Article

Fraudulent Latent Prints: A Discussion on Their Implications in Forensic Casework

Hilary Werner [1]
Rachel Hudman [1]

Abstract: This article reviews a selection of cases involving forged or fabricated friction ridge impressions. Definitions and methods of forged and fabricated friction ridge impressions are described. Although the detection of fraudulent friction ridge impressions by a latent print examiner may be difficult in casework, notable distortion factors from known cases are summarized. Further research regarding methods of forgery and fabrication and formal training of examiners should raise alertness and benefit the criminal justice process.

[1] City of Phoenix Police Department Crime Laboratory, 621 W. Washington Street, Phoenix, AZ 85003

Introduction

The identification of individuals through impressions of the friction ridge skin has become a globally recognized tool for the criminal justice system. Unfortunately, this ubiquity has occasionally prompted offenders or dishonest investigators to use friction ridge impressions to misdirect investigations. The intent to mislead an investigation with fraudulent friction ridge impressions generally involves the forgery or fabrication of fingerprint evidence. The first documented forgery case occurred in Punjab, India in 1903 [1]. Since then, there have been more than forty recorded cases involving fraudulent impressions. Given that additional instances have likely gone undetected, the true number of cases involving the forgery or fabrication of friction ridge impressions is unknown [1, 2].

Forged or fabricated friction ridge impressions are generally recognized by the latent print discipline as a known possibility [3] but can be overlooked in real casework due to the limited exposure to ground truth counterfeit friction ridge impressions [4, 5]. This article will provide an overview of published methods to produce fraudulent prints, documented cases involving fraudulent fingerprints, and visual clues that may alert the examiner to fabricated or forged impressions. Furthermore, this article will summarize research indicating that latent print examiners may be ill-equipped to detect fraudulent friction ridge impressions. While not a complete history of cases involving forged or fabricated prints, it is the authors' goal to consolidate information regarding methods of production and detection as a first step toward the incorporation of detection of fraudulent friction ridge impressions in latent print training programs.

Forged Prints

A forged fingerprint is the intentional placement of a friction ridge impression on a surface or item that was not actually touched or handled by the subject. Typically, forgeries involve the use of a template of the friction ridge skin; however, there have also been attempts to transfer latent print residue from one surface to another. The goal of the forged fingerprint is to divert an investigation toward a person who did not actually touch the surface or item [5].

Techniques to produce forged fingerprints include stamping, molding and casting, etching, and lifting with redeposition [6]. Stamps may be created by engraving a two-dimensional impression (e.g., an inked impression) into a three-dimensional medium (e.g., rubber, silicone, and wood). Typically, the impressions created by stamps are laterally reversed because the engraver fails to horizontally flip the fingerprint prior to engraving (e.g., the difference between looking at a fingerprint on a finger versus looking at an impression of the fingerprint).

The molding and casting process is completed by placing friction ridge skin in a malleable medium such as forensic casting material, silly putty, or clay and making a cast of the fingerprint. If a mold is created without casting the fingerprint, the resulting impression will be laterally reversed and the three-dimensional structure of the ridges and furrows will be inverted, causing the furrows to be the main contact points with the surface (rather than the ridges). Etching involves the use of acid to engrave a two-dimensional fingerprint onto a metal plate, typically copper or aluminum [7]. The final technique, lifting with redeposition, involves lifting an unprocessed impression with an adhesive material such as tape or other smooth, non-porous material [2, 6]. The residue from the original friction ridge impression is then transferred onto another surface [6].

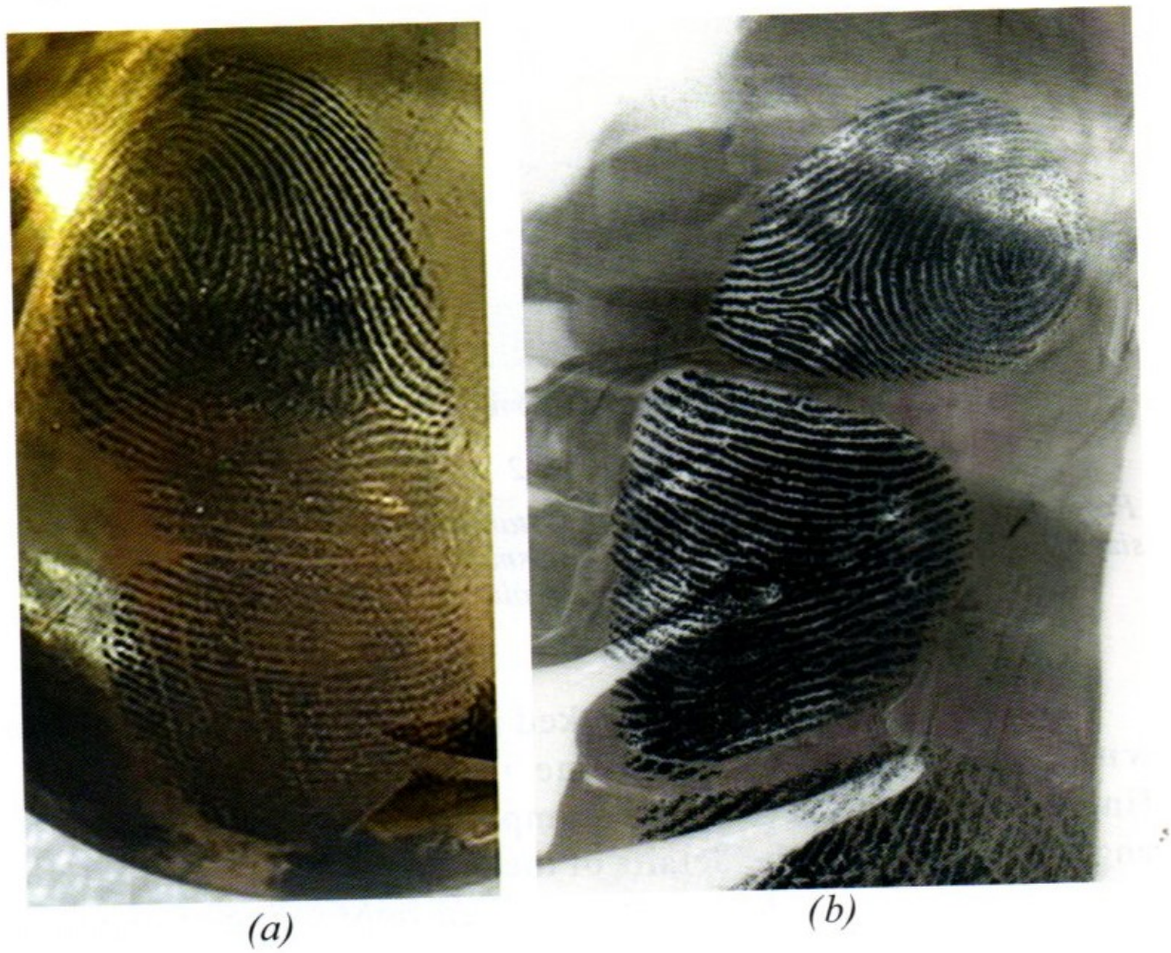
While latent print examiners may be familiar with the techniques listed above, as technology advances additional methods could emerge aiding in the development of fingerprint forgeries. Fingerprints created via three-dimensional printing have been able to bypass fingerprint authentication on electronic devices such as phones, laptops, and padlocks [8]. In 2020, Rascagneres and Ventura reported that 3-D printed fingerprints had an 80% success rate at bypassing fingerprint sensors at least once [8]. As 3-D printing technology improves and becomes more cost effective, the potential for fingerprint forgeries using this method could increase. Although researchers are working towards demonstrating the efficacy of 3-D printing technology against biometric scanners, the authors did not find any research to date specifically pertaining to forged fingerprints, suggesting this has not been an effective means used by criminals [8].

Forged fingerprints often display signs of distortion that are atypical of actual fingers and friction ridge skin contacting a surface. With proper training and exposure to forged fingerprints, latent print examiners can learn to recognize these atypical distortion signals. Atypical distortion factors observed in forged impressions include [2]:

- Shape of the impression – the size and outline of the impression are inconsistent with how an object is naturally handled given the angle of contact with the surface, deposition pressure, and the type of surface (for example, a stamp replicating the complete pattern area of a finger applied to a curved substrate).
- Scale – the dimensions of the impression or ridges and furrows could be larger than a standard impression. It may be necessary to enlarge the surface area of a material (for example, a rubber stamp) in order to capture the ridge structure and minute details of the donor's friction ridge skin.
- Continuity of ridges – there are missing sections of ridges or sections of ridges that are of lower clarity compared to adjacent ridges of higher clarity.
- Inconsistent smearing – smears around the border or in the interior of the latent print are not consistent with how an object may be handled or how the skin may have moved on the surface.
- Background noise – a halo around the impression or areas devoid of ridges.
- Well-defined impression edges – ridges of the friction ridge skin abruptly end and tend to look polished on the impression edges.
- The absence of adjacent impressions or regions of the skin when simultaneity should be expected based on how an object is normally touched.
- Processing technique – atypical signature of a latent print processing technique. For example, ninhydrin typically results in a fragmented appearance of friction

ridges. However, forged impressions processed with ninhydrin may display continuous ridges.

Figure 1 shows a forged latent print photographed on a doorknob (a) and a lift of an actual index finger grasping a doorknob (b). Figure 1 (b) shows the expected interaction of a digit with a curved surface. The skin in Figure 1 (b) has folded into the regular flexion creases, creating a large gap at the location of the creases and the digit has rolled onto its side, causing the finger to appear curved in the lift. The forged latent print Figure 1 (a) however, reflects the expected interaction of the digit with a flat surface, rather than a curved surface.



(a) (b)

Figure 1

Forged latent print photographed on the curved surface of a doorknob (a) and a genuine latent print from an index finger powdered and lifted from a doorknob (b).

Figure 2 is a forged impression created with a stamp on a lift card. The manufacturer of the stamp was unable to replicate

the fine detail in the center of the fingerprint when the stamp was created actual size (life size). The end result was a zone of disorganized rubber in the center of the fingerprint stamp. The disorganized stamp material could be confused for dysplasia or attempts to obfuscate the friction ridge skin with nail polish or glue.

Figure 2

Forged inked impression created with a stamp that was manufactured actual size. The detail in the fingerprint was too small for the stamp manufacturer to accurately replicate.

Figure 3 displays a forged inked impression that was created with a stamp (a) and a genuine inked impression (b). The fingerprint used to create the stamp was enlarged to permit the engraver to capture the details of the fingerprint. As a result, the fingerprint and the ridges of the forged impression are significantly larger than a natural fingerprint.

(a) (b)

Figure 3

Enlarged forged inked impression created be a stamp (a) and a genuine inked impression (b).

Figure 4 displays is a forged inked impression on a fingerprint card created with a stamp (a) and a actual genuine inked impression of a finger (b). The ends of the ridges at the perimeter of the forged impression (a) are rounded and polished, rather than tapering as expected (b).

(a) (b)

Figure 4

Forged inked impression(a) and a genuine inked impression from natural friction ridge skin (b).

Additional distortion factors that have been observed as a result of the materials used to produce forged impressions include [6]:

- Distinct outlines around the perimeter of the impression that appear to be unnatural.
- Air bubbles and the potential lack of pores.
- Laterally reversed impressions resulting from the use of a stamp or mold.
- Inverted ridges and furrows resulting from the use of a mold.
- Near exact replications of fingerprint impressions over the same or multiple items in a case.

Figure 5 displays three forged inked impressions using a stamp. The overall shapes of the impressions and fine details of the ridge edge shapes (examples highlighted in the green and pink boxes) are nearly identical. The structure of the stamp is expected to provide for such extreme similarities among the impressions. Given the more pliable nature of the friction ridge skin and variations in contacts with a surface, the extreme degree of similarity in the fingerprints in Figure 5 should be suspect if encountered in a case.

Figure 5

Forged inked impressions using a stamp. The green and pink boxes highlight examples of ridge shapes with a remarkable degree of similarity.

Forgery Case Example

Broward Sheriff's Office Case (Florida, United States, 2018) – A case report published by Sellenraad (2018) from the Broward Sheriff's Office Latent Print Unit documented the receipt of numerous checks for examination. Three hundred eighty-one (381) checks were received in late May of 2013, and each had at least one inked impression for comparison [9]. Prior to Sellenraad's analysis of the checks, the agency provided information that indicated the prints on the checks may be forged impressions, thus lending to a higher degree of scrutiny for distortion factors related to forged fingerprints. Sellenraad grouped the checks by comparative value to include "value with pattern type, value with unknown pattern type, no value (e.g., smudges or markings without friction ridge skin observed), and not a finger or friction ridge skin (i.e., knuckles prints)" [9].

The inked prints on the checks were compared to each other and impressions that appeared to be from the same source were grouped together. As a result of this grouping process, three patent prints were noted to be very similar. These prints were considerably larger than those observed on other checks and displayed similar outlines along the borders of the impressions. There was also a replicated void in the upper left portion of the prints [9].

Through brief experimentation, Sellenraad was unable to create multiple impressions from the same source skin that shared the remarkable degree of similarity found in the three patent prints from the case. As a result, Sellenraad concluded that the three patent prints were forgeries that resulted from the application of a stamp to the checks [9]. According to Sellenraad, Broward Sheriff's Office Detective Kesslinger confirmed that a stamp was applied to some of the checks after the suspect admitted to forgery [9].

Fabricated Prints

A fabricated friction ridge impression is an impression that is intentionally indicated as having been recovered from a particular surface, when in fact it came from a different surface. The fabrication of friction ridge impressions has historically been

committed by an official investigator with the intent of falsely incriminating a person [6]. A fabrication is a deliberate violation of policy and procedure to misdirect an investigation. It should be noted that case documentation mistakes (honest mistakes as opposed to willful violation of policies and procedures) can lead to a similar outcome for the person wrongfully incriminated. Intentional or not, latent print examiners should be aware of the indicators.

Common methods for fabrication include misleading case documentation, lift tape transplants, and exemplar lifts. Misleading case documentation occurs when a latent print is recovered from one item or surface, but the case documentation (e.g., lift card label or case notes) intentionally indicates it was recovered from a different surface or item. It should be noted that an unintentional mistake in case documentation could also lead to a latent print, and consequently a person, being connected to the wrong surface or item. A lift tape transplant involves three stages: 1) an impression is developed with latent print powder on one surface and lifted with tape, 2) the tape is placed on a different surface or item and photographed, and 3) the tape is placed on a lift card and labeled with the fraudulent surface information. Lastly, latent print powder can be applied to an impression recorded in a set of exemplars, lifted with tape, placed on a latent print card, and labeled as recovered from an item or surface related to a crime scene [6].

Much like forged prints, fabricated prints often display signs of atypical distortion that could be detected by a latent print examiner. Forgeries and fabrications share a few distortion factors in common, including impression shape, background noise, and near exact replications of the feature set in the impressions. There are other distortion factors however, that are specific to fabrication. Indications of a fabricated print include [6]:

- Background noise from a surface that is inconsistent with the surface listed in the case documentation. Examples include:
    - Paper fibers or printer ink from lines or text on exemplar records.

- Markings or background noise on the tape indicate inappropriate surface texture given the indicated surface.
- Absence of appropriate background noise given the indicated surface.

- The shape of the impression is inconsistent with the deposition of the latent print on the surface, given the anatomical region represented in the impression and the nature of the surface itself. For example, an impression that is lifted from a rolled exemplar record may include more of the friction ridge skin than is typically recorded in a latent print.
- Variation in the collection materials used for a given scene. For instance, latent print kits are often stocked with specific types of lift cards, lift tape, latent print powders, markers, and pens. As a result, there is often consistency in these items for a given investigator at a given scene. Sudden differences in the materials within a case have been observed in documented fabrication cases.
- Corrections made in a manner that results in the original notes being illegible (e.g., correction fluid or obliterations to text).
- Different apparent handwriting on labels for latent print lift cards or photographs indicated as recovered from the same item.
- Presence of multiple inks or powders within an impression (fabricated impressions from exemplar lifts may include a combination of printer ink, black ink, or powder)
- Alterations to known exemplar prints - powder residue on the exemplar card, variations in ink (light versus dark), or modifications to the paper surface (for example, thickness, tears, etc.)
- Near exact duplicates of latent prints are virtually impossible; therefore, replications of various charac-

teristics in unison including pressure, deposition angle, surface area, and outline would not be expected.

Figure 6 displays genuine latent prints from a plastic container (a), a plastic water bottle (b) and the handle of a fork (c). If these latent prints were labeled as having been lifted from the exterior of a vehicle, the contextual information captured in the lifts would obviously be inappropriate for surfaces associated with the exterior of a vehicle.

(a) *(b)* *(c)*

Figure 6

Genuine latent prints from a plastic container (a), a plastic water bottle (b) and the handle of a fork (c) displaying the expected contextual information for the surface.

Fabrication Case Examples

Alan McNamara (Manchester, England, 2001) – According to a British Broadcasting Corporation (BBC) article, Alan McNamara, a local businessman from Manchester, England was arrested for residential burglary in which his fingerprint was said to have been recovered from a wooden jewelry box in the home [10]. Mr. McNamara denied ever having been in the home. The expert for the prosecution testified that a new lifting technique was used in this case and implied that the box was dirty. McNamara's defense team hired latent print experts and consultants, Pat Wertheim and Allan Bayle.

Wertheim and Bayle disagreed with the results of the prosecution's expert witness. Wertheim and Bayle concluded that the impression was not consistent with having been deposited on a wooden surface. The latent impression was void of visible wood grain and was shaped as if it had been lifted from a smooth curved surface [10]. The defense argued it was more probable that the impression was taken from a vase within the residence and theorized it could have been in McNamara's business sometime before the burglary, which is when he could have handled it. Despite the expert testimony of the defense, the jury found McNamara guilty, and he served 30 months in prison as a result [2].

Harry Oakes (Nassau, Bahamas, 1943) – In 1943, Sir Harry Oakes, a rich baronet living in the Bahamas, rejected a business transaction with Charly Luciano, Benjamin Siegal, and Meir Lansky (alleged members of the American Mafia) which resulted in his murder [1]. Although, the Bahamas had their own police force, and Scotland Yard had jurisdiction, two police captains from Miami Police Department were hired to investigate. During the investigation, a latent print impression was supposedly lifted from a textured room partition and identified to Alfred de Marigny, Harry Oakes' son-in-law. Its validity was later questioned by a private detective, Raymond Schindler, and the defense attorneys because the weaved pattern of the screen was not visible in the photograph [1]. In truth, the latent had been lifted from a glass used by Alfred during a police interview. It was later determined that correct procedures for the collection of fingerprint evidence had not been followed, which led to an acquittal of the defendant by the jury [6].

Frederik van der Vyver (Stellenbosch, South Africa, 2005) – Inge Lotz was found bludgeoned and stabbed to death in her apartment in March of 2005. Her boyfriend at the time, Frederik "Fred" van der Vyver, was accused of her murder due to fabricated fingerprint evidence collected during the investigation [11]. On the day of her death, Inge rented a DVD and returned to her apartment alone. Sometime in the late afternoon, an intruder entered Inge's apartment where they found her on the couch and attacked her from behind [11]. The South African Police (SAP) responded to the scene and collected several items of evidence, including latent prints lifted from various surfaces. Two of the

items, a drinking glass and the DVD cover, were taken to the kitchen by an investigator to be processed and documented. Pertinent descriptive information was not annotated on the lift cards by the investigator while at the scene, which was a violation of policy, and was not added until the following day at the office of the SAP. Additionally, no photographs were captured of the latent impression on the DVD cover prior to it being lifted [11].

An analysis of the latent impression from the rented DVD cover resulted in the identification to Fred van der Vyver. During the trial, the defense team did not deny that the source of the impression was Mr. van der Vyver. The defense questioned the veracity of the surface information indicated on the latent lift card and hired their own latent print experts, Pat Wertheim and Arie Zeelenberg. Wertheim and Zeelenberg independently concluded the shape of the impression was consistent with having been lifted from a curved surface such as a drinking glass, and not a flat surface like the DVD cover [12]. Figure 7 is an image of the latents prints that were indicated as being developed on the DVD case.

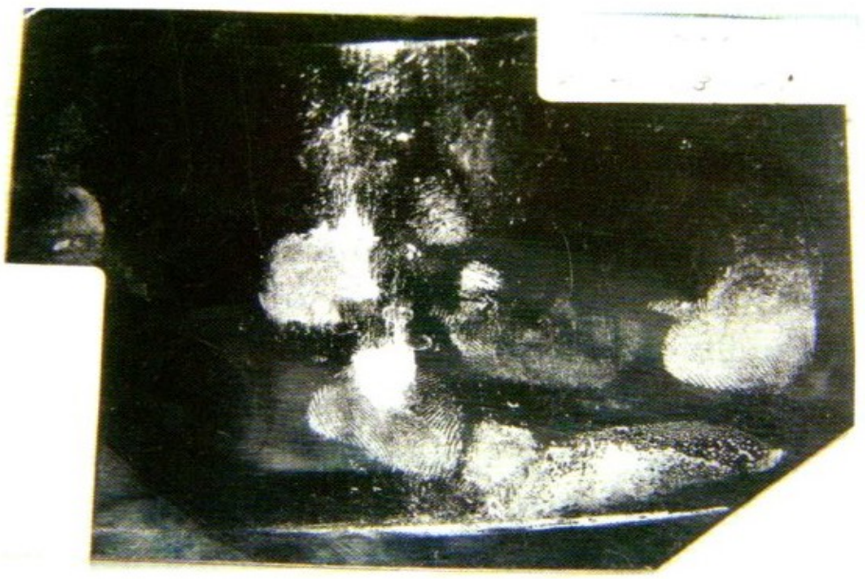


Figure 7

Latent prints purportedly developed on a DVD cover by the South African Police in the Fred van der Vyver case. Wertheim and Zeelenberg concluded the shape of the latent print was inconsistent with being from a flat surface like a DVD cover. Reprinted by special permission of Pat Wertheim from Mr. Wertheim's Scientific Examination Report supplied to the South African Police.

Judge Deon van Zyl remarked about the prosecution's case, "The question arises if there was enough evidence in the first place to bring this case to court.", which led him to adamantly claim Fred van der Vyver was "innocent and dismisses him" [13].

Cedric Green (Georgia, United States, 1995) – In early January of 1995, a fast-food restaurant was robbed at gunpoint. Latent prints recovered from the Hardee's Restaurant in Garden City, Georgia were later identified to Cedric Green. Green was identified as a suspect in the case following incriminating statements that he made to others. A confession by a man claiming to be his accomplice solidified the case against Green [14]. On June 28, 1995, Green voluntarily visited the Garden City Police Department to respond to questions and his exemplar prints were taken by an official, Linwood Griner. Officer Sam Kaminsky with the Garden City Police Department later compared the known prints to those allegedly lifted from the crime scene. A warrant was obtained for Green's arrest based on the incriminating remarks, supposed confession, and latent print evidence. The trial commenced and it was discovered by the Chatham County Police Department and the Chatham County District Attorney "that there were certain irregularities in the latent prints [of Green] allegedly lifted from the Hardee's crime scene which cast doubt upon their authenticity"[1]. Due to probable cause, charges in the case were resubmitted without the fingerprint evidence.

Green was ultimately acquitted of the armed robbery at the Hardee's Restaurant and Officer Sam Kaminsky was charged for falsifying evidence [14]. The exact details of how the fabrication was created are unknown, but Officer Sam Kaminsky was found guilty of falsifying/misuse of evidence [14]. According to the Giglio (Brady) list, in 1997 Kaminsky was also decertified as a peace officer shortly after the occurrence of the Green case [15].

William DePalma (California, United States, 1967) – An armed robbery occurred in late 1967 at the Crocker-Citizens

1 Personal communication with the Clerk of the Superior Court of Chatham County, Georgia stated there is an issuance of a nolle prosequi ("not to wish to prosecute") and has prevented the authors from obtaining sufficient research or additional qualifying information about this case.

Bank branch in Whittier, California [16]. A man fitting the description of the armed robber, William DePalma, was stopped one hour later for questioning and his car was searched. A report was filed regarding the incident, and he was released. Several days later, a similar robbery occurred at the Mercury Savings and Loan Bank in Buena Park which led Whittier Detective Sergeant Joe Plummer to review DePalma's criminal record [16]. Previous minor infractions contributed to DePalma becoming the prime suspect leading to his eventual arrest and charging. During his trial, DePalma professed his innocence and provided thirteen alibi witnesses stating he was miles away from the bank at the time of the robbery. However, prosecution presented eyewitness testimony of two bank tellers and fingerprints lifted from the bank counter. Despite consistent testimony from the numerous alibi witnesses, the prosecution's evidence was sufficient for a conviction.

Prior to beginning his prison sentence, William DePalma contacted private investigator, John Bond, who learned of contradictory evidence in the case. This evidence included robberies that were similar in nature, falsified eyewitness testimony, and a fabricated fingerprint identification [16]. The private investigator interviewed former Buena Park Officer David Nelsen and learned that the lifting officer, Sergeant James Bakken, had fabricated latent fingerprint evidence in another robbery case. In addition, Bakken was found to be lying about his academic and professional training [16]. These revelations lead the Buena Police Department and District Attorney to have two experts re-evaluate the latent evidence [1]. The new microscopic examination found the latent to be consistent with it being lifted from a paper copy of DePalma's 1957 exemplar. It is said to be an "exact duplicate" of his left index finger [16]. Furthermore, the fabricated evidence included a portion of the adjacent finger [16]. The findings were presented to the District Attorney's office, DePalma was acquitted in 1974 and Sgt. Bakken was indicted on falsifying and fabricating evidence in both robbery cases [1].

Herman Wiggins (California, United States, 1970s) – One of the more infamous cases of fabrications occurred in San Diego, California during the 1970s and involved former patrol officer Herman Wiggins. Officer Wiggins purportedly stopped people

whom he thought looked suspicious [4]. During the stops he would search the individuals and have them place their hands on the hood of his patrol vehicle [1]. Wiggins would later apply fingerprint powder and lift the latent impressions with the intention of adding them to the latent lift evidence from other crime scenes [4]. When confronted with falsifying evidence, Officer Wiggins explained that latent lift cards could have become mixed up after he dropped his briefcase [17]. It was later discovered that Officer Wiggins fabricated fingerprints in approximately forty cases, which resulted in two years of incarceration [17].

New York State Police Troop C (New York, United States, 1980s) – On December 23, 1989, the home of the Harris family was doused in gasoline and set on fire. Upon further investigation of the home's remains, the family of four were found brutally murdered inside [18]. Several items of evidence were collected from the crime scene, including a gasoline can. It was suspected the fire was started in an effort to conceal the murders; therefore, the gasoline can was examined for latent prints [19].

Transactions at a local ATM led to eye-witness composite sketches of two individuals, a young black man and middle-aged black woman. The sketches were released to the public and pointed investigators to Michael and Shirley Kinge [20]. In early February 1990, Trooper David Harding alerted senior investigators, David McElligott and Herbert Karl Chandler, to the identification of Shirley Kinge to latent prints recovered from the gasoline can [19]. Based on the evidence, a search warrant was obtained for the apartment of Michael and Shirley Kinge [19]. When police approached, Michael Kinge brandished a gun and the police responded with a fatal shot [18]. Shirley Kinge was taken into custody and found to be in possession of stolen credit cards from the Harris home [20].

Shirley Kinge was convicted of arson and burglary and sentenced to 18 to 44 years in prison [19]. During her incarceration, Trooper Harding from the New York State Police Troop C interviewed for a position at the Central Intelligence Agency and admitted to regularly planting evidence at crime scenes [18]. This admission led to the Federal Bureau of Investigation re-opening cases involving Trooper Harding. Shirley Kinge's case was one of the many cases reviewed. Troopers David Harding and Robert

Lishansky later admitted to using Shirley Kinge's fingerprints from her job to fabricate the latent prints indicated as having come from the gasoline can found at the Harris residence [18]. Shirley Kinge's conviction was overturned, and she was released after spending two and half years in prison [18].

In the aftermath of the Kinge case, additional investigations into the conduct of the New York State Police Troop C were ordered by Governor Mario Cuomo [20]. The investigations revealed that misconduct began in 1984 with Trooper Craig Harvey, who later would become the lieutenant supervising forty investigators that comprised Troop C [18].

Studies of The Detection of Forged and Fabricated Prints

Harold Cummins (1934) – Harold Cummins was part of an investigation in 1933 concerning fingerprints pressed into a plastic material, which piqued his interest into the prospect of forged fingerprints. Cummins conducted a study to determine whether fingerprints could be forged. The study involved eight fingerprint experts who were asked to analyze prints to determine their authenticity. The experts were presented a card with four prints from a right index finger, as shown in Figure 8 [21]; two of the prints were genuine prints and two were forged. The experts were informed the card had a representation of both kinds of fingerprints, but not how many of each were present. The study found three out of the eight experts correctly categorized all four of the fingerprints as genuine or forged. The remaining experts made errors. Six genuine prints were characterized as forgeries and five forged prints were characterized as genuine. Given the errors, Cummins suggested that potential contextual bias of knowing that forgeries were present may have affected the results. Overall, the results demonstrated that distinguishing between genuine and forged prints was not infallible [21].

Figure 8

A card with four right index fingers presented to the study participants. Two genuine prints (1 and 3) and two counterfeit prints (2 and 4). Reprinted by special permission of Northwestern University, the Northwestern Pritzker School of law, and the Journal of Criminal Law and Criminology from Cummins, Harold, "Counterfeit Finger-Prints," J. of Crim. L. & Criminology 1934, 25 (4), 666-670.

Phyllis Senay (1990) – A limited study conducted by Senay in 1990 also found that five fingerprint technicians were unsuccessful in the detection of forged prints [22]. Senay's interest into counterfeit fingerprints was heightened after a published article in a 1982 *Royal Canadian Mounted Police (RCMP) Gazette*. The article discussed a bank robbery in which a fabricated fingerprint was placed on a seat buckle in a vehicle [22]. As a result of this case, a study was conducted to test the ability of examiners to recognize forged fingerprints. In this study a mold of the friction ridge skin was utilized to create a silicone cast. Perspiration was then applied to the cast and stamped onto glass. After development, five fingerprint technicians compared the impression to known fingerprints and each technician identified the impression. The impression was verified without any questions from the technicians about its authenticity [22]. While minimal information was available regarding this study, it demonstrates that forged fingerprints can go undetected.

Boris Geller, Joseph Almog, and Pierre Margot (2001) – From 1998-1999, Boris Geller, et al. sent out a ten-question survey to two hundred forty individuals and received one hundred fifty-two completed questionnaires in return. The recipients were fingerprint and laboratory personnel in four different countries including Estonia, France, Israel, and Switzerland, and the surveys were translated into their respective native languages [23]. The goal of the survey was to determine the experts' awareness and attitude towards fingerprint forgeries.

source. In the second part of the study, the examiners were asked to reevaluate the eighteen latent prints previously compared and indicate whether each latent print was genuine, forged, or fabricated. Additionally, participants were provided with definitions and written examples of forged and fabricated prints.

In the first part of the study, two of the eighteen comparisons (Latent Print 2 and Latent Print 12) each resulted in twelve opinions of exclusion [5]. Latent Print 2 and Latent Print 12, shown in Figure 9, were both forged latent prints exhibiting both lateral reversal and ridge/furrow inversion (resulting in tonal reversals of the ridges and furrows). One participant provided an exclusion opinion for Latent Print 6 [5], shown in Figure 10, and explained the opinion was influenced by distortion in the latent print (presence of air bubbles).

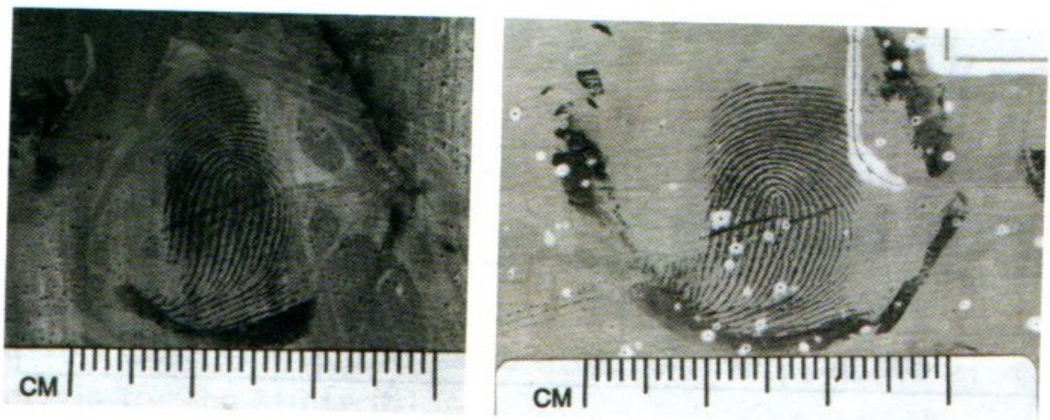


Figure 9

Latent Print 2 and Latent Print 12 respectively had the greatest number of exclusion decisions in the study. Both latent impressions were casts of friction ridge skin created by using Mikrosil casting putty and had a clear ring around them. Reprinted with permission from Barton, K.; Matthias, G. Distinguishing Forged and Fabricated Prints. J. For. Ident. ***2019****, 69 (2), 195-206.*

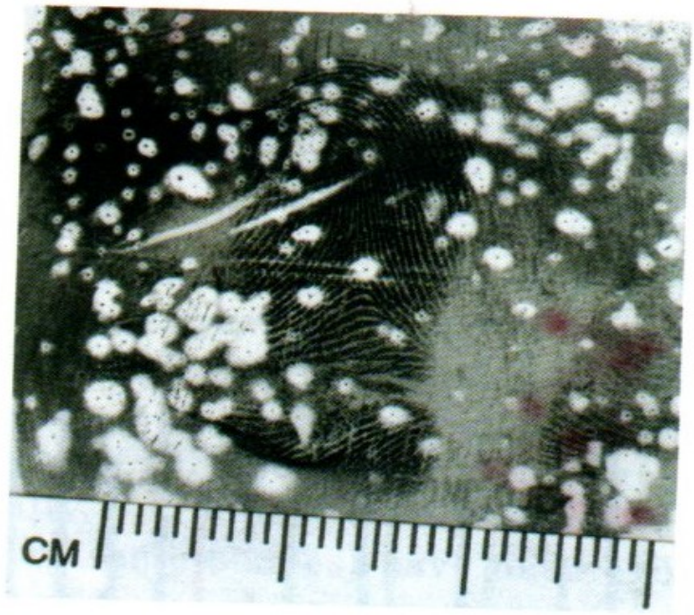


Figure 10

Latent Print 6, a genuine latent impression, from the Barton and Matthias study had a source exclusion conclusion by one participant due to the background noise present (air bubbles). The presence of air bubbles was the participant's provided reason for the exclusion. Reprinted with permission from Barton, K.; Matthias, G. Distinguishing Forged and Fabricated Prints. J. For. Ident. ***2019****, 69 (2), 195-206.*

In the second part of the study, results showed that participants declared the true impressions forged or fabricated in a majority of the trials. One of the participants went so far to say that all the prints were forged or fabricated, with no genuine prints present in the eighteen images. The authors speculated the results were influenced by the provided instructions and that participants "were in a different state of awareness" [5]. Participants declared fabricated prints as genuine prints more often than they declared forged prints genuine. This is likely due to the more realistic appearance of the fabricated impressions. Forged prints also tend to have more pronounced atypical distortion factors. Results from the participants are shown in Figure 11 [5]. In Figure 11, blue are genuine impressions, red are forged impressions, and green are fabricated impressions. The height of each bar represents the number of times the impression was mis-classified (e.g., Latent 1 is a real latent impression that was mis-classified 12 times, Latent 2 is a forged impression that was mis-classified 4 times, etc.). The results of this study and Bourquin's 2011 study indicate that more formal training is

necessary if latent print examiners are expected to detect forged or fabricated prints.

Figure 11

A graphical representation of Part 2 of the Barton and Matthias results [5] showing how many times each of the 18 latent impressions was mis-classified as real, forged, or fabricated by the 26 participants.

Conclusion

Although documented cases of forged or fabricated latent print evidence are rare, it is imperative to stress that there may be some that have gone unnoticed. It has been the intent of this review to alert latent print examiners of their potential existence in casework and provide examples of indicators that may be present in these types of cases. The goals of this article were to summarize the state of knowledge regarding methods of production of forged or fabricated prints; atypical distortion factors that may aid in the detection of fraudulent friction ridge impressions by latent print examiners; case examples providing context for the fraudulent activity; and studies of latent print examiner skills detecting forged or fabricated friction ridge impressions.

Forged and fabricated fingerprints often produce known distortion factors that can be detected by a sufficiently trained examiner. While some of these factors may appear in genuine latent print casework, the appearance of certain distortion

factors in the aggregate should alert the examiner to potential problems and trigger further inquiry. When concerns arise regarding fraudulent prints, it is the examiner's responsibility to address them in accordance with their agency's code of ethics, policies, and standard operating procedures.

It is significant to note that the aforementioned case examples lack ground truth; however, they provide support for robust agency case documentation requirements regarding latent prints [24] to limit opportunities for fraudulent activity by investigators and the necessity of sufficient training for latent print examiners. Additionally, while only a few studies (all with limited participants and sample sizes) have been conducted assessing the ability of latent print examiners to detect forged and fabricated prints, each demonstrated that the skill set required for detection is lacking and must be improved if examiners are expected to perform this role. Future research should include a broader selection of both latent print examiners with a variety of experiences and latent print samples created with a variety of methods. Finally, it is possible that examiners' abilities may improve through training either as part of their onboarding or through external training providers. In order to provide a well-rounded and effective training experience, it should include at a minimum, techniques involved in the creation of forged and fabricated prints, a comprehensive discussion of atypical distortion factors signaling forgery or fabrication, a review of the available research studies, and practical exercises.

Forgeries most often require forethought as well as substantial effort and resources by the criminal, and therefore may not occur as often as fabrications. Although, as technology progresses (for example, 3-D printing, metal etching) and biometric systems are incorporated into everyday use, forgeries and fabrications may become easier to produce. The need for ongoing research and training regarding fraudulent friction ridge impressions will continue.

Acknowledgements

The authors would like to express their gratitude to the City of Phoenix Police Department and the Crime Laboratory for providing their support. We would also like to thank Pat