delta, crease, scar)*
- *At least one region of robust and distinct target data*

A latent print of unknown anatomical region and distal orientation will be marked suitable for comparison if it has at least fourteen (14) discernable minutiae and either a focal point or at least one region of robust and distinct target data.

''Discernable" is dependent upon the analyst. Not all analysts can see the same information, so the minutiae must be discernable to the case analyst. The discernable minutiae do not necessarily have to be contiguous if the analyst can explain the breaks in the ridge paths (e.g. "ridge shift consistent with a decrease in pressure and slight movement").

Due to the extreme variability of latent prints, latent prints that do not meet the above-listed criteria may be marked suitable for comparison at the discretion of the case analyst. For instance, a latent fingerprint may lack eight (8) minutiae, but may have other significant data (e.g. incipient detail, scar detail, or seven highly selective minutiae) or high clarity. This additional data will contribute to the determination of suitability for comparison. The analyst should document which data permitted the analyst to determine the latent print was suitable for comparison when a latent print does not meet the above-listed criteria.

The above-listed criteria are based on the combined experience of the Latent Print Detail and are a quality assurance standard adopted to help mitigate errors and provide a minimum standard with which to evaluate the analysts' determination of suitability for comparison.

Once a latent print unit has determined minimum criteria, then the answer to "what needs to be documented?" becomes clearer – the minimum criteria. It also helps define "complex"; a complex print would be at or near the minimum criteria. In addition, the criteria can be used as part of the quality assurance program to assess the performance of the analysts or to settle conflict during verification or technical review.

Articulated criteria for the "suitable for comparison" decision are also beneficial when a new analyst is being trained. The author has found that many agencies struggle with teaching a new analyst as to how to make the decision and often rely on repeated exposure to latent prints, without necessarily building the needed skill sets in a logical manner. For instance, with the example criteria above, it is clear that building latent print orientation and focal point identification skills should precede selection of target groups and search parameters. Documented criteria provide not only a framework to guide training but also a language for the analysts to discuss the decision-making process during training and beyond.

Documentation of Analysis

Prior to discussing the documentation of the data in the friction ridge impression, it is important to note that the analyst should have the following information whenever possible: surface from which the latent print was recovered, orientation of the latent print on the surface or item, the development technique used to visualize the latent print, and the method used to recover and preserve the latent print. This information can be critical to assessing distortion factors in the latent print and variability in appearance between the latent print and the known print.

The analyst typically receives latent lift cards or images (hard copy photographs or electronic images) of developed or visible latent prints. For each lift card or image, the analyst should indicate which latent prints were deemed suitable for comparison, the likely anatomical region and orientation (e.g., finger or palm in the distal orientation), any distortion issues that may impact the comparison or evaluation, and, if complex, the specific data relied on to make the determination. This type of documentation makes the following transparent to a reviewing analyst: exactly which latent prints were determined to be suitable for comparison, the orientation(s) and anatomical region(s) searched by the case analyst (e.g., through the hypothenar regions of the left palm of the subjects in a specific orientation), problem areas in the print, and possibly the specific data that were targeted for search. If an analyst routinely fails to identify prints, this information can be vital to assessing why the analyst has failed to identify prints and provide a directed opportunity for skill improvement (e.g., orienting prints, selecting target data, modifying search parameters or patterns, and honing tolerances for variability in appearance).

Figure 1 shows an example of a latent print with analysis annotations. The latent print was scanned from a black powder lift card and was indicated as having come from a tire rim. The curved marking over the print indicates the anatomical region (distal

phalanx) and the distal orientation. If an analyst uses symbols or markings to annotate suitable latent prints, the symbols or markings should be clearly defined. The letter "A" is a designator assigned by the analyst (if there were additional prints on the lift card, they would be marked "B", "C", etc.). The analyst has documented sufficient data to demonstrate that the print is suitable for comparison (green and blue dots on minutia) and has selected a preliminary target group (blue). The analyst has also highlighted areas of concern in the print in yellow; these are regions where the friction ridges do not trace through completely. The notes should provide a description of areas of concern in the print. For this latent print, the analyst would indicate that there are areas where the ridges are disconnected; these regions are consistent with slippage of the finger on the surface.

Another example is given in Figure 2. The latent print was scanned from a lift card and is a black powder lift from an ashtray. Like the previous example, areas of concern have been marked in yellow and minutiae have been marked in green and blue. The analyst would discuss the regions of concern in the notes: one area of ridge detail is obscured by streaks (above the delta) and another (below the delta) has broken ridges that cannot be traced reliably. The analyst should also note that the print appears to be one impression across a contoured surface; however, the data in the contours to the right of the documented region are too obscure to be useful for level 2 information but appear consistent with a whorl pattern.

In one last, very complex example, a latent palm print was recovered from an emergency door exit bar with black powder (Figure 3). The analyst has traced different areas of ridges in different colors. The analyst annotated the impression as a palm with a bracket at the proximal end of the print, the arms of the bracket pointing distally. The analyst has indicated focal points (deltas and creases) in orange. The notes would reflect that the majority of the print appears to be a contiguous interdigital palm region; however, it is broken into areas that cannot be clearly traced through (likely due to the curved nature of the surface or handling of the surface). The analyst would also indicate that there is an area, circled in yellow, that has ridge detail, but may not be part of

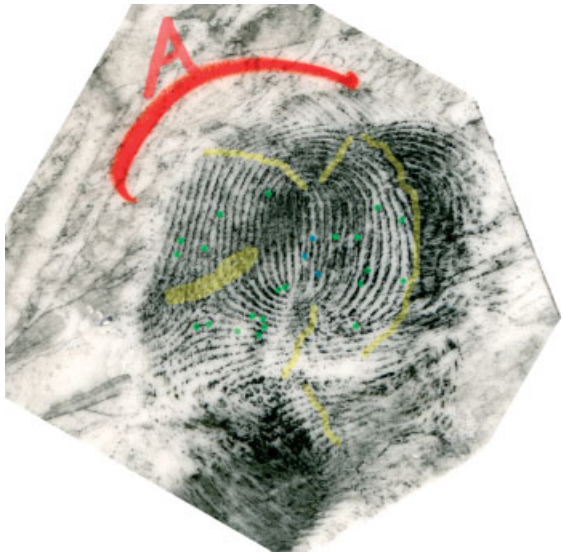

Figure 1 Analysis notations on a copy of a latent print recovered from a tire rim. The yellow markings are areas of concern, where the ridges appear to disconnect. The green and blue dots mark clear minutiae; the blue dots indicate initial target data selection for manual search through the known prints

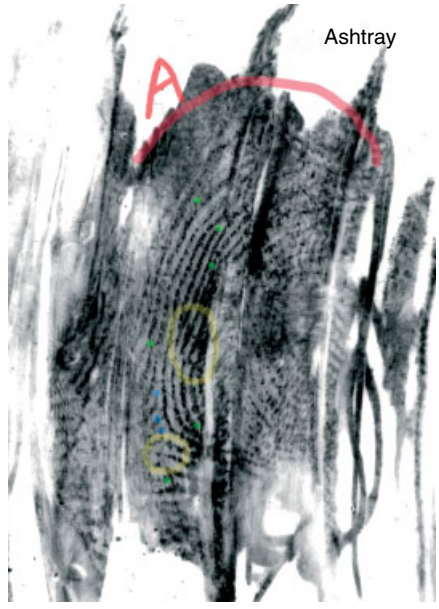

Figure 2 Analysis notations on a copy of a latent print recovered from an ashtray. The yellow markings are the areas of concern. The green and blue dots mark clear minutiae; the blue dots indicate initial target data selection for manual search through the known prints

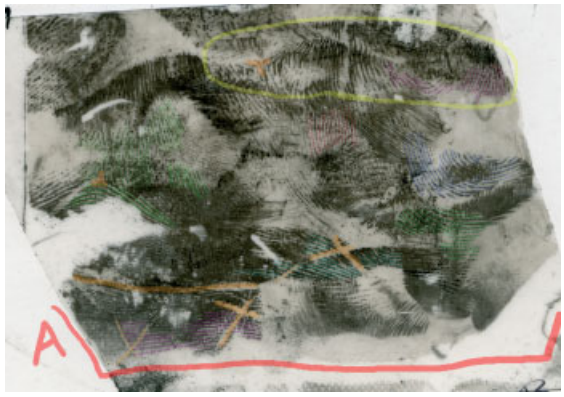

Figure 3 Analysis notations on a copy of a latent print recovered from an emergency door exit bar. The yellow marking is an area of concern. The analyst has indicated focal points (orange) and has traced several regions of ridge detail (various colors)

the main impression: possibly a disconnected region of the same palm. Given the complexity of the print, the analyst would also indicate that numerous target groups would be selected for search through the known palm prints.

Comparison and Evaluation

The comparison and evaluation processes are treated together for ease of understanding the documentation process. The comparison can be thought of as follows: which information provided by the latent print was searched, how it was searched, and which known prints were compared. The evaluation is the final conclusion after the search process is complete.

Documentation of Exclusion

The comparison process for an exclusion is annotated primarily using the analysis notations of the latent print (e.g., how the print was searched) and the inclusion of a legible copy of any known prints compared (or reference to the specific known prints used in the case). For instance, if three subjects were compared to the latent palm print in Figure 3 and all three were excluded, the analyst would have the annotated latent palm print and, preferably, a legible copy of the known palm prints of the subjects in the case file. The notes would reflect that the three subjects were excluded from the latent palm print. A reviewing analyst would know on the basis of the annotations and notes that the latent palm print was searched as an interdigital region of the known palms in a specific orientation, which details the case that the analyst considered during the comparison process and the case analyst's final conclusions.

Documentation of Inconclusive

There are a number of reasons why an analyst may reach an inconclusive determination. Possible reasons include, but are not limited to, the following:

- Subject(s) lack fully or clearly recorded known prints.
- Limited detail is found to be consistent with a subject but it is insufficient to conclusively identify or exclude the subject (due either to the latent print or to the known print).
- Limited detail is found to be consistent with a subject; but there is a significant difference and the analyst is unsure whether the difference is due to variability in appearance from the same source friction ridge skin or due to the print originating from a different source.
- No detail is found in agreement but the analyst cannot reach the threshold to exclude the subject(s).
- The selectivity of the data is so low or the distortion factors are so overwhelming that the analyst is unable to draw any reliable conclusions.

The annotated latent print and the legible copies of any known prints compared partially document the inconclusive determination. The case notes should be very clear as to why a comparison resulted in an inconclusive decision. If the analyst finds limited detail consistent with a specific subject, he should document the detail he found consistent and whether the inconclusive determination was due to the latent print or the known print. If the determination was due to the known print, it should be noted as to what additional known prints are needed to possibly render a more definitive conclusion. If the determination was due to the latent print, the analyst should specify the reason (e.g., insufficient detail consistent between the latent and the known prints, low selectivity of detail present, and too much distortion).

An example of limited detail consistent between the latent print in Figure 2 and a corresponding

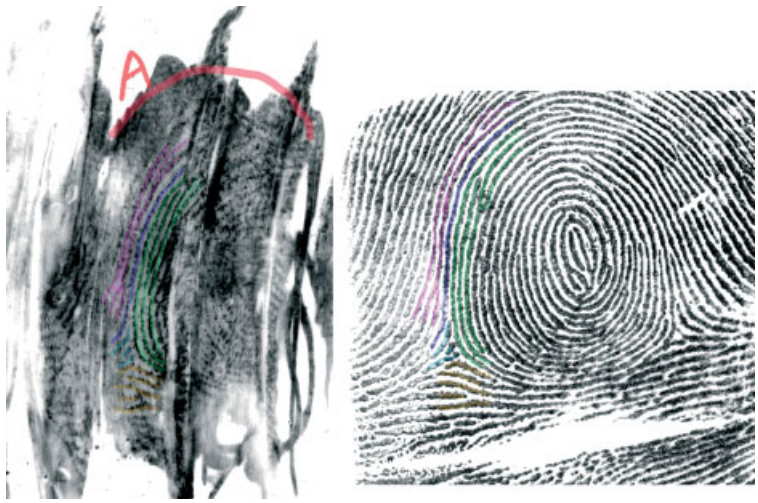

Figure 4 The documentation of the detail found consistent between the latent print and a known print for an inconclusive result

known print is illustrated in Figure 4. The analyst's notes would reflect that the result was inconclusive for a specific finger (e.g., right thumb) of a specific subject (e.g., John Doe) and would also reflect on the reason for the same. In this example, the inconclusiveness may be due to insufficient agreement between the latent print and the known print due to the quantity of detail available in the latent print. The analyst could save his initial "analysis" markings in a Photoshop layer (or as a separate image) and then save the "comparison" markings in another Photoshop layer (or as a separate image). This would capture both the detail noted during the analysis and the detail used to formulate a conclusion. If limited detail is found consistent with one subject, the analyst should continue to document the conclusions of any comparisons to any other subjects in the case (e.g., if possible, excluding the other subjects).

It should be reiterated that the quality or quantity of the known prints is frequently the limiting factor in the comparison process. It has been the author's experience that the bulk of "inconclusive" decisions are a result of the known prints being poorly recorded (low clarity) or not having the comparable area recorded at all. It is critical that analysts recognize and document when the known prints are inadequate to render a definitive conclusion.

The increased level of documentation allows the reviewing analyst to evaluate the information relied on to reach the inconclusive decision. If a conflict arises during verification, the annotated images provide a basis for discussion between the analysts and an ability to detect and improve interpretation issues.

Documentation of Identification

Identification, especially for complex latent prints, should include annotated images demonstrating the basis for the conclusion. This again permits the reviewing analyst to evaluate a significant amount of the data used by the case analyst to formulate his conclusion. If interpretation problems arise, annotated images may provide insight into the problems and, consequently, into ways to prevent the problems in the future.

Figure 5 is an example of annotated images demonstrating an identification (the latent print is the same as that in Figure 1). The analyst's notes would reflect that the result was an identification related to a specific finger (e.g., left thumb) of a specific subject (e.g. Jane Smith). A legible copy of the known prints would be kept in the case file.

Note that the known print (Figure 5a and c) is shown on either side of the latent print (Figure 5b). The same blue bifurcation noted in both copies of the known print is highlighted twice in the latent print. The finger shifted slightly to the left on the tire rim, causing two regions of ridge detail from the

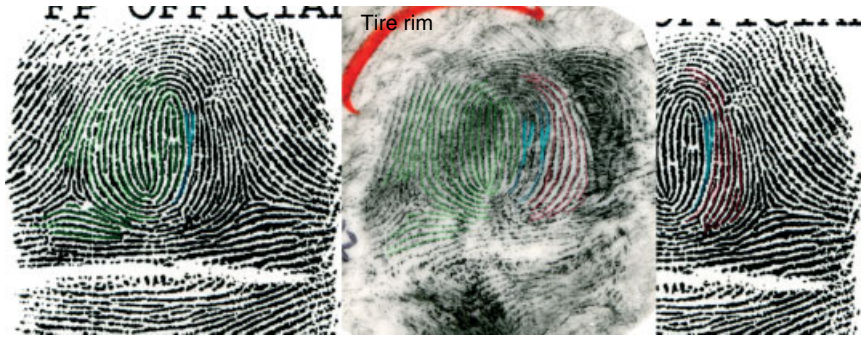

Figure 5 Annotated images demonstrating the detail found in agreement between the latent print and the known print

same finger to be deposited next to each other. The dividing line between these regions is between the two blue bifurcations in the latent print (these two bifurcations are the same bifurcation on the skin). The blue bifurcation to the right belongs to the red ridges on the right side of the print. The blue bifurcation on the left belongs to the green ridges on the left side of the print. The notes should reflect these complicating issues. The analyst could save his initial "analysis" markings in a Photoshop layer (or as a separate image) and then save the "comparison" markings in another Photoshop layer (or as a separate image).

Verification

Once the case analyst has completed his examinations and assembled the case file, it is typically passed on to another analyst for verification of the case analyst's conclusions. Agencies should have a written policy indicating as to which conclusions will be verified by the reviewing analyst and under what circumstances the management must be notified of a conflict. Industry standard is that all identifications must be verified and other conclusions may be verified [15].

The notes must be clear as to which conclusions were verified, by whom, and when. If the verifying analyst concurs with the case analyst, oftentimes the verifying analyst simply initials and dates next to the case analyst's conclusions in the notes. If the reviewing analyst generates annotated images, these should be included in the case file.

If the reviewing analyst does not agree with a conclusion, he should document his conclusion in the case notes. Once documented, the reviewing analyst should consult with the case analyst to discuss the issue and attempt to resolve the problem (e.g., did the case analyst write down the wrong finger? Or, did the case analyst fail to mark a print for comparison?). The result of the consultation should be documented in the case notes, corrections made appropriately, and management notified when necessary (e.g., if an erroneous identification occurred). Management should also be notified if the analysts could not resolve the issue. Any resulting corrective actions should also become part of the case file.

Conclusion

Joseph Bono, President of the American Academy of Forensic Scientists, gave a speech in June 2010 that was published in *The Prosecutor*, a publication of the National District Attorneys Association [16]:

> *''Now it's time to confront some of my colleagues here who work in the laboratory: Training and experience in the absence of demonstrative evidence mean little to me. A reputable examiner should be able to show the decision makers – the prosecutor, the defense attorney, the judge and the jury – the basis for a conclusion that is understandable and can be justified by data or images. If the examiner resorts to the "trust me, I know what I am doing logic," a red flag should immediately go up: DON'T TRUST HIM!" [pp. 15–16]*

There are many challenges facing latent print units as they strive toward transparency of the ACE-V process through documentation. Cultural shifts in the top management, the analysts, and the courts will have to take place. Cases may take more time (affecting

backlogs and turnaround times) and technology and training will need to be provided to the analysts. Documentation of ACE-V is not just a matter of creating charted images. Management should have documented criteria and protocols related to ACE-V. These criteria and protocols provide the analysts a framework from which to operate and provide the management with a yardstick to assess analyst performance. Increased transparency will improve the quality system of a latent print unit.

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