

## **RELIABILITY OF FINGERPRINT ANALYSIS**

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### **INTRODUCTION:**

Friction ridge development may have arisen due to thousands of years of evolutionary development, but it has another use in modern science, specifically forensic science. Today, forensic science refers to any science applied to legal matters. There are many sub disciplines of forensic science, but all apply the topic to matters of law. Legal matters" refer to crimes or prospective crimes as well as civil disputes. No matter what sub discipline you intend to practice, legal matters are decided in a court of law. Courtroom testimony is a critical final step in the analysis of forensic evidence, whether that evidence is bones, insects, or fingerprints. Fingerprint analysis is a cornerstone of forensic science, used to identify individuals based on unique patterns on fingertips.

### **FINGERPRINT AS FORENSIC EVIDENCE:**

Fingerprint analysis is a cornerstone of forensic science, with a history spanning over a century. It's been instrumental in identifying individuals, linking suspects to crime scenes, and solving crimes. When a crime is committed, forensic science plays three key roles: determining if a crime occurred, identifying those involved and their connections, and reconstructing the crime scene. Fingerprints, taken from suspects and compared to existing records, are a crucial part of this process, helping investigators piece together the puzzle. They have been used to solve countless crimes over the course of history.

### **FORENSIC ANALYSIS:**

The uniqueness of fingerprints makes them a valuable tool in identification. Since no two fingerprints are alike, experts can link a print to its source. Fingerprint comparison involves analyzing two friction ridge impressions to determine if they match, essentially asking: did

the same person leave both prints? This process typically involves comparing unknown prints from crime scenes or evidence with known prints to determine the source.

Two key characteristics aid in this comparison:

- Pattern types
- Minutiae

Pattern types—arches, loops, and whorls—are not unique to the individual. They are class characteristics. Class characteristics are those features that place an individual or object in a group or subcategory. Minutiae are individualizing characteristics. Individualizing characteristics are those features that are unique to one particular person or thing. Fingerprint examiners analyze both the class characteristics and individualizing characteristics of fingerprints in order to reach a conclusion.

### UNIQUENESS AND PERMANENCE:

Two main premises form the basis for the science of fingerprint identification:

1. Fingerprints are unique.
2. Fingerprints are permanent.

Fingerprints are truly unique, with no two individuals sharing the same pattern – not even identical twins with identical DNA. This uniqueness is rooted in the random nature of fetal development, where tiny differences in pressure and growth create distinct ridge patterns. Throughout history, fingerprint identification has consistently confirmed this uniqueness, making them a reliable identifier. Fingerprints are also permanent, remaining unchanged throughout life. Formed in the womb, they stay the same despite aging, injuries, or environmental factors. Even attempts to alter or damage fingerprints can't erase their unique patterns, making them a robust tool for identification.

This combination of uniqueness and permanence makes fingerprints a valuable tool in forensic science, helping investigators link individuals to crime scenes and solve cases. It will first address the background, theory, and history of the science of fingerprint identification; followed by a discussion of the development, visualization, and documentation of latent fingerprints from evidence and crime scenes; and finally fingerprint comparisons and courtroom testimony.<sup>2275</sup>

### CRIME SCENE INVESTIGATION:

Crime scene investigation (CSI) is a forensic analysis of the location and circumstances surrounding a crime. It comprises gathering investigative, forensic, and physical evidence to link a sequence of events to reconstruct the crime scene. Evidence can be anything associated with a crime scene that may determine innocence or guilt in a court of law. Fingerprints are a big deal in crime scene

investigation. They can make or break a case by linking a suspect to the scene, the victim, or evidence. It's like connecting the dots – fingerprints can:

- Directly link a suspect to the crime scene (e.g., print on a door handle or window)
- Indirectly link a suspect to the crime (e.g., print on a piece of evidence like a gun or tool)
- Connect a victim to the crime scene
- Even help reconstruct what happened at the scene

By analyzing fingerprints, investigators can build a stronger case and get closer to solving the crime. Plus, fingerprints are tough to fake or erase, making them a reliable piece of evidence.<sup>2276</sup>

### CRIME SCENE KIT:

A fingerprint analyst's workspace is a controlled lab environment with all the bells and whistles, but a crime scene is a whole different ball game. It's unpredictable, and they have got to bring everything they need with. That's why crime scene investigators pack a crime scene kit with the essentials – it's like a portable toolbox filled with specialized gear to process the scene and collect evidence. They've got to be prepared to get the job done, no matter the conditions.

The following is a list of equipment and supplies necessary for a thorough CSI for fingerprint evidence: Gloves, Writing implements, Scales, Magnifier, Rubber/gel lifters, Fingerprint powders (black, bichromatic, magnetic, and fluorescent), Fingerprint brushes (fiberglass, feather duster, and magnetic), Fingerprint lift tape (various widths), Latent print backing cards (black and white), Silicone-based casting material, Light sources (flashlight and forensic light sources), Camera equipment (camera body, lenses, filters, flashes, tripod, and 1:1 latent print adapter), Ink pad, Tenprint cards or elimination print packet, Handprint System, Evidence

<sup>2275</sup> Hillary Moses Daluz- Fundamentals of Fingerprint Analysis – CRC Press Taylor & Francis Group – Pg.No.6,7,11

<sup>2276</sup> Roberta Julian, Leone Howes and Rob White - Critical Forensic Studies - Pg.No.121

packaging (paper bags, boxes, envelopes, etc.), Evidence packaging tape.

### ADMISSIBILITY OF NOVEL SCIENTIFIC AND TECHNICAL EVIDENCE

Scientific and technical evidence is different from ordinary evidence in several important ways. First, it is presented by individuals who have been accepted by the court as experts. Because of their special knowledge and training, they are allowed to give opinions and draw conclusions that an average person would not be able to make. In this way, experts help explain complex technical information to the jury. Second, since this type of evidence comes from scientists and specialists, it may appear highly accurate or unquestionable. For this reason, it is very important to make sure that such evidence is reliable and valid before it is presented in court. Most judges and jurors do not have the technical knowledge needed to judge its accuracy on their own, so legal safeguards are necessary to ensure its trustworthiness. This is especially important when the evidence involves new or innovative scientific methods or tools. Courts must be confident that these new techniques have been properly tested and proven reliable before relying on their results. The development of rules about admitting scientific evidence in court has been shaped by important cases that show how challenging it has been for courts to decide the standards for accepting new scientific methods.

### EXPERT TESTIMONY:

In addition to analysing evidence, one of the most important responsibilities of a forensic scientist is to appear in court and testify as an expert witness. This role distinguishes forensic science from other scientific fields. Not all skilled scientists are comfortable working in the stressful environment of a courtroom, and they may struggle to present their findings effectively. Likewise, someone who is a strong speaker may not necessarily be a competent scientist.

A successful forensic scientist must be capable in both areas—scientific analysis and clear, confident courtroom testimony. The following are some guidelines and tips for becoming an effective expert witness.<sup>2277</sup>

### MODUS OPERANDI :

**Modus Operandi** The successful identification of a latent print is only the beginning of an investigation. A fingerprint identification provides an answer to "who," but not to "what, when, or how in the investigation of a crime scene, knowledge and understanding of human behavior are invaluable as clues to where to find the best physical evidence, including latent prints. The more an investigator understands about the how and why of a suspect's criminal actions, the easier it is to concentrate on those areas that will be most productive in the hunt for evidence. Like the rest of us, much of a criminal's behavior is habitual. Certain burglars prefer certain entry points and particular methods of entering and searching. These habits become a criminal's modus operandi.

An investigator's experience helps them recognize patterns in crimes, known as the modus operandi (MO). This can include things like:

- Breaking in using a specific method (like pliers on doorknobs)
- Targeting specific items (like jewelry in master bedrooms)
- Acting out in peculiar ways (like making a sandwich or leaving messages)

These patterns can:

- Link multiple crimes to the same person
- Give clues about the suspect's identity
- Provide valuable evidence for prosecution

Sometimes, these quirks become a signature, making it easier to track down the perpetrator.

<sup>2277</sup> Max M. Houck and Jay A. Siegal - Fundamentals of Fingerprint Analysis - Second Edition - Chapter 23 Legal aspects of Forensic science - Academic Press - Pg. No. 591 & 603

It's like a criminal's fingerprint - unique and revealing.

### **FINGERPRINT COMPARISONS :**

The purpose of processing latent fingerprint and collecting known fingerprints is to compare one to the other to determine whether they come from a common source (i.e. whether or not the same person made both the known print and the latent). A latent print identification is possible due to the two premises of fingerprint analysis: friction ridges are but unique and permanent.

The fingerprint analysis process unfolds differently depending on the investigation's stage. When a suspect is identified, their known fingerprints (collected via powder, ink, or digitally) are compared to latent prints found at the crime scene. These latent prints are typically developed using powders or chemicals and then documented either physically on lift cards or digitally.

If there's no suspect yet, investigators follow a different path: They first compare the latent prints to elimination prints - these belong to individuals who had legitimate access to the scene, such as homeowners, witnesses, or first responders. This helps filter out irrelevant prints. Next, they search the remaining latent prints in the Automated Fingerprint Identification System (AFIS) database. AFIS allows for rapid searching through vast collections of prints, potentially linking the crime scene prints to a known individual in the system

This process helps investigators generate leads, identify suspects, and piece together evidence. The power of AFIS lies in its speed and scale, making it a crucial tool in modern forensic science.

A latent print will not usually be an exact replica of any other latent print or known print from a single source. Even when a person presses the same finger onto a surface several times, each latent impression will vary slightly. Factors such as the development technique used, the pressure applied during deposition, distortion,

the nature of the surface, the amount of residue present on the friction ridges, movement at the time of contact, and the skin's elasticity all influence the appearance of a developed latent print. These same variables can also affect the appearance of a known print recorded on a tenprint card or displayed digitally. In examining a latent print, an expert focuses on the overall pattern type, ridge count, ridge flow, and, most importantly, the nature and positioning of minutiae along the friction ridges.

Comparing fingerprints is an exercise in pattern analysis. Some people are more adept than others at pattern analysis. The successful latent print examiner is detail oriented and can perceive detail without succumbing to inherent biases imposed by the human mind.

### **EVALUATION:**

The evaluation stage is like the conclusion step in the scientific method. At this point, the examiner decides whether the latent print (the unknown print found at a scene) and the exemplar (the known print) come from the same person, from different people, or whether there is not enough information to make a decision.

This decision depends on how confident the examiner feels about the amount and clarity of details in both prints. The examiner looks at both the quality and quantity of features in the latent print and compares them with the known print. Their training, knowledge, and experience also play an important role in making this judgment.

The quantitative factors refer to the number and sequence of minutiae points (level two details) seen in the prints. The qualitative factors refer to overall features such as ridge flow, pattern type, scars, pore size, and pore location (level one and level three details).

### **VERIFICATION:**

The verification stage is similar to the peer review step in the scientific method. It acts as a double-check of the first examiner's decision. A second fingerprint examiner independently performs the same ACE-V steps and arrives at

their own conclusion. Verification is important because it helps prevent errors. If a mistake is made, an innocent person could be punished or a guilty person could escape justice. Either outcome is unacceptable.

The second examiner will either agree with or challenge the first examiner's conclusion. The final result—whether identification, exclusion, or inconclusive—is reported only if both examiners reach the same conclusion.<sup>2278</sup>

#### FLAWS:

Fingerprint evidence has several weaknesses. The examination process can be subjective, meaning it depends partly on the examiner's personal judgment. There is also a risk of examiner bias, especially if the examiner is exposed to background information about the case. Crime scene prints are often incomplete, smudged, or of poor quality, making comparison more difficult. There is no universal standard for how many matching points are required for identification, and matching partial prints can be particularly challenging. Environmental conditions can also affect the quality of prints, and in rare cases, fingerprints may be intentionally altered. All of these factors increase the possibility of false positives (wrongly identifying someone) or false negatives (failing to identify the correct person).

These problems can have serious consequences, including wrongful convictions or the release of guilty individuals. Because examiners must sometimes rely on subjective judgment—especially when dealing with partial or unclear prints—different experts may reach different conclusions when analyzing the same evidence. Bias is another concern. If an examiner is influenced by case details or expectations, it may affect how they interpret the print. This highlights the importance of maintaining objectivity and minimizing bias in fingerprint analysis.<sup>2279</sup>

#### CONCLUSION:

The fingerprint analysis is a powerful tool in forensic identification, its reliability hinges on several critical factors. These include careful handling of evidence to prevent contamination, expert analysis by trained professionals, and an awareness of potential pitfalls like partial prints or database mismatches. By acknowledging these limitations and leveraging advancements in technology, such as automated identification systems and AI-enhanced matching, fingerprint analysis can continue to be a trusted method in investigations. Ultimately, a balanced approach combining human expertise with technological support ensures the integrity and reliability of fingerprint evidence in legal proceedings

<sup>2278</sup> Hillary Moses Daluz- Fundamentals of Fingerprint Analysis - CRC Press  
Taylor & Francis Group - Pg. No. 228, 238, 244 & 245

<sup>2279</sup> <https://www.egattorneys.com/flaws-with-fingerprint-evidence>