ACE-V EXAMINATION METHOD TRAINING MANUAL

A Project

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by

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Division of Criminal Justice

Abstract

of

ACE-V EXAMINATION METHOD TRAINING MANUAL

by

Shauna Brittani Brewer

The Analysis, Comparison, Evaluation, and Verification (ACE-V) examination method is the current methodology used in forensic identification by latent print examiners. Law enforcement agencies use ACE-V as their preferred examination method as a way to change the science of forensic identification into a more objective process, and as a way to increase the amount of proper identifications. A training manual, on how to utilize the ACE-V examination method, will allow both experienced and future latent print examiners to gain the knowledge, expertise, and training necessary to conduct objective examinations. The manual will serve as guide for any latent print examiner, will answer questions that may arise during a comparison, and will lead to a

reduction in the rate of erroneous identifications. Utilizing this manual as a central reference point can effectively assist latent print examiners in their effort to objectively identify fingerprints.

_____, Committee Chair
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Date

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Chapter 1

Introduction

Forensic identification, the process of comparing finger and palm prints to solve crimes, is one of the most valuable forensic processes within the criminal justice system. This forensic science is considered to be a valuable process because it allows trained latent print examiners who work in law enforcement agencies to examine the unique friction ridge details on individuals' fingers and palms and make conclusive identifications (Barnes, 2012; Clark, 2002; Polson, 1950). These identifications link individuals to the scene of the crime. This science allows latent print examiners to take latent prints, also known as hidden and often incomplete prints, that are found at the scene of the crime (Dror & Mnookin, 2010), and compare them to known inked prints taken by various law enforcement agencies (Rodriguez, Jongh, & Meuwly, 2011). When latent fingerprints are recovered from the crime scene they are examined and compared to the known prints with the aim of making an identification (Bond, 2009). Latent print examiners are able to utilize this forensic process in such a manner because the details in friction ridge patterns do not repeat and are unique to every individual (Stoney, 2001). The uniqueness and individuality of finger and palm prints make forensic identification one of the most beneficial forms of identification.

Historically, latent print examiners sifted through numerous fingerprint identification cards comparing them to the latent prints found at the scene of the crime. It was an extremely laborious and time-consuming process that involved little training or

expertise (Cole & Lynch, 2006; Komarinski, 2005). In fact, as Grieve (1990) stated, "in the United States, there was no single entity that served as a model for fingerprint usage, let alone training and requirements" (p. 206). Due to the process being a simple matching procedure little training was thought to be of a necessity or even a requirement. As years passed, forensic identification units within law enforcement agencies initiated training programs to enhance and improve the process of forensic identification. Various methodologies were incorporated into agencies nationwide, including the Henry system, the Automated Fingerprint Identification System (AFIS), and what is currently used to make identifications, the Analysis, Comparison, Evaluation and Verification (ACE-V) examination method. These methodologies were created and adapted by various law enforcement agencies with the main purpose of training latent print examiners how to make more time efficient, justified, and consistent identifications (Clark, 2002; Egli, Champod, & Margot, 2007; Ulery, Hicklin, Buscaglia, & Roberts, 2011). As Clark (2002) stated, in order to make an individualization by fingerprints, it must be biologically and scientifically impossible for an impression to have been made by multiple individuals.

Statement of the Problem

The current examination method, ACE-V, was discovered and incorporated into various law enforcement agencies to decrease the rate of erroneous identifications and to make the subjective science of forensic identification into a more objective process (Speckels, 2011; Triplett & Cooney, 2006; Vanderkolk, 2004; Wertheim, 1990). The ACE-V examination method is intended to break down the identification process into

four different phases: Analysis, Comparison, Evaluation, and Verification. ACE-V is comprised of examinations, evaluations, investigations, decision-making, and documentation (Scientific Working Group on Friction Ridge Analysis, Study and Technology [SWGFAST], 2013a). It is about taking adequate time in each phase of this methodology to effectively determine whether or not the latent print and the known print came from the same source. However, due to the lack of knowledge, exposure and skill in using the ACE-V examination method, it is rarely used in its correct form (Speckels, 2011). Many examiners combine the first three steps, Analysis, Comparison, and Evaluation into one and then pass the case onto another examiner to verify the conclusion that was made (Vanderkolk, 2004). Even with the ACE-V examination method, latent print examiners have made errors that have led to misidentifications within our criminal justice system. This has been caused from the subjectivity of forensic identification, and the mere fact that different examiners utilize the ACE-V methodology in different manners and examine finger and palm prints in different ways (Speckels, 2011; Triplett & Cooney, 2006; Ulery et al., 2011; Vanderkolk, 2004). These errors have caused forensic identification to no longer be considered an infallible science.

Purpose of the Study

The purpose of this study is to create an ACE-V training manual for the Sacramento Sheriff's Department's Forensic Identification Unit. This manual will be significant because there is no similar document in existence at the Sacramento Sheriff's Department to train both experienced and future latent print examiners. It will allow latent print examiners to gain the knowledge, expertise, and training necessary on how to

conduct an objective examination, and will lead to a decreased amount of erroneous identifications in the subjective field of forensic identification. While the manual is intended for the Sacramento Sheriff's Department, the idea of a manual on the ACE-V examination method can be incorporated into other related law enforcement agencies, which are in need of formal documentation on how to utilize the ACE-V methodology. This manual will serve as a guide to new and experienced latent print examiners and will answer questions that they may have regarding the individual components of the ACE-V examination method.

Organization of the Project

Chapter one reviewed the background of fingerprints, and gave a brief introduction as to what the ACE-V method was about and the objective and purpose of the project. The remaining chapters will cover the project topic in a more detailed fashion. Chapter two is the literature review where previous research will be examined, analyzed and discussed. Chapter three will provide the reader with an overview of how the project was completed; i.e. how the idea was conceptualized, and what steps were taken to complete the project. The last chapter, chapter four, will briefly review the product of the project, provide the reader with limitations to the project, and will offer recommendations for future revisions to the training manual.

Definition of Terms

To ensure clarity, terms that are used often, and throughout the text are defined:

ACE-V. Acronym for the scientific examination method: Analysis, Comparison, Evaluation, and Verification. Commonly described as the scientific method that latent print examiners use to perceive detail in both known and latent prints and make decisions based on observations (Triplett & Cooney, 2006; Vanderkolk, 2012).

Analysis. The assessment of latent finger or palm print impressions to determine suitability for comparison (SWGFAST, 2013a; Vanderkolk, 2012).

Automated Fingerprint Identification System (AFIS). Computer technology that stores and searches millions of prints and retrieves possible candidates for fingerprint comparison (Jain & Pankanti, 2001).

Comparison. The side-by-side assessment of friction ridge details to determine whether the details in the two prints are similar in sequence and spatial relationships and therefore were produced from the same source (Vanderkolk, 2012).

Evaluation. The stage in the ACE-V examination method where the examiner determines, based on the analysis and comparison phases, whether the information contained in the two prints is sufficient to reach a conclusion of identification, exclusion, or inconclusive (SWGFAST, 2013a).

Exclusion. The decision made by the examiner which distinguishes that the two areas of friction ridge details did not come from the same source. There are sufficient features, within these two prints that are in disagreement, to make this conclusion (SWGFAST, 2013a).

Exemplar or known prints. Finger or palm prints taken in a controlled manner, such as a law enforcement agency, which serve as the example or model for comparison against prints that were retrieved from the crime scene (SWGFAST, 2013b).

Fingerprints. An impression of friction ridge details from any part of an individual's finger.

Friction ridge details. Area comprised of various components of the finger including the ridge flow, ridge characteristics, and ridge structure of any part of the finger or palm (SWGFAST, 2013b; Wertheim, 2012).

Identification. The decision made by the examiner which determines the two compared prints did originate from the same source (SWGFAST, 2013a).

Identification cards. Exemplar finger and palm prints that contain the name, date of birth and sometimes the x-reference, or arrest number, of a specific person.

Inconclusive. When the examiner is unable to conclude whether the two prints came from the same source. The friction ridge details, within the latent impression, lack adequate quality and a comparable area (SWGFAST, 2013a).

Latent prints. Hidden or concealed finger or palm prints that are developed through the crime scene investigation process, either in the field or in a laboratory. These developed prints are typically partials and are compared to known prints using the ACE-V examination method.

Ten-Print. An intentional recording of an individual's fingerprints (SWGFAST, 2013b).

Verification. "The independent application of the ACE process as utilized by a subsequent examiner to either support or refute the conclusions of the original examiner" (SWGFAST, 2013b, p.9).

Chapter 2

Literature Review

Introduction

Forensic identification is a scientific tool used in the criminal justice system to confirm the guilt or innocence of an individual who is suspected of committing a crime. It is considered a valuable forensic process because it allows trained latent print examiners to make comparisons and identifications, using the ACE-V methodology, based on unique characteristics that are contained on the palmar surfaces of an individual's fingers and palms (Barnes, 2012; Clark, 2002). This forensic science plays a key role in criminal prosecutions because out of the billions of fingerprint comparisons that have been completed, no two fingerprints have ever been found to be identical (Langenburg, 2012). However, just because no two prints have ever been found to be the same does not mean that errors have not occurred. In fact, due to the subjective nature of this science, errors have occurred and misidentifications have been made. In order to reduce the subjectivity, errors, and misidentifications it is essential that one understand the characteristics of fingerprints as well as their implementation into the criminal justice system. By understanding the history and unique individualities that are contained in every fingerprint, latent print examiners will be able to utilize the ACE-V examination method in a more objective manner. This will lead to an increased amount of proper identifications (Ulery, Hicklin, Buscaglia, & Roberts, 2012), therefore reducing the overall crime rate in the United States.

Understanding Fingerprints

The term *prints* commonly refers to the friction ridge impressions that lay upon the palmar surface (or palm side) of fingers, hands, and feet. These friction ridge impressions are the details that make it possible for latent print examiners to discover unique fingerprint characteristics as well as identify and link individuals to various scenes. In order to better understand how latent print examiners make these identifications, it is important to understand how the palmar surface of skin is formed and why the friction ridge impressions do not change throughout an individual's life (Ashbaugh, 1991; Hazarika & Russell, 2012; Moenssens & Meagher, 2012; Olsen, 1978; Stoney, 2001).

Friction ridge details are formed during the gestation period, which is a result of the human skin development process (Ashbaugh, 1991; Wertheim & Maceo, 2002). During this gestation period, ridged skin develops, as well as the epidermal and dermal layers of skin, and results in the permanence of friction ridge impressions (Ashbaugh, 1991; Wertheim & Maceo, 2002). This permanent ridged skin is caused by genetics and environmental factors, both of which are physiological (Ashbaugh, 1991). Genetics and environmental factors continue to contribute to the friction ridge impression development as the skin progresses through the gestation period and enters the maturation process (Wertheim & Maceo, 2002). As noted by Wertheim & Maceo (2002), as the skin progresses through the maturation process, the friction ridge skin completes its biological uniqueness and begins to take its own shape, structure, and path. These unique and permanent individual friction ridge skin impressions are what makes it possible for latent

print examiners to make identifications with certainty; because as Wertheim & Maceo (2002) stated, once biological uniqueness occurs during the maturation process, “No two organisms are exactly alike” (p.44). Therefore, once a fetus has fully developed and birthing takes place, the palmar surface of the skin is permanent and will not change throughout an individual’s life (Busey & Dror, 2012).

The palmar surfaces, fingers, hands, and soles of the feet, all contain permanent friction ridge details that remain the same throughout life, and even death (Olsen, 1978). However, while fingers, hands and feet can all be used to establish identity, the most common type of friction ridge details that are often discovered, examined, and compared are those found on the end joints of the hands, the fingers. Finger ridge impressions are the most common type of evidence found at crime scenes and can be broken down into three distinct categories of pattern types: loops, arches, and whorls (Cherry, & Imwinkelried, 2006; O’Neill, 1940). The most common type of fingerprint pattern is the loop, with approximately 65% of all individuals having at least one finger that contains a loop type pattern (Becker, 2009; LaChard, 1919; Olsen, 1978). The loop pattern contains ridges that enter from one side, make, or tend to make, a ring like curve, and exit on the same side they entered (Saviano, 2003). The next common pattern is the whorl, with about 35% of all individuals containing at least one whorl-like pattern (Becker, 2009; LaChard, 1919; Olsen, 1978). The whorl pattern is a pattern that contains ridges that form at least one recurving ridge and takes on the resemblance of a circular shape (Saviano, 2003). The last pattern type, the arch, is only common in about 5% of all individual fingerprints (Becker, 2009; LaChard, 1919; Olsen, 1978**)**. The arch pattern

enters on one side of the print, curves upward and exits on the opposite side on which it entered; it tends to take on the shape of a hill (Saviano, 2003). These three pattern types can be referred to as level 1 details and make up the first step in classifying and analyzing both latent and exemplar prints. Level 1 details are the first step taken when beginning to analyze a latent or exemplar print (Saviano, 2003; Vanderkolk, 2012). These details determine the general pattern type and the flow of the ridges, however they do not have the ability to identify the unique characteristics of friction ridge details, nor can they establish the identity of an individual (Saviano, 2003).

The ridged skin on the fingers does not only contain the pattern area and the general flow of the ridges (level 1 details), but it also contains unique characteristics that individualize and separate one fingerprint from another. The ridges on the friction skin do not tend to flow in one continuous movement. In fact, the ridges often have features that contain broken up ridges that take on various shapes, sizes, and directions (Clark, 2002; Vanderkolk, 2012). These individualizing and unique characteristics are commonly broken down into three main types: ending ridges, bifurcations, and dots (Olsen, 1991). These unique features, of specific ridge flow and differing points of minutiae are referred to as level 2 details and can be used to make an identification when examining and comparing fingerprints in criminal investigations (Anthonioz, Egli, Champod, Neumann, Puch-Solis, & Bromage-Griffiths, 2011; Vanderkolk, 2012).

While level 2 details contain sufficient unique characteristics and individualizing information, there is one more level of detail that needs to be introduced, level 3 details. Level 3 details contain characteristics, such as the positions of pores and edges and the

shapes of the minutiae on the palmar surfaces of the fingers (Anthonioz et al., 2011). However, it is not common to see pores and shapes on prints; most of the time they are not visible. Therefore, level 3 details are not required for a latent print examiner to make a conclusive identification (Anthonioz et al., 2011).

The three levels of details assist in the analyzing, comparing and evaluation of friction ridge impressions. However, there is another aspect that contributes to the forensic identification examination process, the clarity of the prints (Ashbaugh, 1991; Clegg, 1998; Hicklin, Buscaglia, & Roberts, 2013; Osterburg, 1964; Ulery et al., 2011). The clarity of a print refers to the amount of distortion, such as smudges, overlaid prints, and cloudiness that a latent print may contain and can often be compared to a spectrum (Ashbaugh, 1992). As stated by Ashbaugh (1992), on one end of the spectrum if all, or most, of the ridge details are visible, then the clarity is accepted to be of good quality. On the other end of the spectrum, if the latent print is distorted and smudged, then the clarity is accepted to be lacking. Therefore, the greater the clarity in a fingerprint, the higher the acceptability rate. However, the clarity of a friction ridge impression directly corresponds with the latent print examiner's confidence in the presence, or absence, of unique characteristics, which can be carefully and correctly discerned when comparing and evaluating the two prints (Clegg, 1998; Cole, 1998; Olsen, 1978; Hicklin et al., 2013; Osterburg, 1964; Ulery et al., 2011). Therefore, while many latent prints will lack clarity, the latent print examiner's training and expertise in the field will make up for what the latent print lacks in appearance.

The development of unique and permanent friction ridge palmar surfaces during the gestation period, and the way in which latent print examiners conduct their examinations, make forensic identification one of the most beneficial and positive forms of identification. The use of forensic identification can place an individual at a scene of a crime and lead to a conviction. Without the understanding of how fingerprints become unique and why they are permanent, it would be difficult to accept this form of identification. However, fingerprint identification is a beneficial scientific tool, and therefore it is important to understand how fingerprint identification became a worldwide phenomenon and how it became one of the most common types of physical evidence used in criminal investigations.

History of Fingerprints

The introduction and implementation of fingerprint identification dates back to 221 B.C., where it was used as a way to conduct business transactions, sign documents, and conduct trades between various individuals (Barnes, 2012). Individuals impressed their fingerprints onto business documents and transactions to claim ownership. There was no evidence that indicates these individuals realized, or understood that fingerprints were unique and different between individuals. It has been discovered that the first culture to use the friction ridge impressions of fingerprints, as a means of identification, was the Chinese (Barnes, 2012). The Chinese sealed their fingerprints in clay to show authorship and to prevent others from tampering or impersonating with their original work (Barnes, 2012). From that point on fingerprint identification was considered to be an infallible means of personal identification (Barnes, 2012; Clark, 2002; Polson, 1950).

This individualization relied and still relies on the fact that no two individuals have ever been found to have identical matching fingerprints due to their unique friction ridge characteristics (Clark, 2002). While it is evident that fingerprint identification dated back to 221 B.C., it was not until the nineteenth and twentieth centuries that fingerprint identification took on a scientific approach. This scientific approach changed how criminals were convicted.

The implementation of fingerprints changed the criminal justice system and the way in which criminal justice professionals differentiated people based on one individualistic characteristic, their fingerprints. In the late 17th century, various European scientists began publishing their observations and findings regarding friction ridge details and the skin (Barnes, 2012). In 1684, Nehemiah Grew was the first European scientist to describe, in detail, friction ridge skin. Only three years later, in 1687, the Italian physiologist, Marcello Malpighi described in detail the function, form, and structure of friction ridge skin and made an observation with a microscope, stating that individuals contained spirals, loops and ridges on their fingerprints (Barnes, 2012). While Malpighi was able to make this observation, he did not understand the significance of his observations. Malpighi and Grew contributed to a phenomenon that would continue to be studied for hundreds of years to come.

It was not until a hundred years later, when J.C.A. Mayer of Germany presented an arrangement of ridges theory stating that the friction ridge skin never duplicated between two persons. However, individuals could contain some similarities (Polson, 1950). This theory sparked great attention, and the research regarding fingerprint

identification made significant advances. Fingerprint identification gained significant scientific importance, and in 1823, John Evangelist Purkinje, a professor of anatomy at the University of Breslau in Germany, confirmed, via J.C.A. Mayer, that fingerprints were unique between all individuals. That same year he published a thesis, regarding the diversity of ridge patterns between individuals and established and described various fingerprint patterns (Barnes, 2012). He described and separated the fingerprint patterns into various categories including, but not limited to: ellipses, almonds, circles, and spirals (Polson, 1950). These few discoveries motivated researchers to continue to study fingerprint identification.

Now that fingerprints were an interested study topic, it was time to develop an application of using fingerprints for practical reasons. During the 1850s, Sir William Herschel, the British Chief Administrative Officer for Hooghly District of Bengal, India, recognized that fingerprints were a source of human identification (Polson, 1950). About twenty years later in 1877, Herschel increased and improved the practical use of fingerprinting and submitted a request to extend his fingerprint system into jails, so that prisoners could be readily identified (Barnes, 2012). Throughout his twenty years of observation, Herschel determined that fingerprints did not change over time. However, he was never able to develop a generalized fingerprint classification method that could be easily accessed and used. It was only two years later in 1879, when Dr. Henry Faulds, a Scottish medical missionary, described in the scientific journal *Nature* that in his observation of fingerprints there was a use for them in detecting and identifying criminals (Barnes, 2012; Berry & Stoney, 2001). Faulds' observations, concerning detection and

identification of criminals, allowed for the possibility of identifying criminals by the latent impressions they left behind at various crime scenes. Quickly after, in 1882, the United States discovered and documented their first record of the use of fingerprints (Berry & Stoney, 2001).

The discovery of fingerprints, by Herschel, as a way to identify criminals was continued by Sir Francis Galton (Barnes, 2012). Sir Francis Galton, an English biologist, continued Herschel's work by making his own fingerprint observations. Through his observations, he discovered various details within friction ridge impressions and legitimized patterns. These discoveries are referred to as *Galton's details* and/or *Galton's characteristics* (Barnes, 2012; Clark, 2002). In addition to making these discoveries, Galton was the first to establish that friction ridge skin was unique and persistent throughout an individual's life (Barnes, 2012).

Another leading fingerprint researcher at this time was Juan Vucetich. Vucetich, who had studied Galton's research and discoveries, began his experimentation with fingerprints in 1891 (Barnes, 2012). Vucetich began recording fingerprints of criminals and formulated his own classification system, which became the first practical use of fingerprints by law enforcement (Barnes, 2012). Other countries began looking into this criminal fingerprint classification system, and soon after Sir Edward Richard Henry, the Commissioner of London's Metropolitan Police Department, developed his own system of fingerprint identification. Sir Edward Richard Henry's classification system classified fingerprints into groups, based on pattern type and Galton's research (Dror & Mnookin, 2010). Henry's classification system was published in 1900 and was used by the Federal

Bureau of Investigation (FBI) and English speaking countries for years to come (Barnes, 2012). The Henry classification system, while used for years, turned out to be a laborious and time-consuming classification process. However, this would not be discovered for some time, for these major strides made during the nineteenth century changed the way in which criminals would be both identified and convicted.

Fingerprint identification changed dramatically throughout the nineteenth and twentieth centuries. Prior to the Industrial Revolution, most people lived in rural communities where everyone knew each other, so the need for identification was minimal. It was not until after the Industrial Revolution when communities became heterogeneous that the need for an identification system increased. It was at the end of the nineteenth century and the beginning of the twentieth century when fingerprint identification systems emerged as a way to identify criminals (Moses, Higgins, McCabe, Prabhakar & Swann, 2012).

In 1906, the first conviction in which fingerprint identification played a significant role was issued in the United States (Rodger, 1984). However, during the first ten years of the twentieth century, the use of fingerprints in criminal identification was minimal (Grieve, 1990). It was not until the 1920s when local police identification bureaus established fingerprint systems. On July 1, 1924, under the authority of the U.S. Congressional budget appropriation bill for the Department of Justice (DOJ), Congress established and formed the Identification Division at the FBI (Moses et al., 2012). When the Identification Division was first established, it contained a total of 810,188 fingerprints (Moses et al., 2012). In 1933, the FBI created the Latent Fingerprint Section,

followed by the Civil Identification Section. When individuals were arrested, they would be fingerprinted and their fingerprints would be filed in the Latent Fingerprint Section. With crime rates rising, the files continued to grow. The number of fingerprint cards continued to rapidly increase, and thirteen years later, in 1946, the one-millionth fingerprint card was received into the FBI Identification Division (Newton, 2003). This was now the world's largest collection of fingerprint records (Grieve, 1990). This increase in crime and fingerprint cards increased the daily workload of latent print examiners (Moses et al., 2012). This manual system, used to search files and identify fingerprints to criminals, was a laborious event.

It was in the 1960s and 1970s, that the Automated Fingerprint Identification System (AFIS) was created (Moses et al., 2012). However, AFIS was not fully implemented worldwide until 1999 because problems with databases and computer technology limited their use and effectiveness for latent examination work (Moses et al., 2012). However, throughout this evolution, the AFIS database continually developed as a way in which latent print examiners could search and locate specific fingerprints in a timely manner (Bond, 2009; Lin, Liu, Osterburg, & Nicol, 1982; Liu, Lin, Osterburg, & Nicol, 1982).

AFIS is a computerized system that stores individual fingerprints and allows for latent print examiners to search latent or partial prints against stored exemplar prints (Dror, Wertheim, Fraser-Mackenzie, & Walajitys, 2012). It has the ability to store millions of prints and also search for them in a matter of minutes. Once the search is complete the AFIS database produces fingerprints that are likely to match the latent print.

It is important to remember that while AFIS does this search in a matter of minutes, it is up to the latent print examiner to complete a manual comparison of all possible candidates. AFIS was created to be a helpful information storage unit that made the process of searching for possible candidates a more reliable and efficient task. Therefore, latent print examiners do not rely on AFIS, but instead AFIS relies on the examiner to locate the fingerprint that contains no dissimilarities. As Komarinski (2009) stated, "latent examiners make idents, not AFIS" (p.4).

Forensic identification has played a major role in our society for over one hundred years (Charlton, Fraser-Mackenzie, & Dror, 2010; Dror, Peron, Hind, & Charlton, 2005). This science has been evolving and continues to evolve throughout our society; from time consuming laborious searches of possible suspects, to the development of AFIS to make this science a more time efficient and reliable task. While technology has played a positive role in forensic identification it is important to remember that latent print examiners still use a method to manually compare and evaluate identifications. This scientific method is known as Analysis, Comparison, Evaluation, and Verification (ACE-V).

Overview of the ACE-V Method

ACE-V is the scientific method used in forensic identification to identify whether or not two prints are identical and came from the same source (Langenberg, 2009). It is a scientific process that is intended to objectively analyze, observe, and evaluate friction ridge impressions and their details (Speckels, 2011). However, while ACE-V's current

form is intended for the sole purpose of objectively analyzing friction ridge details that is not why it was originally created.

The term ACE-V was created by Roy Huber, an Assistant Commissioner from the Royal Mounted Canadian Police (RCMP), in 1959, and was originally termed the *Law of ACE* (Triplett & Cooney, 2006). The *Law of ACE* was more commonly referred to as the ACE methodology. Huber created ACE with the purpose of discovering a method that would be considered scientific in nature (Speckels, 2011; Triplett & Cooney, 2006). He is credited with defining this approach as a way to compare two things, regardless of subject matter, and to identify if the two items have a correlating relationship (Speckels, 2011). It was an instrument that applied the essential components of the scientific method. These essential components of the scientific method included asking a question, forming a hypothesis, testing the hypothesis, analyzing the data, and drawing conclusions. Huber's creation of ACE followed many of these steps.

Huber's methodology always began with forming the same question regarding whether or not the two items of comparison shared a common relationship (Speckels, 2011). The first step in his ACE methodology began with a comprehensive analysis of the object that was being studied. This analysis phase was similar to forming a hypothesis. During this analysis phase, examiners observed, comprehensively, the quality, uniqueness, and varying characteristics that the object under study contained (Speckels, 2011; Triplett & Cooney, 2006; Vanderkolk, 2004). Once the analysis of the object was complete, the examiner continued on to the next phase of comparison. During this phase, the two items of study were compared to one another and essentially the

hypothesis was tested, as to whether or not the second object contained the same unique and varying characteristics as the first (Vanderkolk, 2012). Once the comparison was complete and the examiner believed that s/he had sufficient information to form a conclusion, the examiner would move into the final step of the ACE methodology known as evaluation. During this evaluation phase, the examiner would note whether or not the two items shared a relationship and did, in fact, come from the same source (Speckels, 2011). While evaluation was the final step in the ACE methodology, it is evident that Huber was forgetting a step in the scientific method: the verification, or retesting of the original hypothesis (Speckels, 2011; Vanderkolk, 2004). It was not until twenty years after the original implementation of ACE that David Ashbaugh, in 1979, added verification to the ACE methodology. This modification changed the name from ACE to what it is more commonly referred to as, ACE-V. David Ashbaugh suggested that ACE-V was more of a scientific method than ACE because it retests the hypothesis by conducting a verification process for every comparison that is conducted (Ashbaugh, 1999). As Ashbaugh (1999) stated, "verification is a form of peer review and is a part of most sciences…its purpose is to verify the process and objectivity as opposed to only checking results" (p. 148). Once verification was formally added to the ACE methodology, the scientific method was completed.

The addition of verification to the ACE method in 1979, made ACE-V a scientific method that was beneficial to latent print examiners and the way in which they conducted their friction ridge examinations. The ACE-V methodology became a convenient tool for latent print examiners to accurately utilize the components of the scientific method, in an

objective manner, to determine whether or not two friction ridge impressions came from the same source and shared a similar relationship (Speckels, 2011). It became the common method used throughout many forensic identification agencies.

Up to the current date, ACE-V is still the main method used to conduct the manual comparison of two prints. It is the scientific method of forensic identification. However, it is important to understand that ACE-V is an applied science. This means that ACE-V is a scientific method that relies on both interpretation and judgment (Speckels, 2011). ACE-V, while it is intended to be utilized in an objective manner, still contains some factors that need to be addressed. The fact that ACE-V is utilized as an applied science, where judgments and interpretations play a vital role in the decision-making process, leaves room for biases and errors to be made. This process is therefore more subjective than one may realize. In order to determine a way in which to make ACE-V a more objective scientific process and decrease subjectivity and error rates in the field of forensic identification, it is important to understand why biases and errors take place. The next two sections will focus on subjectivity and errors and the major roles those two subjects play in the manual comparison of forensic identification.

Subjectivity and Bias

Subjective and personal biases affect the forensic identification examination process in a negative manner. Subjectivity relies on personal knowledge, judgments and views regarding various subjects and leads to biased opinions and conclusions. In forensic identification, subjectivity and personal biases have played a major role in the decision-making process (Black, 2012). This is true because humans are involved in the overall

assessment of the examination and often times rely on past experiences, knowledge and personal judgments to arrive at conclusions (Black, 2012; Speckels, 2011).

Different factors involved in a case can influence latent print examiners during their examination and affect the reliability and reproducibility of a case (Ulery et al., 2012). These subjective and biased factors are known as contextual and confirmation biases (Budowle et al., 2009). Contextual bias is the use of information to reinforce a position that is consistent with a person's own thoughts and beliefs (Budowle et al., 2009; Langenburg, Champod, & Wertheim, 2009). Confirmation bias is the intentional searching of additional information to reinforce and confirm beliefs and to avoid information that disagrees with one's own opinion (Budowle et al., 2009). These biases result from the natural tendency to interpret information in a manner that categorizes, communicates, and classifies with one's own personal beliefs (Budowle et al., 2009). It demonstrates that emotional and individual thoughts play a critical role in how information is interpreted and evaluated (Dror et al., 2005). Unfortunately, this leads to subjective decision-making and overrides sound judgment in forensic identification.

In the study, conducted by Dror et al. (2005), latent print examiners were introduced to information regarding various criminal cases. This information included background on the case, emotional and explicit crime scene photographs, and how and where the prints were collected from. Once this information was given to the examiner they were asked to conduct a comparison, using the ACE-V method, and conclude whether or not the latent and the exemplar print shared a similar relationship. The study discovered that when the latent prints were distorted, smudged and difficult to analyze,

that confirmation bias, contextual bias, and background information on the case, did affect the way in which the examiner analyzed and compared the prints. It was noted that distorted and difficult prints led to an increased number of erroneous and false identifications. This discovery illustrates that subjective and biased opinions influence the comparison and identification process. The emotional background of explicit photographs and details, regarding the case at hand, affected the sound judgment of the examiner (Budowle et al., 2009; Dror et al., 2005). In another study, conducted by Dror & Charlton (2006), subjective thinking also played a role when examiners were given prints and told whether or not they shared a similar relationship and came from the same source. Therefore, subjective and biased evaluations result in conclusions that can lead to erroneous identifications.

This unintentional, or sometimes intentional, thinking affects how others perceive forensic identification. If forensic identification is considered to be subjective, due to the influence of human examiners, then it will lose credibility with criminal investigations as well as with the criminal justice system. It is essential to this scientific field that a more objective process be developed to prevent biased and subjective conclusions. Minimizing the subjective nature of forensic identification will increase the reliability of the ACE-V method by incorporating and influencing a more objective way of thinking during the forensic identification process (Ulery et al., 2012).

Errors

Expert assessment and performance are important factors in the forensic identification process (Dror & Charlton, 2006). The proper assessment and comparison

of prints can affect why and how often errors occur. Errors in forensic identification often occur because of the lack of proper training, expertise, and attention to detail. These areas of errors do not occur consistently, but do in fact tend to occur for trivial, technical reasons (Black, 2012).

Errors tend to occur because the lack of skills and judgments that various examiners possess (Budowle et al., 2009; Ulery et al., 2012). This lack of skill can be due to relatively short or inadequate training and can result in technical errors that include matching a latent to the wrong exemplar fingerprint (i.e. stating that the right index finger matches the latent, when in reality it is the left index finger that is the true match to the latent). These errors often result because of the ambiguity that is involved in the latent and exemplar print comparison process.

Erroneous identifications can also result from ambiguous and unclear latent prints. Latents are often smudged, distorted, and unclear prints that are left behind at the scene of a crime. When latent print examiners analyze these prints they can interpret distortion and smudges as unique characteristics and therefore compare the latent to the exemplar print with a false and erroneous idea of what pattern and characteristics the latent print contains. The distortion and smudges within a print are due to the pressure and positioning of the finger when laid onto a surface. This is common in latent print examinations and can often make two matching prints look completely different and non-identical. This leads to errors within forensic identification.

One example of pressure distortion and wrongful examination was conducted in 2004, in the Madrid, Spain bombing (Cole, 2005; Dror et al., 2005). In 2004, a latent

fingerprint was discovered at the scene of the bombing in Madrid. The fingerprint identification examination was conducted by the FBI Latent Fingerprint Unit and was matched to a gentleman living in the United States named Brandon Mayfield. Mayfield was subsequently arrested for the bombing, after the discovery by the FBI Latent Print Unit, and was placed into custody. However, he was the wrong suspect. A few weeks later, Spain officials contacted the FBI Latent Fingerprint Unit and claimed that they had found the suspect, in Spain, and had made an arrest. The two prints were re-examined and it was discovered that the FBI had in fact made an error and arrested the wrong man. This error was caused by ambiguity of the latent print, and therefore led to the erroneous examination and comparison of the latent print to the exemplar set of prints that had been produced by the Automated Fingerprint Identification System (AFIS). Three different latent print examiners had verified this examination and all confirmed that Brandon Mayfield's prints were identical to the latent found at the scene (Cole, 2005; Dror et al., 2005).

The Brandon Mayfield error occurred because the lack of clarity and distortion that was contained in the latent print. It was an error that occurred due to emotional and biased perspectives, as well as improper evaluation of the two prints. The latent print examiners were confident that the two prints came from the same source and disregarded any dissimilarity that was present (Leo, 1998). This error could have been prevented.

It is impossible to completely eliminate errors within the forensic identification examination process because it is human examiners who make the comparisons (Budowle et al., 2009; Dror & Charlton, 2006). All humans will make mistakes as part of

our human nature. However, it is important that latent print examiners understand how errors arise and how they can be prevented through careful and appropriate analysis, comparison, and evaluation during the ACE-V methodology process. The more specialized training a latent print examiner has on errors and how they can be prevented, the more reliable and reproducible the results will become (Ulery et al., 2012).

Summary

Forensic identification is a specialized scientific field. There are several components to understanding how friction ridge detail, on latent prints, is analyzed, compared, and evaluated to exemplar prints. Understanding the components of prints improves the forensic identification process, as does training, experience, skill and judgment. These factors will improve how the examination and comparison process will be conducted.

Forensic identification is currently a subjective field that utilizes the scientific method ACE-V. In order to properly utilize the scientific method, subjectivity, biases, and errors need to be minimized. It is important that objectivity within forensic sciences is of a high priority. Without objectivity the ACE-V method is of no scientific value. Therefore, it is important to create an ACE-V training manual that will train both experienced and future latent print examiners on how to properly conduct an objective examination. This manual will serve as a guide on how to properly use the ACE-V method and will lead to a decreased amount of erroneous identifications. While there is no possibility of 100% objectivity, due to the use of human examiners in this forensic field, there is a possibility for a higher level of objectivity (Dror & Charlton, 2006). By

placing the main focus of the ACE-V examination process on completing a comparison in the most objective way possible, it will improve the forensic identification process and make it a more reliable field (Ulery et al., 2012).

Chapter 3

Project Process

The intent of this project was to create an Analysis, Comparison, Evaluation, and Verification (ACE-V) training manual for the Sacramento Sheriff's Department's Forensic Identification Unit. This manual describes, in detail, how to properly utilize the ACE-V method for forensic identification. The creation of this manual is significant because there are no similar documents in existence at the Sacramento Sheriff's Department to train both experienced and future latent print examiners. Rather, current latent print examiners are briefly introduced to the ACE-V methodology through reading materials that state what an ACE-V examination should entail. They are not given specific instructions on how to properly conduct this examination and are not held to any specific standards. Therefore, this ACE-V examination training manual allows latent print examiners to gain the knowledge, expertise and training necessary to conduct objective ACE-V examinations and will lead to an increased amount of proper identifications.

The conception of this project stemmed from work in the forensic identification field. The researcher developing this training manual works in the Forensic Identification Unit at the Sacramento Sheriff's Department and in that employment, observed that there was no other documentation in existence that identified the process and steps utilized during the ACE-V examination method. This training manual provides an in-depth description on how both new and experienced latent print examiners can conduct the examination method in an objective manner. The manual serves as a guide to assist and

answer foreseeable questions that latent print examiners may have regarding the individual components of the ACE-V method. This training manual was created with the intent to minimize errors, subjectivity, and biased opinions when making fingerprint identifications. It is a training manual that engages the trainee, or reader, by utilizing a hands-on approach that involves the usage of fingerprints as a visual learning aid.

The materials for this manual were collected from official source information that focused on the ACE-V method and discussed the method's strengths and weaknesses. The official source information included journal articles and books relating to the science of forensics, a guide book on preparing and creating an effective and instructional training manual for various agencies, as well as personal communication with present latent print examiners who work in the field at the Sacramento Sheriff's Department. Once these items were collected, evaluated and understood, the author made a detailed outline that briefly depicted what the manual would entail. The author first began by determining what information the reader would need to know before s/he began reading and learning about the ACE-V examination method. The author decided to begin by giving a brief introduction as to what ACE-V was, what the acronym stood for, and the purpose of creating the manual. Next, the author outlined the importance of remaining unbiased during examinations, and how the reader could use the manual as a reference source to ensure that s/he was remaining as objective as possible. The next section that was outlined described the organization of the rest of the manual. Once these sections were outlined, the author began to break down the outline in a more detailed fashion. The author bullet pointed the topics needing to be addressed and discussed in every step

of the ACE-V method. The last section of the manual, report writing, was outlined after the rest of the manual had been written. Waiting to create the report-writing template allowed the author to more fully understand the independent role of every step in the ACE-V method. Therefore, the author was able to create a more comprehensive template that would assist the latent print examiner in his/her examinations.

Once all the sections were thoroughly outlined, and before the writing began, the author incorporated styles and techniques referenced in *How to Write & Prepare Training Manuals.* The styles that the author included in the ACE-V training manual included presentation and layout techniques, and information on how to create various sections that would be easy to understand. In the book, *How to Write & Prepare Training Manuals,* the author Stimson (2002) stated that the layout and presentation of any training manual would encourage the reader to look at and learn the material. The presentation and layout of the training manual is the responsibility of the author, and if presented in an appealing manner will persuade individuals to read the given material (Stimson, 2002). Important layout and presentation features include using easy-to-read headings, colors on the pages, and pictures. In conjunction with these features, the author should not place too much writing on a single page, and should focus on breaking the manual up into short and logical sections that are connected with smooth transitions (Emerson, 1952; Stimson, 2002). By breaking the manual into logical sections and minimizing the amount of words on any one page will make the manual look less intimidating to the reader, and will make for an easier read and therefore, a more understandable piece of training material (Emerson, 1952; Stimson, 2002). Once the author of the ACE-V training manual was

informed about these styles and techniques to write and prepare training manuals, production of creating the manual began.

The final product is a manual describing how ACE-V could be conducted in an objective manner, and illustrated, through the use of visual examples, how objective and unbiased identifications could be accomplished. The fingerprint examples collected for this study were training materials that had been created and copyrighted by Michael Stapleton, CEO of Stapleton & Associates, LCC and Retired Federal Bureau of Investigation (FBI) Special Agent. This training material was composed of 80 different ten-print cards that contained fingerprints of individuals who were given fictitious identities. Once the fingerprint examples were obtained, the researcher randomly selected the fingerprint examples that would be incorporated into the ACE-V training manual. The prints were used as examples in the manual as a visual learning tool. The objective for using these fingerprints allows the trainee, or reader, to conduct a mock examination using the ACE-V examination method.

This specific product, produced for this project, includes an ACE-V training manual complete with visual learning tools. It was completed in a clear and concise manner so that any layperson could read and comprehend how to complete an objective fingerprint examination. The fingerprints used in this manual were used solely as a visual learning aid that enhanced the value of the training manual itself. The ACE-V training manual is a product that engages the reader by allowing them to practice the examination process and to understand how to break down the ACE-V steps and

complete an objective and valid examination. This product will hopefully increase the reliability and validity of the ACE-V methodology.

Project Product

This manual (see Appendix A) will serve as a guide for the Forensic Identification Unit at the Sacramento Sheriff's Department. The manual is divided into ten sections. The sections are as follows:

Introduction. The first section explains the need and purpose of an ACE-V training manual. It briefly discusses how the Sacramento Sheriff's Department's Forensic Identification Unit does not have any formal documentation regarding the ACE-V methodology and how using the ACE-V method will reduce erroneous identifications.

Employee roles and responsibilities. This section discusses the goals, objectives, and roles and responsibilities of latent print examiners when using the ACE-V method. These goals and objectives include remaining unbiased throughout the examination process as well as using objective judgment, rather than subjective. It clarifies the latent print examiner's role during the ACE-V examination process and describes the importance of latent print examiners and how using ACE-V in an objective manner leads to an increased amount of proper identifications.

Organization. The third section of the manual describes the manual's layout. It lists the remainder sections and explains the importance of having those sections within the manual.

ACE-V definitions. This section defines and gives a description of the ACE-V examination method. It describes the purpose for ACE-V and will assist the reader with better understanding why ACE-V is an important aspect in our criminal justice system.

Analysis. This section introduces the first step of the ACE-V method. Within this section, the three levels of details are explained and fingerprints are used as visual learning aids. Discussing the three levels of details and using fingerprint examples makes the analysis phase of the ACE-V method more manageable. By breaking down the three levels of details, the reader is able to use these notes for future fingerprint examinations. This will assist in ensuring that fingerprint examinations are being completed in an unbiased and objective manner.

Comparison. This section covers the second step involved in the ACE-V methodology. The comparison phase is discussed and fingerprint examples are utilized and explained in order for the reader to fully comprehend the importance of this step in the examination process. During this section, multiple fingerprint examples are compared to one another in order for the reader to understand how to properly conduct a comparison of fingerprints. This section strengthens the readers' knowledge on common characteristics that are included in various fingerprint examples.

Evaluation. This section of the manual describes the third step in the ACE-V method. This section provides the reader with the knowledge to make a conclusion as to whether or not the two fingerprints compared came from the same source and therefore, share a correlating relationship. The three conclusions that are defined and discussed include: identification, exclusion, and inconclusive. One of these three conclusions will

always be used to describe whether or not the two fingerprints originated from the same source.

Verification. This section of the manual describes the final step used in the ACE-V method. This section discusses how a second latent print examiner will verify, or check, the examination completed by the original examiner. Two different types of verification are defined: blind and non-blind. Blind verification is when a second examiner completes a comparison, using the ACE examination process, with no knowledge as to what conclusions the original examiner came to. Non-blind verification takes place when a second examiner double-checks and completes the ACE examination process with knowledge of the original examiner's conclusions. Both are addressed and described because both are accepted forms of verification.

Report writing. This section follows the discussion of the ACE-V methodology and lays out how a latent print examiner will write their final report. This section assists the examiner by providing them with examples as to what should be included when the final report is submitted. Including this section in the manual helps to clarify what types of notes are important to take when conducting an examination. This will be useful when any latent print examiner is called to court to testify. Having adequate notes on how a latent print examiner conducted their examination will assist the examiner with his/her credibility and will make testifying less stressful.

Example templates for report writing. This is the final section of the manual. It includes an example template that can be used when latent print examiners are writing

their final reports. This template makes report writing simpler and more organized. The template provided may be copied and printed.

Chapter 4

Conclusions and Recommendations

Forensic identification is a specialized scientific field that utilizes the scientific method Analysis, Comparison, Evaluation and Verification (ACE-V). In order to properly utilize this scientific method, the use of subjective decision-making, biased opinions, and errors need to be minimized. Without objectivity the ACE-V method would be of no scientific value.

In order to create a more objective scientific process, a training manual was created that demonstrates how to properly conduct a fingerprint comparison and execute the use of the ACE-V examination method. The manual produced was based on the examination of previous research from journal articles, books, and online periodicals. Findings in the literature determined that subjective, biased and incorrect identifications were occurring due to the lack of proper training, expertise, and attention to detail; and while the errors did not occur frequently, they were often taking place for trivial and technical reasons (Black, 2012). Understanding the many components of forensic identification, such as how friction ridge detail on latent prints are analyzed, compared and evaluated will improve the ACE-V examination process, and will increase the skill and judgment that a latent print examiner will use when conducting a fingerprint comparison.

As a result of the research conducted and the literature reviewed, a manual for latent print examiners regarding the ACE-V examination method was produced. This manual will train, test, and inform new and experienced latent print examiners on the

proper usage of the ACE-V method, and will provide them with a reference that they can refer to when they are conducting fingerprint comparisons. Therefore, the manual has met its intended objectives. However, this manual has not been piloted, and for that reason it is unknown whether latent print examiners have benefited from the information provided within the manual itself.

Due to the fact that this manual has not yet been field tested, it may need improvements. Therefore, the author will allow the manual to be both read and critiqued by fellow colleagues at the Sacramento Sheriff's Department as well as other forensic identification professionals. By allowing this constructive criticism, the manual can be revised, as needed, with written improvements.

The lack of field-testing is an important limitation to the project product. However, the other limitation that needs to be addressed is the lack of the use of palm prints in the ACE-V training manual. While the author created the ACE-V examination method training manual with only the use of fingerprints, it is important to address that palm prints also play an imperative role in forensic identification; and for that reason, in future improvements and revisions to the manual, the addition of palm prints should be addressed.

The main purpose of the project was to create a training manual regarding the ACE-V method. The manual produced will provide new and experienced latent print examiners with the knowledge and training necessary to conduct an objective fingerprint examination. It will test the examiners knowledge throughout and can be used as a source to reference during various examinations. Thus, the author is hopeful that after

the manual has been read, critiqued, and field-tested it will be an effective tool utilized among the Sacramento Sheriff's Department employees.

Appendix A

ACE-V EXAMINATION METHOD TRAINING MANUAL

By: Shauna Brewer

TABLE OF CONTENTS

Page

INTRODUCTION

This manual establishes the procedures that latent print examiners should follow when using the Analysis, Comparison, Evaluation, and Verification (ACE-V) examination method process. The manual will provide employees with information on how to properly use the ACE-V method and the steps in which to follow. The manual will allow latent print examiners to gain the knowledge, expertise, and training necessary on how to conduct an objective examination, and will lead to an increased amount of proper identifications. It will serve as a guide to both new and experienced latent print examiners and will answer questions that may arise regarding the individual components involved in the ACE-V examination method.

EMPLOYEE ROLES & RESPONSIBILITIES

Latent print examiners, who are employed within the Identification Unit, are required to engage in the ACE-V examination method with unbiased and objective beliefs. This can be achieved by consciously dissecting the ACE-V method in its intended manner. This manual can be used as a reference guide for latent print examiners as a way to ensure a thorough and complete examination has been completed. The employee is responsible for producing and assigning the proper results for each individual examination.

ORGANIZATION

This manual will be broken down into the ACE-V individual components: Analysis, Comparison, Evaluation and Verification. Within each individual section, this manual will give instructions on how to properly use the ACE-V method. The goal of breaking the manual down into the individual components will be to assist the latent print examiner in conducting an objective examination. These individual sections can also be used as a reference guide for future examinations.

The last section of the manual will provide the reader with directions on how to properly write a report. This will assist the examiner with the knowledge on how to take sufficient notes when completing an examination. Therefore, when called into court to testify, the latent print examiner will be prepared to accurately articulate how the ACE-V examination method was used to determine his/her findings.

ACE-V

ACE-V is the acronym used for the scientific examination method: Analysis, Comparison, Evaluation, and Verification. ACE-V is the examination method used in forensic identification to perceive detail in both known and latent fingerprints and make decisions based on objective observations (Triplett & Cooney, 2006; Vanderkolk, 2012). These objective observations determine whether or not two prints originated from the same source and therefore share a correlating relationship (Speckels, 2011). By using ACE-V, latent print examiners are able to objectively analyze, observe and evaluate friction ridge impressions and their details. On the following pages the four components of the ACE-V methodology, Analysis, Comparison, Evaluation, and Verification will be described.

ACE-V DEFINITIONS

Analysis: The first step in the ACE-V examination method. Analysis is the assessment of the unknown, or latent fingerprint, before examining the known fingerprint impression. During this phase, latent print examiners observe, comprehensively, the quality, clarity, uniqueness, and varying characteristics the latent finger or palm print impressions contain. Once the analysis is complete, and all possible information has been gathered, the examiner can determine the suitability for comparison and begin his/her comparison (SWGFAST, 2013b).

Comparison: The side-by-side assessment of both the latent and known fingerprint. During this assessment the friction ridge details, in both the latent and known prints are compared to one another to determine if the two prints are similar in sequence and spatial relationships and therefore were produced from the same source. Once the comparison is complete, and the examiner believes that s/he has sufficient information to form a conclusion, the examiner moves onto the evaluation stage within the ACE-V examination method (Vanderkolk, 2012).

Evaluation: During this stage the examiner notes whether or not the latent and known prints share a similar relationship. With this knowledge the examiner determines, based on the analysis and comparison phases, whether the information contained in both the latent and known prints is sufficient to reach a conclusion. The three conclusions that will be discussed, in detail, include identification, exclusion, and inconclusive (Vanderkolk, 2012).

Verification: The final step in the ACE-V examination method. It is the analysis, comparison, and evaluation by a second independent examiner to either support or refute the conclusion of the original examiner (SWGFAST, 2013b).

ANALYSIS

The first step in the ACE-V examination method. Analysis is the assessment of the unknown, or latent fingerprint, before examining the known fingerprint impression. During this phase, latent print examiners observe, comprehensively, the quality, clarity, uniqueness, and varying characteristics the latent finger or palm print impressions contain. Once the analysis is complete, and all possible information has been gathered, the examiner can determine the suitability for comparison and begin his/her comparison (SWGFAST, 2013b).

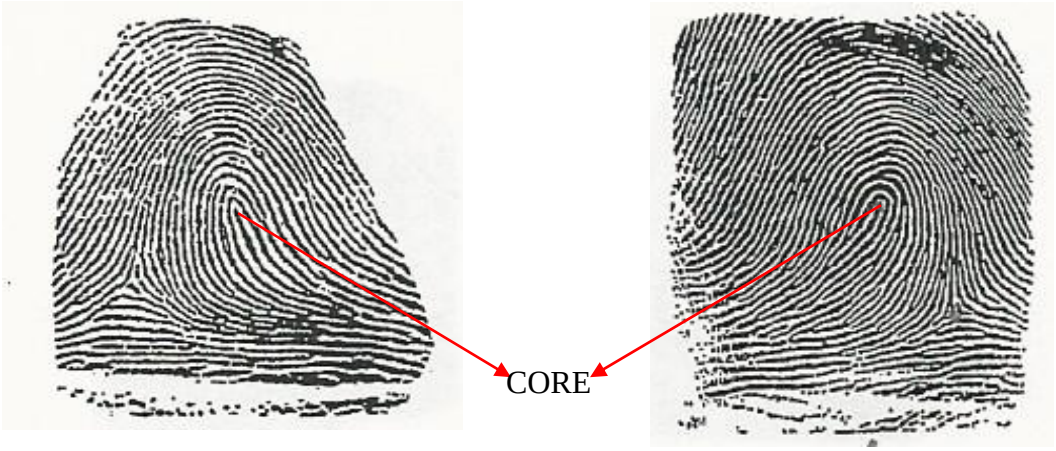
ANALYSIS:
LEVEL 1 DETAIL

During the analysis phase, in the ACE-V examination process, the examiner will assess the latent fingerprint for easily identifiable characteristics, otherwise known as level 1 detail. Level 1 detail includes:

- Identifying the core of the print
- Identifying the delta of the print
- Determining the pattern type
- Determining the general flow of the ridges
- Locating any unique scarring on the latent fingerprint
- Determining the orientation of the fingerprint

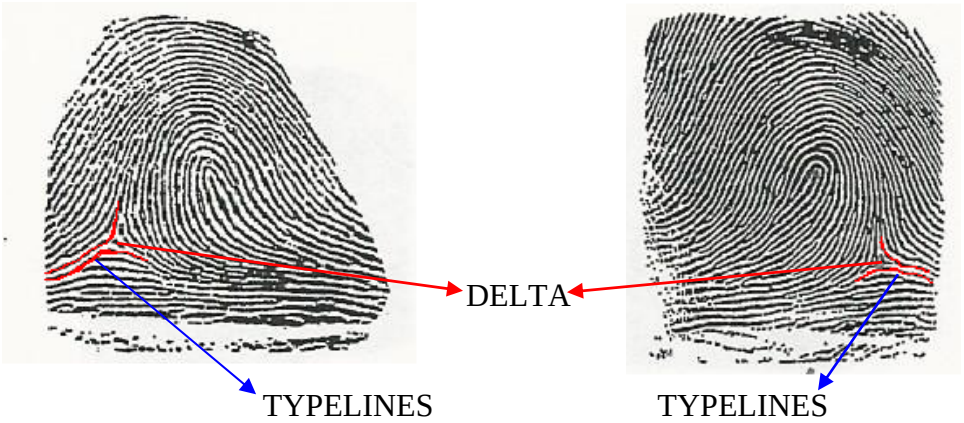
ANALYSIS:
LEVEL 1 DETAIL
CORE AND DELTA

Core: The center-most point in the fingerprint impression (SWGFAST, 2013b).



Delta: The point located at, or directly, in front of the point of divergence of the two type lines (SWGFAST, 2013b).

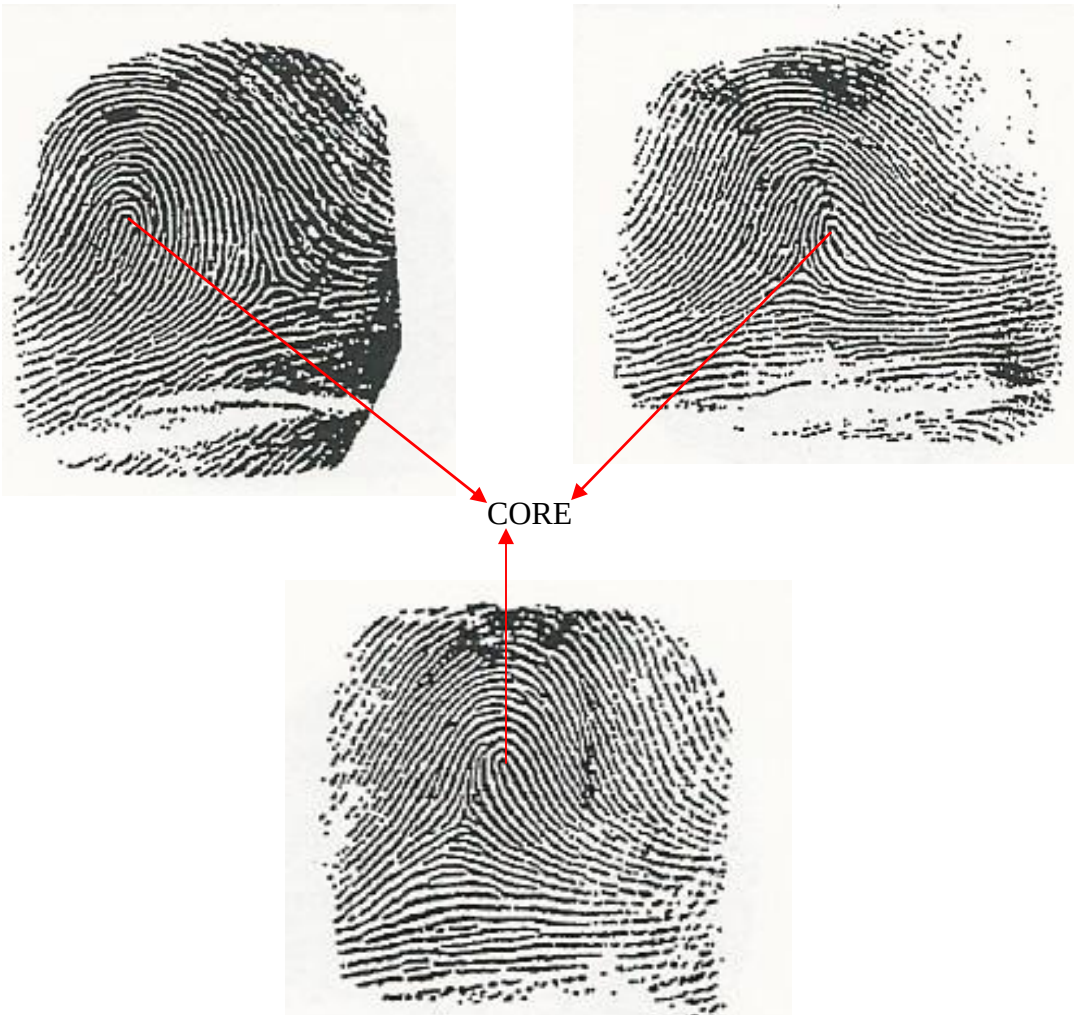
Typelines: The two ridges that start flowing parallel to one another, diverge, and surround, or tend to surround, the pattern (SWGFAST, 2013b).



ANALYSIS:
LEVEL 1 DETAIL
CORE EXERCISE

Directions: Circle where the core is located.

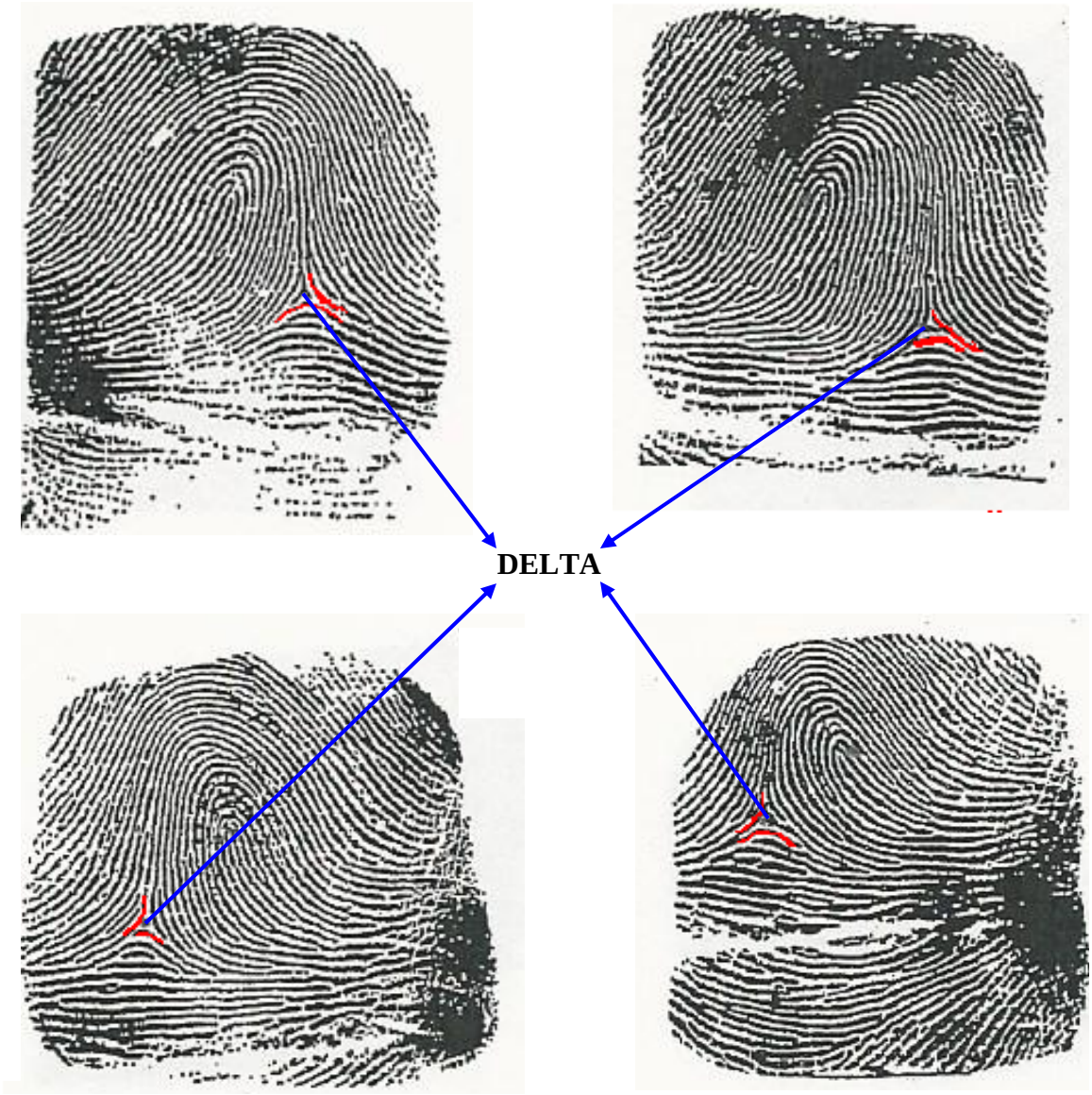
ANALYSIS:
LEVEL 1 DETAIL
CORE EXERCISE ANSWERS



ANALYSIS:
LEVEL 1 DETAIL
DELTA AND TYPELINE EXERCISE

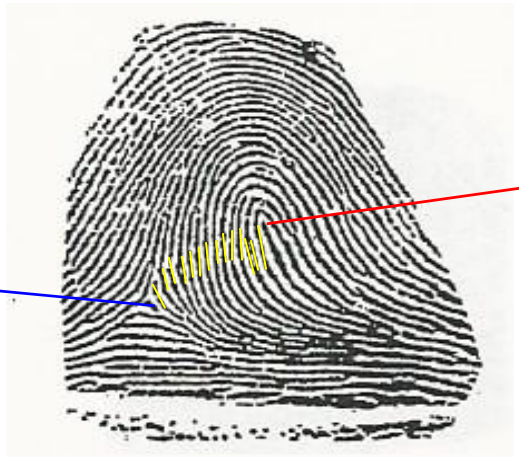
Directions: **Circle** the delta and **outline** where the type lines are located.

ANALYSIS:
LEVEL 1 DETAIL
DELTA AND TYPELINE EXERCISE ANSWERS



ANALYSIS:
LEVEL 1 DETAIL
CORE AND DELTA

Once the core and delta have been located, the ridge count can be obtained. The ridge count, in a latent print, is gathered by counting the number of ridges that lie between the delta and the core. The ridge count will assist the examiner by allowing him/her to decide what known prints will be included in the comparison phase and which will be excluded.



KEY POINT: When obtaining the ridge count, neither the core nor the delta is counted as a ridge. The delta and the core are your starting and stopping points in the ridge count.

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPES

Fingerprint patterns are separated into three main pattern types based on the general flow of the ridges. Ridge flow is based on the direction in which one or more ridges tend to travel. The three main pattern types include: Loops, Arches, and Whorls.

LOOP

Contains ridges that enter from one side, make, or tend to make, a ring like curve, and exit on the same side in which they entered (Saviano, 2003).

WHORL

Contains ridges that form at least one recurving ridge and takes on the resemblance of a circular shape (Saviano, 2003).

ARCH

Enters on one side of the print, curves upward and exits on the opposite side upon which it entered (Saviano, 2003).

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPE EXERCISE

Directions: Label the fingerprints as loop, arch, or whorl.

_____

_____

_____

_____

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPE EXERCISE ANSWERS

LOOP

WHORL

ARCH

LOOP

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPES

The three main pattern types, loops, arches, and whorls, can be further subdivided.

LOOPS

Approximately 65% of all individuals have at least one finger that contains a loop type pattern (Becker, 2009; LaChard, 1919; Olsen, 1978).

BOTH EXAMPLES ARE FROM THE LEFT HAND

ULNAR LOOP

The ulnar loop contains ridges that enter on the side of the little finger, make a ring like curve, and exit on the same side upon which they entered. This pattern is classified as an ulnar loop because the loop opens up towards the ulna bone, which is located directly under the little finger (SWGFAST, 2013b).

RADIAL LOOP

The radial loop contains ridges that enter on the side of the thumb, make a ring like curve, and exit on the same side upon which they entered. This pattern is classified as a radial loop because the loop opens up towards the radial bone, which is located directly under the thumb (SWGFAST, 2013b).

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPES

The three main pattern types, loops, arches, and whorls, can be further subdivided.

ARCHES

The arch pattern is the least common pattern type. It is common in about 5% of all individual fingerprints (Becker, 2009; LaChard, 1919; Olsen, 1978).

PLAIN ARCH

The ridges enter on one side of the fingerprint, curve upward forming a hill like shape, and exit on the opposite side in which they entered (SWGFAST, 2013b).

TENTED ARCH

The ridges enter on one side of the fingerprint, curve upward forming an angle or upthurst, and exit on the opposite side in which they entered (SWGFAST, 2013b).

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPES

The three main pattern types, loops, arches, and whorls, can be further subdivided.

WHORLS

35% of all individuals contain at least one fingerprint that takes on a whorl-like shape (Becker, 2009; LaChard, 1919; Olsen, 1978).

PLAIN WHORL

This pattern type contains at least one or more friction ridges that recurve and make, or tend to make, a complete circle. The plain whorl has two deltas and when a line is drawn from these two deltas it either cuts or touches the recurving friction ridges (SWGFAST, 2013b).

CENTRAL POCKET LOOP

This pattern type has two deltas, and at least one friction ridge that recurves and takes on the shape of a spiral, oval, or circle. A good indication that the pattern type is a central pocket loop is to draw a line between the two deltas and if that line does not touch any of the recurving ridges then it can be labeled to be a central pocket loop (SWGFAST, 2013b).

ANALYSIS:
LEVEL 1 DETAIL
PATTERN TYPES

The three main pattern types, loops, arches, and whorls, can be further subdivided.

WHORLS

35% of all individuals contain at least one fingerprint that takes on a whorl-like shape (Becker, 2009; LaChard, 1919; Olsen, 1978).

DOUBLE LOOP

This pattern type consists of two separate loops that contain their own shoulders. This pattern type has two deltas (SWGFAST, 2013b).

ACCIDENTAL

A pattern type that consists of two or more patterns, excluding the plain arch, and contains two or more deltas (SWGFAST, 2013b).

ANALYSIS:
LEVEL 1 DETAIL
FLOW OF RIDGES

Ridge flow is the general direction that the ridges flow in any given fingerprint.

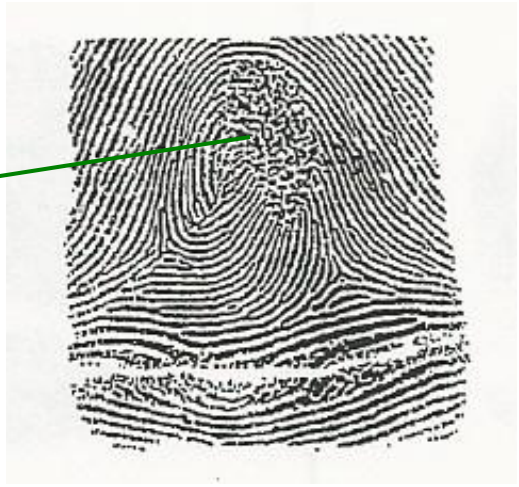
***While ridge flow is categorized as level 1 detail, it is important to understand that the way in which the ridges flow is not considered to be unique (Vanderkolk, 2012).**

ANALYSIS:
LEVEL 1 DETAIL
FRICTION SKIN DAMAGE: SCARRING

Scars are characteristics of fingerprints that can be used in conjunction with naturally formed friction ridges to determine identity (Ashbaugh, 1999). If scars are extremely predominant, and clearly recorded, they can be of great assistance to the examiner during the ACE-V examination method.

SCARRING

SCARRING



ANALYSIS:
LEVEL 1 DETAIL
ORIENTATION

Latent fingerprint impressions are not always oriented right side up. This occurs because out in the field, individuals do not pick up items with a distinct and intentional purpose. However, if examiners are able to correctly identify the orientation of various fingerprints, then the comparison phase of the ACE-V method will be a more feasible process.

CLUES THAT ASSIST IN THE ORIENTATION PROCESS:

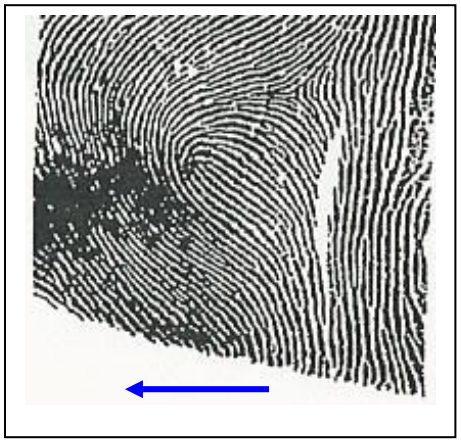
- The ridge flow, at the bottom side of the fingerprint, tends to be straight rather than curved.
- The ridges tend to be more spread out at the bottom of the fingerprint.
- The deltas are typically located on the lower half of the fingerprint.
- The deltas are usually located on the left and/or right side of the fingerprint.
- The top of the fingerprint tends to have curved ridges.
- The shoulders at the core of the fingerprint face upward.

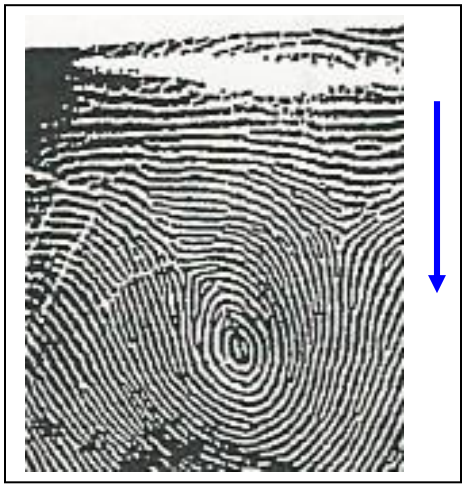
The arrow indicates where the top of the print is located:

ANALYSIS:
LEVEL 1 DETAIL
ORIENTATION EXERCISE

Directions: **<u>Draw an arrow</u>** indicating where the top of the print is located.

ANALYSIS:
LEVEL 1 DETAIL
ORIENTATION EXERCISE ANSWERS





ANALYSIS:
LEVEL 2 DETAIL

Once the examiner has analyzed the latent fingerprint for level 1 detail, and has discovered some of those easily identifiable characteristics, the examiner can move on to analyzing the latent print for level 2 detail.

Level 2 detail consists of:

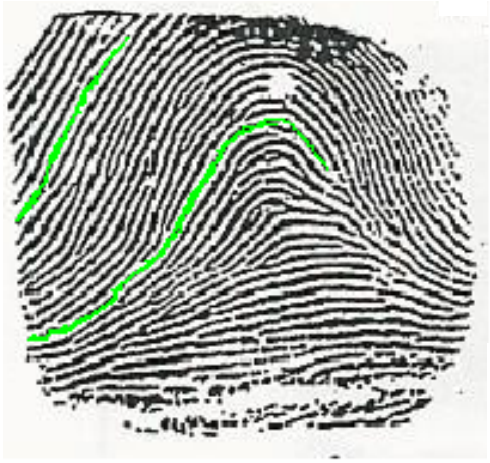
- The paths of specific ridges in a fingerprint and where they begin and end
- Minutiae

KEY POINT: In order for level 2 detail to exist in a latent fingerprint, level 1 detail must be present (Vanderkolk, 2012).

ANALYSIS:
LEVEL 2 DETAIL
SPECIFIC RIDGE PATH

The specific path in which a ridge flows is considered to be part of level 2 detail. When an examiner is analyzing a latent fingerprint for level 2 detail, the first thing s/he wants to do is follow the ridges to see where the ridges begin and where they end.

Below are examples of an examiner following, and highlighting, specific ridges indicating where they begin and end:



ANALYSIS:
LEVEL 2 DETAIL
MINUTIAE

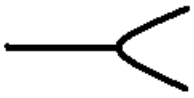
After the specific ridge paths have been determined, and the examiner has noted where certain ridges begin and end, the examiner can move onto the next step in discovering level 2 detail.

In this next step, the examiner looks at the specific ridges for points of minutiae.

Minutiae: Unique characteristics that occur along the ridge paths and assist the examiner in making a proper identification (Vanderkolk, 2012).

Common examples of minutiae include:

BIRFUCATION



SHORT RIDGE

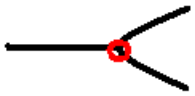
DOT

ENCLOSURE

ENDING RIDGE

ANALYSIS:
LEVEL 2 DETAIL
MINUTIAE

Here are the definitions of the common types of minutiae:



BIRFURCATION: The point where one ridge divides, or forks, and splits into two ridges.

SHORT RIDGE: A ridge that travels for a very short length.

ENCLOSURE: The point where one ridge splits, becomes two for a short length, and then comes back together to form one ridge.

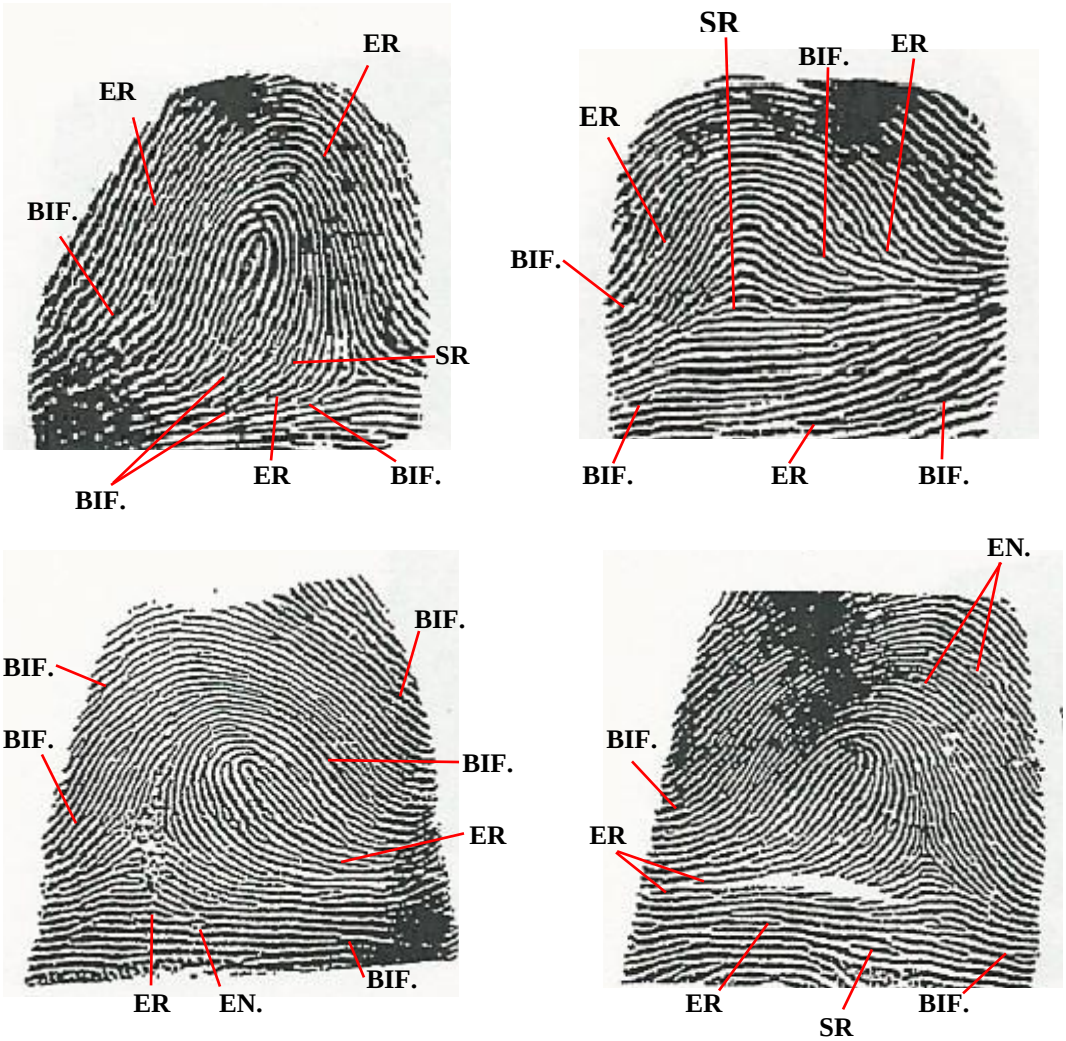
DOT: A ridge that is as big as it is wide, and isolated, therefore forming what appears to be a dot.

ENDING RIDGE: A ridge that expires within the friction ridge structure.

ANALYSIS:
LEVEL 2 DETAIL
MINUTIAE EXERCISE

Directions: In this exercise **<u>circle 8 minutiae points</u>**. **CLUE:** Follow the ridge paths to locate the minutiae.

ANALYSIS:
LEVEL 2 DETAIL
MINUTIAE EXERCISE ANSWERS



BIF.= BIFURCATION; **ER**= ENDING RIDGE; **SR**= SHORT RIDGE; **EN.**= ENCLOSURE

ANALYSIS:
LEVEL 3 DETAIL

The last step in the analysis phase is to look for level 3 detail. Level 3 detail includes the shapes of the ridge structures, such as pores and edges (Vanderkolk, 2012).

Level 3 detail is unique in how it is shaped and where it may appear within a fingerprint. However, if the latent fingerprint is lacking clarity then level 3 detail may not be present.

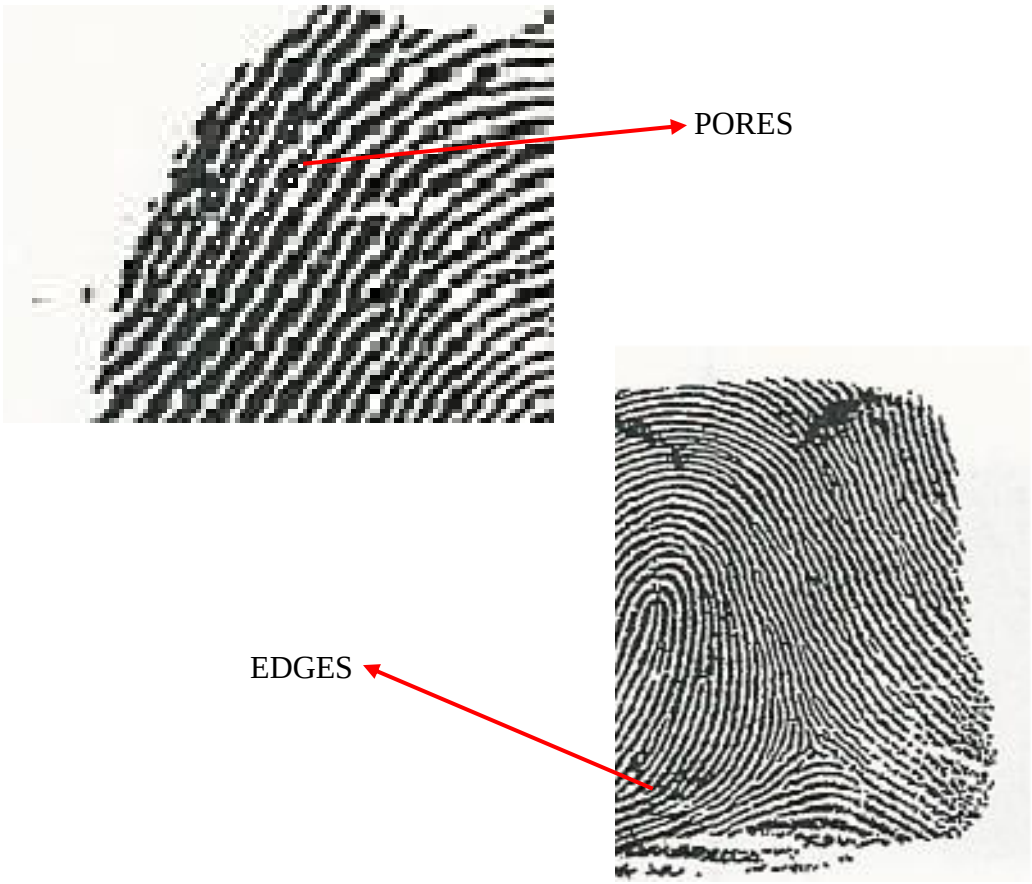
KEY POINT: In order for level 3 detail to exist in a latent fingerprint, level 1 detail and level 2 detail must be present (Vanderkolk, 2012).

ANALYSIS:
LEVEL 3 DETAIL
PORES AND EDGES

PORES: Tiny openings in the skin that occasionally will show up in fingerprint impressions.

EDGES: The end of any individual ridge unit or pore.

Below are examples of both pores and edges in latent fingerprint impressions.



ANALYSIS

Once the examiner has completed the analysis phase, by examining the latent fingerprint for the 3 levels of detail, s/he can move onto the comparison phase of the ACE-V method.

HOWEVER, the examiner can only move onto the comparison phase if both level 1 and level 2 detail are present.

COMPARISON

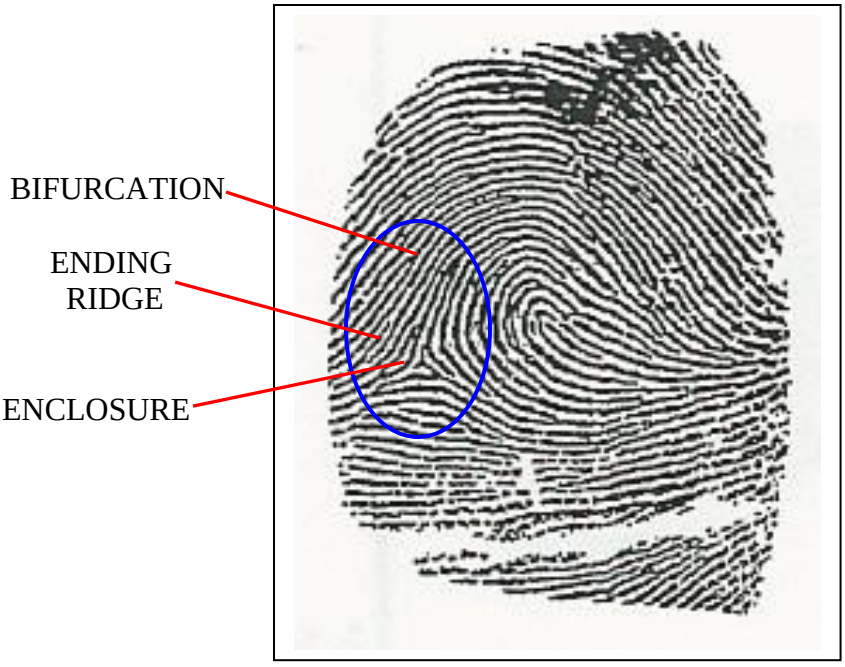
The side-by-side assessment of both the latent and known fingerprint. During this assessment the friction ridge details, in both the latent and known prints are compared to one another to determine if the two prints are similar in sequence and spatial relationships and therefore were produced from the same source. Once the comparison is complete, and the examiner believes that s/he has sufficient information to form a conclusion, the examiner moves onto the evaluation stage within the ACE-V examination method (Vanderkolk, 2012).

COMPARISON: LATENT & KNOWN PRINTS

During the comparison phase an examiner must first take his/her findings from the Analysis: Level 1 Detail and eliminate the known fingerprints that do not contain the same set of characteristics, such as pattern type and ridge flow.

After the examiner has eliminated the known fingerprints that do not contain the same pattern type and/or ridge flow, the examiner must locate his/her "target points" within the latent fingerprint. **"Target points"** would be two or three points of minutiae that are of unique value that would be easy, or feasible, to locate in any given known print.

An example of a set of "target points" is shown below:



Once the "target points" have been located in the latent fingerprint, the comparison between the two prints can begin.

COMPARISON:
LATENT & KNOWN PRINTS
KEY POINTS TO REMEMBER

Once the examiner begins his/her comparison it is important to remember what levels of detail were discovered in the latent fingerprint during the analysis phase. This will assist the examiner by making the comparison to the known fingerprint an easier process.

It is also important to remember that each individual touching of a finger onto any given surface will produce a unique fingerprint impression that varies in appearance (Vanderkolk, 2012). Therefore, the examiner must consider some level of tolerance during the comparison.

For instance:

- The clearer the print and the less distorted it is, the less tolerant for variances the examiner will be.
- The less clear and more distorted the print is, the more tolerant for variances the examiner will be.

EXAMPLE OF CLEAR/LESS DISTORTED FINGERPRINT

EXAMPLE OF LESS CLEAR/MORE DISTORTED FINGERPRINT

COMPARISON:
LATENT & KNOWN PRINTS
EXAMPLES OF COMPARISON PROCESS

Step 1: Eliminate the known fingerprints that do not contain the same level 1 detail as the latent fingerprint:

Here is an example of the latent fingerprint with the 3 levels of detail that were discovered:

LEVEL 1 DETAIL: Pattern type: Ulnar Loop; Core and Delta: located; general flow of the ridges has been determined; Scars: No; Orientation: Fingerprint is ride side up.
LEVEL 2 DETAIL: Fingerprint contains specific ridges and has more than 8 minutiae points.
LEVEL 3 DETAIL: No pores have been identified in this print.

This fingerprint contains a sufficient amount of level 1 and level 2 detail, therefore the examiner can move on to the comparison phase of the ACE-V method.

COMPARISON:
LATENT & KNOWN PRINTS
EXAMPLES OF COMPARISON PROCESS

Step 1: Eliminate the known fingerprints that do not contain the same level 1 detail as the latent fingerprint:

Here is an example of a ten-print card with ten known fingerprints. The examiner will take the level 1 detail characteristics that s/he has gathered from the latent fingerprint, on the previous page, and eliminate all the known fingerprints that do not contain the same pattern type and/or ridge flow.

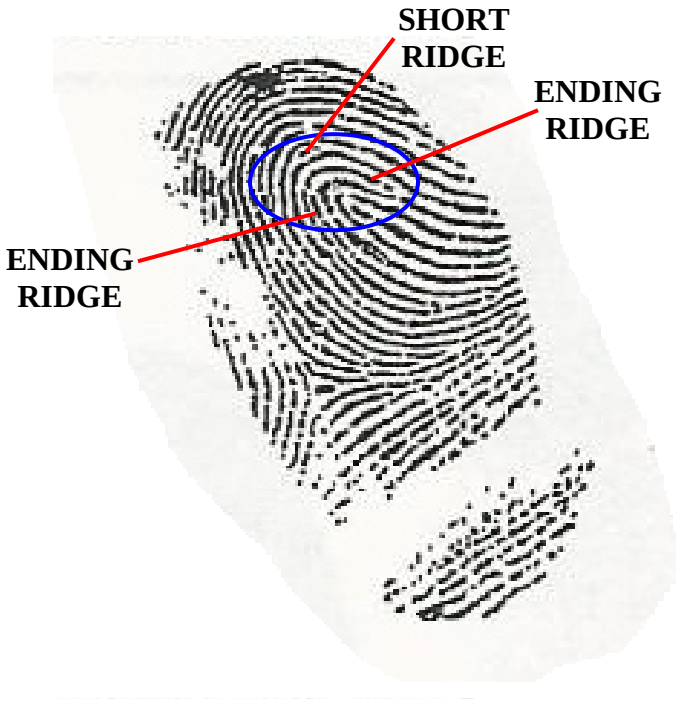
Based on **pattern type**, fingers #2, 4, 5, 6, 7, 8, 9, and 10 can be eliminated. Based on the **general flow of the ridges**, finger #1 can be eliminated.

COMPARISON:
LATENT & KNOWN PRINTS
EXAMPLES OF COMPARISON PROCESS

Step 2: Once the known fingerprints have been sorted and it has been decided which fingerprints will be compared, the examiner must locate his/her "target points."

Here is an example of some "target points" that were chosen:

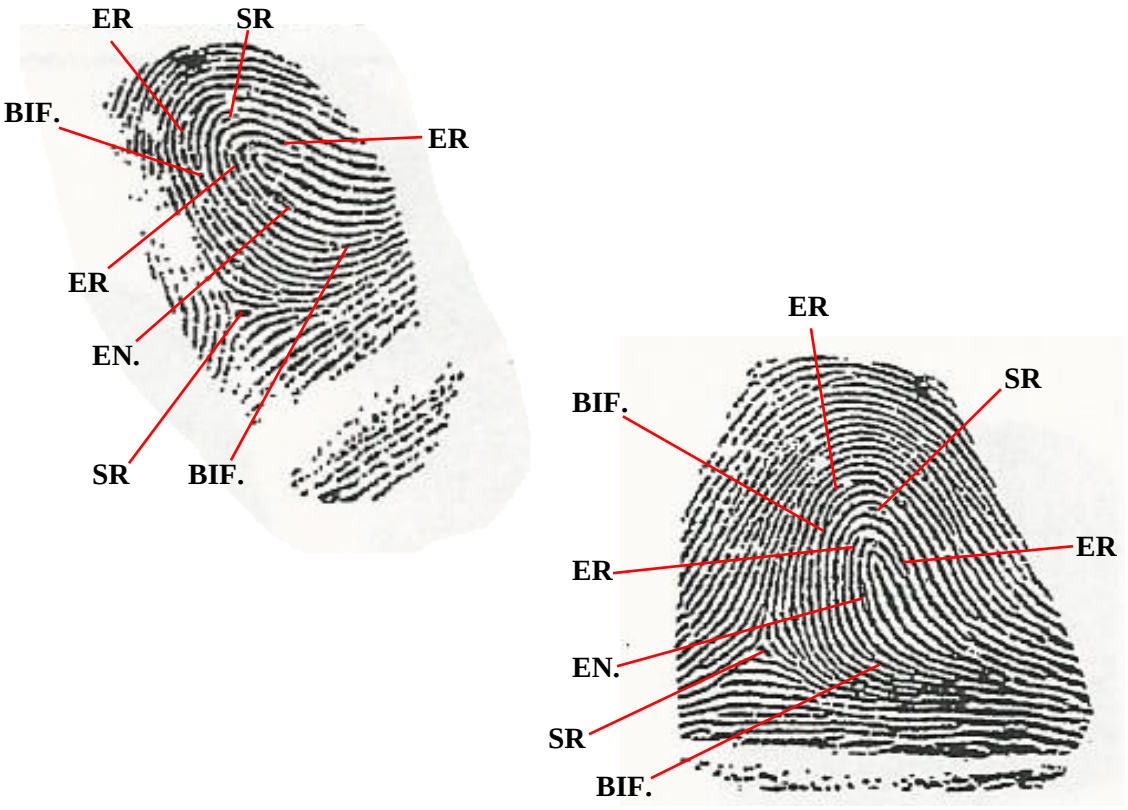
***KEY POINT:** There is no right or wrong set of "target points." It is whatever points stand out to the examiner.



COMPARISON:
LATENT & KNOWN PRINTS
EXAMPLES OF COMPARISON PROCESS

Step 3: Now that the examiner has chosen his/her "target points" the comparison can begin.

Here is an example of the actual comparison between two prints:



BIF.= **BIFURCATION;** ER= **ENDING RIDGE;** SR= **SHORT RIDGE;** EN.= **ENCLOSURE**

On the following page there will be an exercise of comparing a latent fingerprint to a known fingerprint.

COMPARISON:
LATENT & KNOWN PRINTS
COMPARISON EXERCISE

Directions: Compare the two prints that are side by side. **Locate 8 minutiae points** in each print.

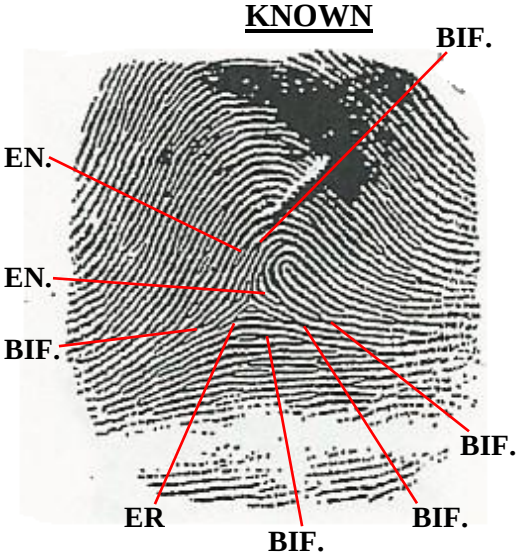
LATENT

KNOWN

COMPARISON:
LATENT & KNOWN PRINTS
COMPARISON EXERCISE ANSWERS

LATENT

KNOWN



BIF.= BIFURCATION; **ER**= ENDING RIDGE; **SR**= SHORT RIDGE; **EN.**= ENCLOSURE

COMPARISON

Once the comparison phase has been completed the examiner can move onto the evaluation phase.

EVALUATION

During this stage the examiner notes whether or not the latent and known prints share a similar relationship. With this knowledge the examiner determines, based on the analysis and comparison phases, whether the information contained in both the latent and known prints is sufficient to reach a conclusion. The three conclusions that will be discussed, in detail, include identification, exclusion, and inconclusive (Vanderkolk, 2012).

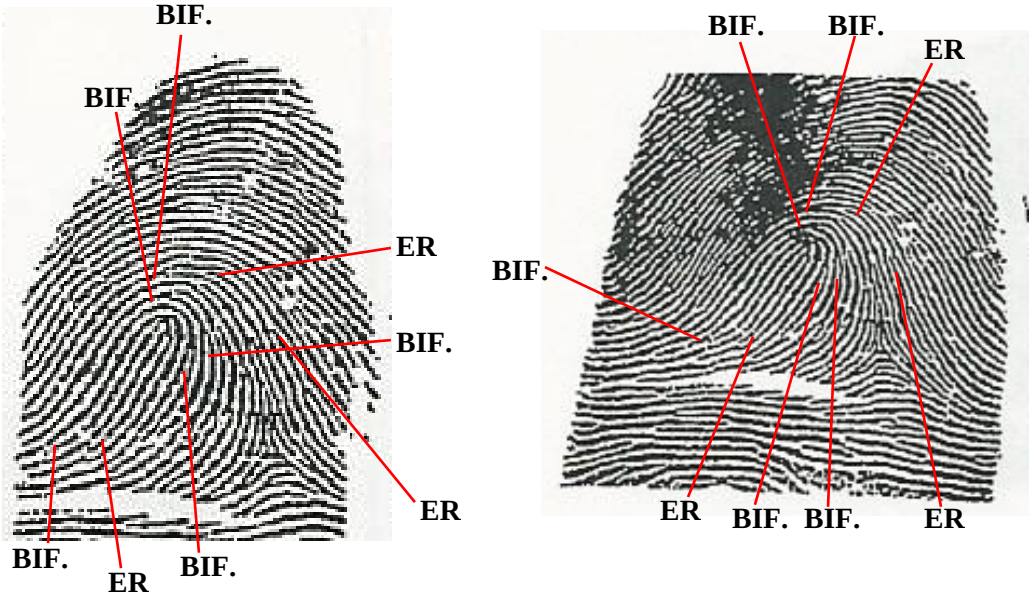
EVALUATION: IDENTIFICATION

The two prints, in comparison, are in agreement and share an adequate amount of unique characteristics to determine that both fingerprints originated from the same source (SWGFAST, 2013a; Vanderkolk, 2012).

To make a conclusive identification both the latent and known fingerprint must share a significant number of similarities. There is no set number of points that must be recognized to make an identification; rather it is up to the examiner as to how many points will satisfy his/her confidence to make a conclusive identification decision (Osterburg, 2000).

In order for both the latent and known fingerprint to share sufficient agreement, at least level 1 and level 2 detail need to be in agreement. If only level 1 detail is in agreement an identification cannot be made (Ashbaugh, 2000; Vanderkolk, 2012).

Below is an example of an identification between a latent and a known fingerprint:



BIF.= BIFURCATION; **ER**= ENDING RIDGE; **SR**= SHORT RIDGE; **EN.**= ENCLOSURE

EVALUATION:
EXCLUSION

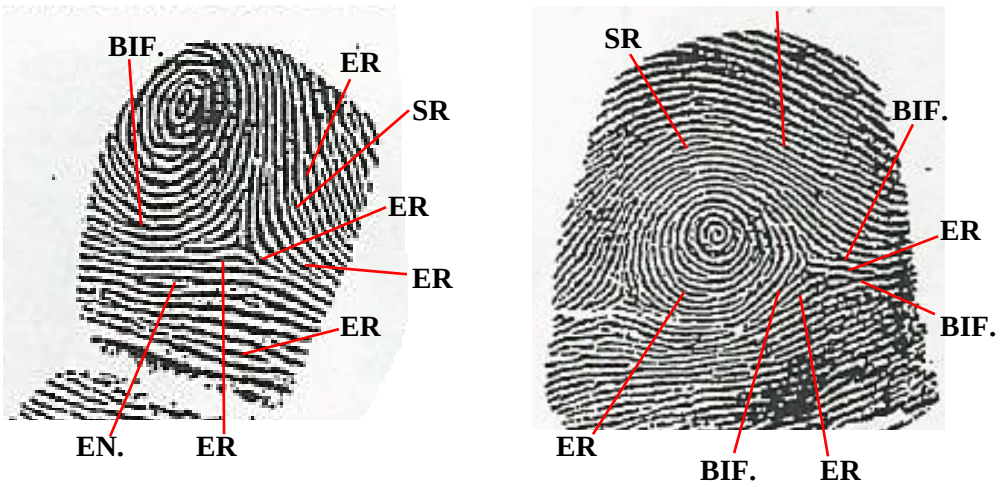
An exclusion determination takes place when the two prints, in comparison, do not share sufficient unique details. (Ashbaugh, 2000; Vanderkolk, 2012).

This decision, made by the examiner, determines that the two areas of friction ridge details did not come from the same source. There are sufficient features within these two prints that are in disagreement (SWGFAST, 2013a).

This determination will take place when level 1, 2, and 3 details are dissimilar and are in disagreement (Vanderkolk, 2012).

*When an examiner makes an exclusion determination, s/he must determine if they are excluding one finger, an entire hand, or the entire person. This is based on whether the examiner compared all fingers to the latent fingerprint, or if they just looked at a few known fingers (Vanderkolk, 2012).

Below is an example of an exclusion determination between a latent and a known fingerprint:



BIF.= BIFURCATION; **ER**= ENDING RIDGE; **SR**= SHORT RIDGE; **EN.**= ENCLOSURE

EVALUATION: INCONCLUSIVE

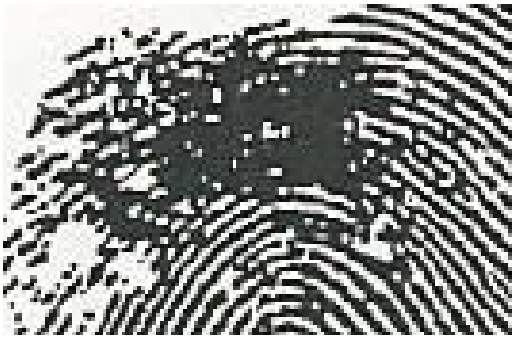
An inconclusive determination is made when the examiner is unable to conclude whether the two prints came from the same source. The friction ridge details within the latent impression lack adequate quality and a comparable area (SWGFAST, 2013a).

If after both the analysis and comparison phase the examiner is unable to determine if there is a sufficient amount of unique characteristics between levels 1, 2, and 3 detail, then the examiner will make a conclusion of insufficient uniqueness to individualize (Ashbaugh, 1999; Vanderkolk, 2012).

There are many reasons why an examiner will make an inconclusive determination:

- Either the latent, or known, fingerprint lacks clarity and unique detail.
- There are dissimilarities between the two prints, but due to the lack of clarity, the examiner cannot be certain that the two prints are in disagreement.

Below is an example of an inconclusive determination between a latent and a known fingerprint:



VERIFICATION

The final step in the ACE-V examination method. It is the analysis, comparison, and evaluation by a second independent examiner to either support or refute the conclusion of the original examiner (SWGFAST, 2013b).

The purpose of verification is to validate that the original examiner utilized the ACE method in an objective manner; it is more than just a process of checking results (Ashbaugh, 1999).

There are two types of verification that can be utilized by law enforcement agencies:

- Blind Verifications
- Non-blind Verifications

VERIFICATION
BLIND AND NON-BLIND

Blind Verification: When a second examiner applies the ACE methodology with no knowledge as to what conclusions the original examiner came too. During blind verification there are no indications of what levels of detail the original examiner noted, nor what conclusions s/he drew once the comparison phase was completed (Vanderkolk, 2012).

Non-blind Verification: When a second examiner applies the ACE methodology with the knowledge of what decisions and conclusions the original examiner came too (Vanderkolk, 2012). This method allows the examiners to work side-by-side, allowing both the original and second examiner to give input about various comparisons and the decisions that were made regarding the case at hand.

Both types of verification methods can be used; it is up to the individual law enforcement agency to decide which is a better fit for their professional entity.

REPORT WRITING

Reports are written and submitted electronically in order for various law enforcement personnel (i.e. detectives, officers, district attorneys, defense lawyers, etc.) to be aware of what is going on in specific cases and what leads may be available on various suspects.

Within the Identification Unit, it is important that latent print examiners take adequate notes on their findings in various examinations in order to write adequate reports and to give sufficient courtroom testimony.

Forensic Identification reports will be approved by the Forensic Identification Supervisor and then submitted electronically for various law enforcement entities to observe.

On the next page is an example report writing template that can be used to assist the latent print examiner when conducting the ACE-V examination method. This example template is for personal use, and should **ONLY** be used to assist the latent print examiner in writing their finalized report.

The example report-writing template should not be submitted as a formal report-writing document. Rather, the report-writing template can be used as a reference for when the examiner is sent to court to testify. It is a document that can be used to help refresh the examiner's memory on how the findings were made and supported.

EXAMPLE REPORT WRITING TEMPLATE

REPORT #: 00-000000 **EXAMINER: ORIGINAL /VERIFIER**

LATENT #: SB-1

ANALYSIS	COMPARISON	EVALUATION
LEVEL 1 DETAIL: PATTERN TYPE: **ULNAR LOOP** CORE: Y/N DELTA: Y/N SCARS: Y/N **LEVEL 2 DETAIL:** ENOUGH UNIQUE POINTS: Y/N TARGET POINT LOCATION: CORE/DELTA/TIP/SIDE, ETC… **CORE** **LEVEL 3 DETAIL:** PORES VISIBLE: Y/N EDGES VISIBLE: Y/N	**SUBJECT COMPARED:** JACKSON, ANDREW **IDENTIFYING FACTOR:** X-0000000 **D/O/B:** 05/16/1973 COMPARE TO WHAT: FINGERS PALMS BASED ON THE 3 LEVELS OF DETAIL, WHICH FINGERS CAN BE ELIMINATED: **#1,#2, #4, #5, #6, #7, #8, #9, #10** WHAT FINGERS WERE COMPARED TO LATENT: **#3**	☒ **IDENTIFICATION** IDENTIFIED TO FINGER/PALM: **#3 R. MIDDLE** ☐ **EXCLUSION** ☐ ALL FINGERS IF NOT ALL, WHAT FINGERS CAN BE EXCLUDED: **BASED ON LEVEL 1 DETAIL:** **BASED ON LEVEL 2 DETAIL:** ☐ **INCONCLUSIVE** ☐ LACK OF CLARITY ☐ NEED DIFFERENT FINGERPRINTS ☐ PALMS REQUESTED ☐ OTHER:

ADDITIONAL NOTES:

REPORT WRITING TEMPLATE

REPORT #: **EXAMINER: ORIGINAL /VERIFIER**

LATENT #:

ANALYSIS	COMPARISON	EVALUATION
LEVEL 1 DETAIL: PATTERN TYPE: _____ CORE: Y/N DELTA: Y/N SCARS: Y/N **LEVEL 2 DETAIL:** ENOUGH UNIQUE POINTS: Y/N TARGET POINT LOCATION: CORE/DELTA/TIP/SIDE, ETC… **LEVEL 3 DETAIL:** PORES VISIBLE: Y/N EDGES VISIBLE: Y/N	**SUBJECT COMPARED:** _____ **IDENTIFYING FACTOR:** _____ **D/O/B:** _____ COMPARE TO WHAT: FINGERS PALMS BASED ON THE 3 LEVELS OF DETAIL, WHICH FINGERS CAN BE ELIMINATED: WHAT FINGERS WERE COMPARED TO LATENT:	☐ **IDENTIFICATION** IDENTIFIED TO FINGER/PALM: ☐ **EXCLUSION** ☐ ALL FINGERS IF NOT ALL, WHAT FINGERS CAN BE EXCLUDED: **BASED ON LEVEL 1 DETAIL:** **BASED ON LEVEL 2 DETAIL:** ☐ **INCONCLUSIVE** ☐ LACK OF CLARITY ☐ NEED DIFFERENT FINGERPRINTS ☐ PALMS REQUESTED ☐ OTHER:

ADDITIONAL NOTES:

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