

Scientific Methodology and the Friction Ridge Identification Process

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Please note that the following is primarily a compilation of ideas and protocols developed by S/Sgt. David Ashbaugh and Pat Wertheim C.L.P.E. with a few modifications based on the author's personal preferences. Extensive detail, especially with respect to the 'examination of the latent', has not been provided since the purpose of this document is to provide a friction ridge identification process within a scientific methodology framework. Certain aspects of this proposed scientific methodology may or may not be applicable depending on the level of examiner expertise and each particular 'latent to print' identification process case.

According to S/Sgt. David Ashbaugh of the R.C.M.P., the complete friction ridge identification process involves both the application of an "identification philosophy and scientific methodology" in order to determine whether or not an 'unknown friction ridge impression' (herein referred to as a **latent**) originated from the same source as a 'known inked print' (herein referred to as a **print**) to the exclusion of all others.[1] David Ashbaugh describes the identification philosophy as, "a guide or explanation of how friction ridge quantitative-qualitative analysis is transformed into an opinion of individuality. It describes the friction ridge formations used during analysis and establishes parameters as to how much knowledge one must have to perform such a function. The philosophy of friction ridge identification can be paraphrased with the following statement: *Friction ridge identification is established through the agreement of friction ridge formations, in sequence, having sufficient [observed] uniqueness to individualize.*"

Analysis, Comparison, Evaluation and Verification, more commonly referred to as A.C.E.-V., is described by David Ashbaugh as the scientific methodology portion of the entire friction ridge identification process. It should be noted, however, that some do not consider verification as part of the actual *identification* process. "Verification is the identification process repeated in someone else's mind." [2] The actual *identification* process involves analysis, comparison and evaluation (A.C.E.) of the latent and known prints by the Latent Print Examiner.

Pat A. Wertheim, C.L.P.E. proposes a different approach to this three-step identification process. Mr. Wertheim proposes a 'Five-Step' formula that he states, "in essence, is nothing more than an alternative way of explaining the same mental process [as with A.C.E.]. The conclusion reached by the examiner would be the same and verification is still required. But some examiners find the five-step formula easier to understand, easier to apply, and more precise in its explanation to a layperson." [2]

The following discussion will deal primarily with the 'Five-step' identification approach:

- 1) **Examination** of the latent.
- 2) Development of **Hypotheses** to be addressed.
- 3) **Experimentation**.
- 4) Formation of a **Tentative Conclusion**.
- 5) **Testing** the Conclusion.

Let's look at each step in detail:

1. Examination of the Latent

This step is comparable to the 'analysis' of the latent as in the A.C.E. method. David Ashbaugh describes the analysis stage as "intelligence gathering".

NB: *Quite often certain information, such as types of distortion present, are not always obvious in the latent at this stage and may be revealed later on in the friction ridge identification process.*

Why is a thorough 'examination of the latent' important?

Don't be fooled by first impressions! (Pun intended.) Even though some latents appear to be of extremely good quality (pores and intrinsic ridge shapes are present in addition to ridge paths being clearly visible) a standard but thorough analysis of the latent may reveal certain not-so-obvious factors. These factors may have a huge impact on the examiner's 'approach' to the comparison of the latent to the print and eventually his/her evaluation and conclusion of ident or non-ident. Latent Print Examiners beware! Everything isn't always as it seems!

When obvious distortion is present throughout the latent, a thorough examination will help the examiner reaffirm in his/her mind what is a friction ridge formation and what is not. If the examiner concludes that certain areas of the latent are affected by or actually caused by distortion, the 'examination of the latent' process will ensure that the expert has the ability to communicate why the latent has a certain appearance. This is especially true for more difficult and complex latents.

David Ashbaugh suggests completing the analysis from bottom of the latent to the top (in three dimensional terms):

- Start with the **substrate** (surface upon which the print is deposited)
- Proceed to look at signs in the latent that may indicate the type of **matrix** (substance that is transferred from the source to the substrate) which resulted in the creation of the actual latent
- Next, consider the **development medium** used to enhance the latent
- Consider noticeable indicators of **how the latent was physically transferred** onto the substrate (pressure-related distortion, flexibility of skin, handling of substrate).
- Consider any '**red flags**' or any other types of distortion that decrease the clarity and reliability of the information provided by the 'apparent' friction ridge formations or features.
- Clarity and tolerance levels are considered before proceeding with **major ridge path configuration** (2nd level detail), **intrinsic ridge formations** (3rd level detail) and **anatomical aspects**.

No matter what order you choose to complete the examination of the latent, it is important to follow the same order each and every time. Overlooking one or more steps could result in an inaccurate assessment and therefore impact the remaining steps in the identification process. Even with apparently uncomplicated latents, the steps should be followed as a matter of routine. The more time spent really analyzing latents, the more adept you will become at recognizing significant factors which will contribute to your final conclusion.

Suggested Protocol for the Examination of the Latent:

Clarity

Without question one of the first things considered when analyzing a latent print is clarity. As Latent Print Examiners we often look at so many low clarity impressions that when a high clarity print comes along it is much appreciated. We must realize though that good clarity such as well defined ridge path, edges and incipient ridges, comes to us with the knowledge that our tolerance for any discrepancies between the latent and the print should be at its lowest. If the *lack of clarity* is accompanied by a lack of quantity of 2nd and 3rd level detail, the examiner may have to rely on alternate information in the print such as creases, incipient ridges or scars in order to make a positive identification. In this situation our tolerance for distortion may be higher but 'sufficient detail' must include a greater quantity of information than if the latent print was clear. The quality of information (lack of, or abundance of, clarity in the latent) is an immediate caution indicator as to

the 'significance' of the information provided by the latent. The quality and quantity of information in the latent determines whether a positive identification can be effected.

Red Flags

It is important for Latent Print Examiners to look for the presence of 'red flags' contained within the latent or the surrounding area. Red Flags are abnormalities in the lift and serve as caution indicators. They include but are not limited to:

- 'Double taps' or 'layered' friction ridge impressions.
- Similar shaped ridge path formations in close proximity
- Matrix smears
- Colour (tonal) reversals.
- Inconsistencies in ridge width or general appearance.
- Light and dark areas.
- Sudden directional change in ridge flow.
- Is the appearance of the lift consistent with the surface from which it was lifted?

When taken into consideration, red flags will assist the Latent Print Examiner in his/her determination of how much significance, if any, certain areas of the latent will have in the identification process.

Development Medium

It is important to know what development process was used to enhance the latent. Each development medium has its own catalyst (substance with which the development medium reacts) and signature (the appearance it takes on after reacting with the catalyst). An awareness of these development medium characteristics will assist the examiner in accurately assessing ridge features contained within the latent.

Substrate Distortion

This is most evident on latents found on surfaces that are uneven or flexible such as serrated knives or plastic surfaces. Substrate distortion can also be found on colour documents such as letters and cheques.

Matrix Distortion

Matrix is the actual substance deposited by the friction ridges for example, sweat that may be contaminated with oil and dirt. Are characteristics of a 'wet' fingerprint present? According to David Ashbaugh, "Water, adhering to the friction ridges between the pores at the time of contact with the substrate, tends to be pressed to the sides of the ridge next to the furrows. This often creates thin matrix lines along each side of the ridge next to the furrows. The resulting print structure has ridge breaks between the pores giving the ridge a dot like appearance. In most cases wet print ridges will appear broken and should only be compared as if they were solid ridges or as second level detail."

Physical Transfer Distortion (P.T.D.)

I consider Physical Transfer Distortion to be any type of distortion caused from physical motion as the matrix was transferred onto the substrate. This could be evident in 'thick' ridges caused by downward pressure of the finger or palm. Lateral or downward swipes originating from the ridge detail area could be indicative of directional movement of the finger or palm shortly after it makes first contact with the substrate. A common example of this would be vertical or horizontal swipes across a surface such as a window being forced open. Flexibility of skin causes physical transfer distortion from normal handling of items such as grasping and holding, or simply anytime the skin comes in contact with an item. In other words, theoretically every latent or print has some form of P.T.D.

Anatomical Aspects

The location and direction of the latent on the substrate can provide valuable clues as to the correct orientation of the latent – especially if the pattern is not discernable. Correct orientation of the latent will certainly make the experimentation (comparison) process easier. If there is a cluster of prints, it may be possible to determine from which finger the print may have originated.

Choose A Target

Protocol for Selecting a 'Target' in the Latent:

- i) On or near a 'Focal Point'.
- ii) On one of the 'type' lines. (diverging ridges of the triradius area)
- iii) On the innermost recurving or recircuiting ridge.
- iv) Determine the outer parameters or 'defined area' containing the target.
- v) Use any 'occasional' features. (for example: creases and wrinkles, incipient ridges, permanent scars, temporary damage, open fields, warts, circular ridge and dissociated ridges)
- vi) Determine which finger or palm.
- vii) 'Name' the target. (more 'creative' names are easier to remember)
- viii) Draw the target. (aids the memory)

Note Taking

Pat Wertheim states that, "A thorough analysis should be accompanied by the taking of detailed notes describing the latent print. Notes should make reference to all observed distortion factors. Notes may also include reference to the level of clarity present in the print. One might actually draw the target, both as an aid in its memorization and as a part of the description of the latent. On occasion, one may even choose to physically follow or trace the ridges completely throughout the print and draw a representation of the entire latent in the notes. This type of demonstrable analysis lends credence to any subsequent identification."

2. Development of Hypotheses to be addressed.

This step is self-explanatory. The purpose of stating a hypothesis is to define your goal. There are only three possible hypotheses a Latent Print Examiner needs to address:

Latent was left by the same 'person of interest' who provided the inked prints.	Latent was left by another person other than the 'person of interest'.	Insufficient information in the latent or known print (or both) to conclude as to the source of the latent
Result = Identification	Result = Non- Identification	Result = Inconclusive

The three possible conclusions that result from testing the above-mentioned hypotheses help the Latent Print Examiner to answer the question, "What is the error rate of fingerprint identification?" Since the question addresses identifications only, the conclusions one may reach are now limited to:

- 1) The friction ridge impressions were left by the same source (Ident) or
- 2) They were not (Non-ident).

Therefore, unless the examiner has made a mistake, it will be the correct answer. The exact number of Latent Print Examiner or 'human' errors is unknown. The error rate for the Science of Fingerprint Identification is ZERO.

3. Experimentation

Experimentation involves going back and forth between the latent and the print, first finding features in the latent (assuming it's the most unclear print), then examining the known print for the same formations within tolerance.

GENERAL Guidelines for Experimentation (Comparing the Latent with the Inked Print):

- At this point, examination (analysis) of the latent is complete and its “full detail is fixed in the mind of the expert and all [obvious] factors of distortions have been considered”.
- Don't take any preconceived thoughts or expectations into the comparison. Don't ever “get married” to a specific digit determination or palm print orientation!
- Most often the latent is compared to the known print – this is assuming that the latent contains less information and detail than the known print. The experimentation process should be carried out such that the poorest quality print is compared to the best quality print.
- Use all known prints available i.e. rolled, flats and palms.
- Be in an ‘alert’ state of mind.
- Use of a magnification process is recommended. The standard fingerprint glass is most common but may be inadequate for a complete examination of third level detail.
- Be alert for ‘unaccountable differences’.
- Exclude any ‘formation’ or ‘feature’ that is not understood but, at the same time, keep an awareness of your tolerances. As these exclusions increase in number your tolerance for them must decrease to the point that too many exclusions must result in a non-ident.
- Consciously use all three levels of detail if possible – NEVER use only one and ignore other features. It is not valid to use some but not all of the **obvious** information present.

Three Levels of Experimentation

Note: Experimentation could begin at Level 1 or Level 2 or Level 3 depending on the total information available in the latent and print.

Level 1 - The ‘overall’ pattern is discernable in the latent. Other “overall type” features such as the presence of incipients, creases, scars may be evident without any magnification.

Is there agreement with the known print within tolerance?

YES	NO
Experimentation continues	Experimentation ends Results = Non-Ident

Level 2 – Observation of 2nd level detail commonly referred to as “points” or “major ridge path deviations”.

- 1) Locate the target* in known print. (*Refer back to the examination process if necessary for a detailed explanation of choosing a target.)
 - a. In same location?
 - b. Apply outer parameters.

- c. Search target only once, then shift to a different target.
 - i. As far from first target as possible
 - ii. 3 targets or 10 minutes
 - iii. move on to a different latent
- 2) Target must be within tolerance. Clarity of the prints will dictate your level of tolerance. “It is an easy task to understand and to account for the differences in appearance between a print resulting from a light touch and a print resulting from a heavy touch.” If this were the only difference between the latent and the known print, this difference would be explainable and said to be within tolerance. If the clarity of the latent is good, a target of a small enclosure in the latent where a short ridge is located on the known print would be considered out of tolerance at level two.
- 3) Search for additional features i.e. bifurcations, ridge endings, dots, enclosures, short ridges, ridge widths.
- 4) If possible, count the ridges from the triradius to the centre of core and compare with known print. Ridge count must be within tolerance.
- 5) “Run the Ridges”
Establish the route of each friction ridge. This helps to ‘bring out’ additional friction ridge formations that may have been missed previously. Ashbaugh explains that, “Independent ridge paths should be discernable; their flow should be **in concert** “. Unless 3rd level detail is visible, ridge breaks should be treated as if the ridge is continual. This is invaluable information for any Latent Print Examiner!
- 6) “Run the Furrows”
Establish the route of the furrows and determine whether or not they are in agreement with the ridges.

Is there agreement with the known print within tolerance?

YES	NO
Experimentation can continue on to Level 3.	Experimentation stops Result = Non-Ident

Level 3 - Observation of shapes within and along the ridges on close inspection only.

- 1) Look for intrinsic ridge shapes, pore shapes and relative one-to-another pore locations if visible (3rd level detail).
- 2) Poreoscopy
- 3) Edgeoscopy

Is there agreement with the known print within tolerance?

YES	NO
Experimentation is complete	Experimentation ends Results = Non-Ident

4. Formation of a Tentative Conclusion

If you have found substantial agreement of friction ridge formations in sequence between the latent and the print it is now possible to formulate a “tentative conclusion” that the latent came from the same source as the known print. As Pat Wertheim explains, “As most experienced Latent Print Examiners will recognize, the comparison does not cease at the first instant the expert reaches a conclusion. In practice, the comparison always continues past this point. The conclusion at the very first is, indeed, tentative.”

5. Testing the Conclusion

Substantial agreement of friction ridge formations in sequence has been established at this point in the identification process, however, using Pat Wertheim’s words, “The examiner continues to search for additional features until it is reliably proven that each time a new feature is found in the latent print, a corresponding feature will exist in the inked print. The continuing comparison, **testing the conclusion**, is the final step in the [identification] process. The hypothesis is said to be proven and the identification finalized when the examiner has established “reliable predictability” in the relationship of features as they exist in the unknown and known prints.”

Consider the question, “At what exact point did you know that you had an identification?” Based on the ‘Five-Step’ identification formula the Latent Print Examiner may choose to answer this question as follows:

“At the moment in time that it was reliably predictable that each isolated feature I selected from the crime scene print could be readily located and found to be sequentially in agreement with the inked print.”

Verification – Final Step in a Complete Scientific Methodology

Verification occurs when another Latent Print Examiner completes a second independent identification process of the first Latent Print Examiner’s friction ridge identification. A complete scientific methodology framework includes verification of the initial friction ridge identification and, in some cases, non-identification.

“Verification is a form of peer review and is part of most sciences. Many organizations erroneously use verification as a method of protecting against errors in place of adequate training. While verification may prevent the occasional error, its purpose is to verify process and objectivity as opposed to only check results. It is also an excellent vehicle for training.” [1]

This step is not to be treated lightly. It is an integral part in establishing friction ridge identification as a ‘science’. If the identification process has been adhered to by the initial Latent Print Examiner, a second Latent Print Examiner should be able to independently complete the verification process and arrive at the same conclusion. Independent verification should begin at Step 1 - Examination of the Latent.

“Without such verification, identification has not been proven to the level required by science. No report should be made of an identification until a second qualified expert has made that verification independently of influence or pressure from any source.”[2]

Conclusion

The "Five-Step Formula" and "A.C.E." are two established identification processes that outline a series of steps Latent Print Examiners can follow when making a friction ridge identification. Training, knowledge, experience and personal preference will determine which identification process the individual Latent Print Examiner finds most suitable. In light of recent North American court challenges, it has become increasingly important for Latent Print Examiners to be able to articulate the processes followed for each friction ridge identification.

The author has further attempted to emphasize that verification is also a process, one that is essential to the concept of 'good science'. Taken together, identification and verification processes provide a comprehensive scientific methodology that Latent Print Examiners can apply to current practices.

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References

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