ACE-V: Meaningful note-taking during its linear application

Simon Bunter BSc FFS, Forensic Scientist (specialising in the examination of fingerprint evidence)

Keith Borer Consultants, Locard House, Belmont Business Park, Durham, DH1 1TW
0191 332 4999
simon.bunter@keithborer.co.uk

Abstract

Errors in fingerprint identifications and current scientific research have led to recommendations being made that Fingerprint Examiners make more detailed notes and that the analysis phase of ACE-V should be documented more thoroughly. This paper identifies that currently note-taking at the analysis stage is greatly lacking and Fingerprint Examiners should adopt a more rigorous, detailed and structured approach. Specifically, Fingerprint Examiners should annotate an image of the mark with the position of the ridge characteristics before they compare it against any fingerprint reference forms. This would provide a contemporaneous record of the Fingerprint Examiner’s unbiased opinion of the mark before that opinion is subject to any influence by the clearer fingerprints on a person’s reference form. This would allow evaluation results to be reported more objectively and with the correct evidential strength.

Keywords

Fingerprints, Analysis, Note-taking, Cognitive Bias, Reverse Reasoning, Circular Reasoning

1. Introduction

There have been many papers published regarding different types of cognitive bias that Fingerprint Examiners are subject to during their day-to-day work. Examples of factors that can influence an examiner include: confirmation bias from knowing a previous examiner’s result [1]; extraneous information such as context [2]; and individual job satisfaction in solving high profile, serious or long-running cases [3]. This paper discusses the specific type of cognitive bias the good quality fingerprint in the reference form presents to the examiner and suggests practical solutions to minimise its influence and effect.

The number of ridge characteristics observed by a Fingerprint Examiner in a crime scene mark can be influenced by the clear ridge characteristics in the known person’s fingerprint against which it is compared [4]. Dror explains that having a reference fingerprint to compare against may cause a motivated perception that affects what an expert examiner may see in the actual evidence [5]. In other words, clear ridge characteristics in the known print can persuade a Fingerprint Examiner that corresponding features are present in unclear areas of the questioned mark. This is known as ‘reverse’ or ‘circular’ reasoning. Dror went onto explain that such circular reasoning allows the fingerprint in the reference form to influence the analysis of the actual evidence, opening the door to a whole set of cognitive biases and influences [5]. Such ‘corresponding’ features cannot be relied on if the Fingerprint Examiner has been influenced in this manner.

An example of how such bias can cause an erroneous identification can be found in the case of Brandon Mayfield who was accused of the Madrid train bombings in 2004. It was reported that the initial FBI Fingerprint Examiner originally found seven ridge characteristics at the analysis stage but reinterpreted five of them to be more consistent with Mr Mayfield’s fingerprint [6]. The Office of the Inspector General’s review of the FBI’s handling of the case recorded that “Having found as many as 10 points of unusual similarity, the FBI examiners began to ‘find’ additional features in LFP 17 (the latent print) that were not really there, but rather suggested to the examiners by features in the Mayfield prints”. 
Fraser-Mackenzie et al have shown that if ACE-V is applied linearly, it can minimise the influence of a known fingerprint in the comparison stage and subsequent evaluation [7]; this is also known as sequential unmasking. Some advocate a strict linear sequential unmasking with no ‘going back’ whereas Dror has suggested more flexibility with the examiner allowed to ‘go back’ but with limitations based around confidence levels of the initial analysis [8].

An article published in 2010 stated that there was no good evidence to indicate that recommendations from cognitive bias research prior to this date had resulted in changes to the day-to-day working practices of Fingerprint Bureaux [9]. Since that article the findings of the Court of Appeal in R-v-Smith (2011) [10] and The Fingerprint Inquiry Scotland report (2011) [11] have been published.

The R-v-Smith Court of Appeal Judgement criticised the Fingerprint Examiner’s lack of note-taking stating that “No competent forensic scientist in other areas of forensic science these days would conduct an examination without keeping detailed notes of his examination and the reasons for his conclusions”. The judgement stopped short of recommending the precise type of notes that should have been recorded, instead referring to the extensive evidence heard by the Fingerprint Inquiry Scotland and its forthcoming report.

The evidence heard by The Fingerprint Inquiry Scotland resulted in 86 recommendations. Several of these recommendations relate to specific types of note-taking and explain the purpose for making them. Recommendation 53 urges that note-taking of the detail found during analysis and comparison becomes general practice for all fingerprint comparison work. Other recommendations would only appear possible to implement if the examiner annotated images of the mark during the analysis stage. For example:

- **Recommendation 25** – “Fingerprint examiners should assess tolerances during the analysis stage so that when they come to evaluate whether the mark and print match they are conscious of the risk of applying excessive tolerances.”

- **Recommendation 26** – “Characteristics first found at the comparison stage should be included in any note of the examination. Less weight should be attached to such characteristics.”

Despite these recommendations, it is the author’s current employment experience (which involves examining fingerprint evidence in UK Fingerprint Bureaux) that these recommendations have still not been implemented in the UK. This paper proposes a practical system for examiners to assess and evaluate tolerances and any reverse reasoning, as advocated in Recommendation 18 of the Inquiry’s report.

The abundance of research regarding this matter and the lack of procedural changes to address the issue, suggests a level of reluctance by Fingerprint Examiners to change their normal practices. This might be because, despite the research, Fingerprint Examiners consider themselves objective and immune to bias [12]. Fingerprint Examiners that are influenced by such bias have previously been criticised and described as “...totally incapable of performing the noble tasks expected of him/her or is so immature he/she should seek employment at Disneyland”[13]. The author’s experience also includes Fingerprint Examiners explaining that, although they are aware of cognitive bias, they simply rely on their expertise to nullify it, as opposed to making any amendments to their working practices.

The presence of different types of bias has been recognised by the Forensic Science Regulator who acknowledges that cognitive bias, if not properly managed, could impact on the reliability of a Fingerprint Examiner’s opinion [14]. Although recognised, however, no methodology is suggested by the Regulator to prevent or minimise the effects of the bias of observing a person’s fingerprint form early on the process. Indeed, the Regulator describes the ACE-V process as “iterative” and “overlapping on occasion... allow[ing] examiners to observe further features within the mark...” and the Regulator’s Codes of Practice and Conduct [15] appear to condone a circular or reverse approach to ACE-V recording that “Although this process sets out the stages sequentially it is important to note that it is not strictly linear in practice. The analysis and comparison stages are not mutually exclusive throughout the examination process”. 
This paper sets out a specific note-taking methodology that Fingerprint Examiners can follow during the analysis and comparison stages to demonstrate which corresponding ridge characteristics are reliable and which are not. This approach also assists with determining whether any proffered explanations for differences between a mark and a print are viable.

This annotated stricter application of ACE-V might cause some Fingerprint Examiners concern with regards to increased time spent on their examinations to fulfill the annotation and retention requirements. The proposed methodology, however, is not intended to be carried out for every crime scene mark, just those that are ‘critical’ to the case.

2.1 The Current Situation

2.1.1 Current Analysis Practice

When using ACE-V it is common practice for a Fingerprint Examiner to analyse a crime scene mark before comparing it to a known person’s fingerprint form. The extent of that analysis, however, is often limited to assessing if the mark is suitable quality to render a comparison worthwhile. If the mark is deemed suitable, very few, if any, analysis notes are made. Any notes that are made tend to be vague or generic such as ‘the mark was analysed and found to contain sufficient detail for comparison’. This approach to the analysis stage of ACE-V is common practice throughout UK Fingerprint Bureaux.

Sometimes more detailed analysis notes are made when a Fingerprint Examiner is preparing a full evidential statement for court but, at this stage, such notes are retrospective rather than contemporaneous, i.e. the identification decision has already been made. Typically, the notes do not involve annotating the ridge characteristics observed in the mark prior to comparison. This approach does not assist in addressing the cognitive bias issues discussed in this paper.

2.1.2 Current Comparison Practice

If the Fingerprint Examiner compares the mark and identifies it, he/she will usually mark-up corresponding ridge characteristics on images of the mark and reference print. This can be done in several ways including: electronically annotating images of the mark and print on a computer system (e.g. AFIS/Ident1); ‘pricking-out’ corresponding ridge characteristics in a physical photograph of the mark; and/or marking up the characteristics on a comparator screen using ink. The retention of such comparison notes varies between examiners and bureaux but generally ‘pricked-out’ photographs are retained in the case file and annotated Ident1 comparison images are sometimes printed-out and retained. Comparison notes made in ink on a comparator screen, however, are often made and then rubbed-out. This approach essentially equates to making contemporaneous comparison notes and then deleting them. This is not in line with the general disclosure rules of ‘Record, Retain, Reveal’.

2.1.3 Current Evaluation Practice

The Forensic Regulator lists four main outcomes of the ACE-V process: Identified, Inconclusive, Excluded and Insufficient [15].

- Identified is defined as “A practitioner term used to describe the mark as being attributed to a particular individual. There is sufficient quality and quantity of ridge flow, ridge characteristics and/or detail in agreement with no unexplainable differences that in the opinion of the practitioner two areas of friction ridge detail were made by the same person”.

- Inconclusive is defined as “The determination that the level of agreement and/or disagreement is such that it is not possible either to conclude that the areas of friction ridge detail originated from the same donor, or to exclude the particular individual as a source for the unknown impression”.

- Excluded is defined as “There are sufficient features in disagreement to conclude that two areas of friction ridge impressions did not originate from the same donor or person”.


• Insufficient is defined as “The ridge flow and/or ridge characteristics revealed in the area of friction ridge detail (mark) are of such low quantity and/or poor quality that a reliable comparison cannot be made. The area of ridge detail contains insufficient clarity of ridges and characteristics or has been severely compromised by extraneous forces (for example, superimposition, movement) to render the detail present as unreliable and not suitable to proffer any other decision”.

If the Fingerprint Examiner is of the opinion that the result of identification is warranted, the extent of the note-taking at this stage would normally include the name of the identified person, the digit or palm that was matched, the name/initials of the Fingerprint Examiner making the decision and the date the identification was made. In other words, their notes only comprise the evaluation result of ‘identified’ with no specific reference to the analysis or comparison stages of their examination.

2.1.4 Current Verification Practice

Identifications are usually checked by one or two further Fingerprint Experts before the result is reported. Generally these verifying experts will be aware of the original examiner’s result, i.e. that the mark has been identified to a specific digit/palm for Mr X. Sometimes ‘pricked-out’ photographs or AFIS print-outs showing the original Fingerprint Officer’s comparison notes might be available in the case file. This can lead to the presence of confirmation bias that has been discussed in other research. Langenburg et al [1] reported that “The observer tends to see what they want or what they have come to expect, rather than evaluate what is present”. Confirmation bias at the verification stage, although an important issue in the ACE-V process, is not the main focus of this paper.

2.1.5 Current Reporting Practice

If a Fingerprint Examiner provides an evidential statement for an identification, they will often record the number of matching/corresponding ridge characteristics. This number is usually the opinion arrived at by the examiner when preparing the evidence as opposed to the number found during the original comparison.

The report/statement will normally state that the examiner was in ‘no doubt’ regarding the identification and that there were ‘no unexplainable differences’.

The ‘no doubt’ wording appears at odds with Recommendation 3 of The Fingerprint Inquiry Scotland report that states “Examiners should discontinue reporting conclusions on identification or exclusion with a claim to 100% certainty or on any other basis suggesting that fingerprint evidence is infallible”.

The ‘no explainable differences’ wording is part of the definition of an identification, so it is perhaps not surprising that it is included. What is at issue, however, is the examiner’s subjective perception of whether a difference is ‘explainable’. How do we know how cogent an examiner’s explanation for a difference is? The proposed methodology in this paper seeks to provide some objectivity to this matter.

Forensic sciences such as DNA profiling, CCTV imagery analysis and handwriting analysis, use scales of support in their reporting, e.g. ‘in my opinion there is very strong support that the questioned handwriting ABC/1 was made by the same person whose handwriting appears in exhibit XYZ/2’. Just because fingerprints are accepted as unique, it does not necessarily follow that a perceived ‘match’ means a mark was definitely deposited by that person. Under current reporting guidelines [15], if a Fingerprint Examiner finds some corresponding ridge characteristics between a mark and a print, they have only two possible results to choose from: Identified (i.e. it was definitely deposited by that person) or Inconclusive. ‘Inconclusive’ covers such a wide range of outcomes that it is essentially meaningless, i.e. it covers the extreme range of opinions between ‘just short of exclusion’ to ‘just short of identification’ and everything in between.
2.2 The Problems

There are two main problems with the current general application of ACE-V and the reliability of identifications:

i. The subjectivity regarding the number of ‘matching’ ridge characteristics.

ii. The subjectivity regarding ‘explanations’ for apparent differences.

In relation to the first issue; despite the lack of a formal numerical standard, the quantity of matching/corresponding ridge characteristics is fundamental to most fingerprint identifications and is often quoted in evidential statements. The number of matching characteristics is subjective and opinions often differ between experts. Even the opinion of a single expert regarding their own evaluation result can change [16].

The current reporting process of quoting the number of ridge characteristics in agreement can sometimes be misleading, particularly when the crime scene mark contains areas of poor clarity and ridge characteristics are difficult to distinguish. To give an example using the current circular approach to ACE-V:

• A Fingerprint Examiner analyses a crime scene mark and finds two clear ridge characteristics in a small but clear area of the mark. The examiner notes that several other areas of the mark are poor clarity containing smudged and/or fragmented ridges. Although the examiner cannot clearly see ridge characteristics in these poor clarity areas, they decide to compare the mark against a suspect's fingerprints. Upon comparison, the examiner finds that the two clear characteristics correspond with those in the suspect’s right forefinger. While carrying out the comparison, the examiner notes a further ten ridge characteristics in the suspect’s right forefinger print that appear to correspond to ten apparent ridge characteristics in the poor clarity areas of the mark. Under current ACE-V procedures, if the examiner was satisfied as to the ‘identification’, it would be reported that 12 ridge characteristics were in agreement and the examiner was in ‘no doubt’. The wording in the report/statement would suggest the match was compelling. If the court were aware of the reality of the process carried out by the examiner, the court’s understanding of the strength/weakness of the evidence would be improved.

In relation to the second issue; visible differences between an identified mark and a known print are not uncommon but what constitutes an acceptable explanation? Differences can be caused by distortion or artefact and sometimes this can be obvious, e.g. over/under-lying marks, movement of the digit causing smearing of the mark, background interference, etc. What about the situation, however, where there are differences but the causes are not obvious? When does a difference preclude ‘identification’, when is that difference ‘explainable’ and when does a difference warrant an ‘exclusion’? Caution should be applied not to retrospectively seek an explanation for a difference for an ‘identification’ based on a perceived sufficient quantity of corresponding ridge characteristics. Again, to give an example using the current circular approach to ACE-V:

• During the comparison stage a Fingerprint Examiner finds 16 corresponding ridge characteristics between a mark and a suspect's right forefinger print. They are satisfied with the 16 corresponding characteristics and would normally report it as an identification. They also note, however, an apparent ridge characteristic in the mark that does not appear in the suspect's fingerprint. The examiner cannot see an obvious explanation for the presence of this characteristic but it is located towards the edge of the mark and some of the nearby ridges appear ever so slightly distorted. As
there are 16 relatively clear matching ridge characteristics and the possibility that the characteristic is due to distortion, the identification is reported with ‘no unexplainable differences’.

In this example, although the Fingerprint Examiner might have some reservations, they may feel pressured into providing a result of ‘identification’ as the only alternative result is the essentially meaningless ‘inconclusive’. If an agreed graduated scale of support was available, this would allow the examiner to provide a more transparent result that reflected any concern regarding the presence of this difference.

The reporting of fingerprint evidence is at odds with most other forensic disciplines in that ‘identification’ results are nearly always ‘conclusive’. Triplett has previously stated that such categorical reporting “…has made conclusions sound conclusive, when in reality they may be strongly supported with visual data, marginally supported with visual data, or lack visual data that can be successfully demonstrated to others (i.e., simply the beliefs of the practitioners stating the conclusion)” [17]. Triplett goes on to propose a defined scale of support to articulate an examiner’s conclusions.

2.3 The Solution

The subjectivity during a comparison can be minimised by adopting a linear approach to the ACE-V procedure, separating out the analysis and comparison stages.

2.3.1 The Analysis Solution

Examiners should annotate an image of the mark with the ridge characteristics and features they note during their analysis stage before any comparison. This should be retained to provide a definitive record of their analysis result prior to any influence from a fingerprint reference form. The Fingerprint Examiner could be encouraged to assign different levels of confidence or tolerance to the observed ridge characteristics. For example, the clarity of ridge characteristics could be split into two groups; ‘clear’ (high confidence) and ‘indicative’ (low confidence). A clear ridge characteristic being one that lies in an undistorted part of the mark, where its presence and position is unambiguous. It is this type of ridge characteristic that, if not present in a person’s print, might result in exclusion but at the very least would mean that a result of ‘identification’ should not be provided, i.e. it is not explainable as it was originally observed as a clear ridge characteristic. An indicative ridge characteristic is one that appears in a distorted area of the mark meaning that its presence or location is unclear. The absence of an indicative ridge characteristic in a person’s fingerprint would not necessarily preclude an identification as it might be explainable due to the distortion or artefact that caused it to be classified as low confidence in the first place. The GYRO methodology has been developed to allow this kind of approach [18].

The annotated images of the mark should be retained to allow the examiner to refer back to them during the comparison and/or evaluation stage.

2.3.2 The Comparison Solution

At the comparison stage the Fingerprint Examiner would be free to compare the mark against any known person’s fingerprint form knowing that they had retained an unbiased record of their uninfluenced analysis. If the Fingerprint Examiner subsequently ‘identified’ the mark, they could check the corresponding ridge characteristics they noted during comparison against those noted in the pictorial record of their analysis. This would assist the Fingerprint Examiner in their evaluation by demonstrating which corresponding ridge characteristics are reliable (those noted during the analysis) and which are less so (those only noted during the comparison).
2.3.3 The Evaluation Solution

An ‘identification’ should only be declared if:

1. There were ‘sufficient’ ridge characteristics noted during the analysis stage that corresponded to those in the person’s fingerprint. Any corresponding ridge characteristics first noted during the comparison stage should be given less weight in the examiner’s evaluation.

2. There were no ‘clear’ ridge characteristics annotated in the mark that were not present in the print and vice versa, i.e. the absence of a ridge characteristic in the person’s fingerprint that was considered ‘clear’ in the analysis of the mark, precludes a result of identification.

Using the Forensic Regulator’s ‘four results’ system, any other ‘matches’ should be classified as inconclusive. Given the previously discussed wide-ranging nature of the inconclusive result, however, the examiner may wish to explain their findings in more detail. Using the second bullet point in 2.2 as an example, at the analysis stage the examiner may have noted 17 ridge characteristics in the mark as ‘clear’. Yet, when they compare it against a person’s fingerprint, they find 16 of the 17 ridge characteristics are present but the 17th ‘clear’ ridge characteristic is not present. Although the lack of this one ‘clear’ characteristic means any match would fall short of an ‘identification’, the examiner may form the opinion that, due to the quantity and quality of the remaining 16 corresponding ridge characteristics, they still think it is highly likely that the mark was deposited by that person. If this is the examiner’s opinion, they should be encouraged to caveat the ‘inconclusive’ result with such an explanation (see the example in 2.3.4 below).

The above is one example of the type of result for a single unexplainable difference. Of course, depending on the mark, a Fingerprint Examiner might wish to exclude a person on the basis of one different ridge characteristic.

2.3.4 The Reporting Solution

When reporting results, the Fingerprint Examiner could reference the features noted at the analysis stage. For example, instead of simply quoting ‘12 ridge characteristics in agreement’, an identification could be reported as:

- ‘Identified – A total of 12 ridge characteristics in agreement, 10 of which were noted during the initial analysis stage. There were no clear ridge characteristics noted during the analysis stage that were not present in the fingerprint form in the name of Mr X.’

Or for an ‘inconclusive’ result, such as that following the example in paragraph 2.3.3:

- ‘Inconclusive – There was a total of 16 ridge characteristics in the mark that corresponded with Mr X’s fingerprint, all of which were noted as ‘clear’ during the initial analysis stage. However, one further ridge characteristic was deemed to be ‘clear’ during the analysis that was not present in Mr X’s fingerprint meaning that an ‘identification’ result cannot be given.

In my opinion, despite it being annotated as ‘clear’ during the analysis stage, there remains the possibility that its appearance might have been due to distortion or background interference in the mark. Due to the quantity and clarity of the 16 corresponding ridge characteristics, in my opinion, it is highly likely (or ‘this finding provides very strong support’) that this mark was made by Mr X.’
If such a reporting system were to be adopted, it would seem appropriate to incorporate some type of support scale to replace the ‘inconclusive’ result. This ‘greater than neutral but less than conclusive’ style of result reporting would be new to the fingerprint profession but is commonly used in other areas of Forensic Science. Such reporting for fingerprint results has previously been proposed and may soon need to be embraced to bring the profession in line with modern forensic thinking.

3. Discussion

The current reporting of fingerprint evidence often uses a subjective number of corresponding ridge characteristics as part of the explanation for the Fingerprint Examiner’s result, e.g. ‘12 ridge characteristics in agreement’. In crime scene marks lacking clarity, the Fingerprint Examiner’s opinion regarding this number can be influenced by the clear ridge characteristics in a person’s fingerprint form. This, in turn, can lead to errors or provide a misleading strength of the ‘identification’. Although it is not possible to completely remove subjectivity from a Fingerprint Examiner’s opinion, the proposed annotated image method at the analysis stage introduces a level of objectivity to the examiner’s application of the ACE-V process. It would help demonstrate which of the reportedly corresponding ridge characteristics were reliable.

The reporting of results using this method would provide the courts with more transparency regarding the Fingerprint Examiner’s finding. It would also assist the examiner when providing evidence of identification in court. Instead of trying to convince the court that they could observe a ridge characteristic in the mark that perhaps the court finds difficult to see, they can produce their initial analysis notes that would demonstrate they had seen that characteristic before they even looked at the features in Mr X’s fingerprint.

In order to properly evaluate and articulate the strength of ‘inconclusive’ findings, a scale of support may need to be agreed on by the fingerprint community. Triplett’s Articulation of Conclusions [17] might provide a fundamental basis to build on.

Annotated images may be considered to be a significant change to how Fingerprint Examiners analyse crime scene marks in their day-to-day work. It might also be considered that this process would take more time than current ‘quick’ analysis procedures (in the short term at least). It would not appear necessary, however, to invoke this process for all marks. The Fingerprint Inquiry Scotland report recommended that particular attention should be given to ‘complex’ marks. Perhaps this process could be used not just when the mark is ‘complex’ but when the probative nature of the mark is ‘critical’ to the case. To explain further using two extreme examples:

- If a plastic carrier bag has 50 marks on it that have been attributed to a person, the issue of whether a 51st ‘complex’ mark can be attributed to the same person may not be relevant or ‘critical’ to the case. The annotated image approach may not be relevant for a case like this.

- If, however, there is a mark in blood on a murder weapon, identifying the donor of this mark could be ‘critical’ to the case. This would be an ideal opportunity to invoke the annotated image approach for analysis, regardless of the mark’s complexity.

In general day-to-day fingerprint work, it would likely be difficult to know which marks might be complex or critical when the analysis stage is undertaken. There are several options for which this procedure can be carried without it being too onerous. One such solution could be for the initial Fingerprint Examiner to carry out the comparisons as normal, without annotating the images of the marks. If a complex or critical mark was identified by this Examiner, the two verifying examiners could make annotated analysis notes for that one mark before comparing it, one of whom could provide the evidential report/statement.
There would not appear to be the need for significant investment to incorporate this approach. Many Fingerprint Examiners probably make some of the appropriate analysis notes during their current working practices, e.g. if they mark-up the ridge characteristics in a crime scene mark for the purposes of searching it on the Ident1 system, this could be retained to constitute their annotated analysis notes prior to comparison. Software packages such as CSIPix and PiAnoS can also be used, but even taking a digital photograph of inked points on a comparator screen could suffice.

Fingerprint Bureaux should be encouraged to adopt a strategy that is workable in the vast majority of cases. Any extra time taken to follow this application should easily be offset by reporting accuracy and transparency benefits. After all, if a mark is critical, is it better to provide a quick result or an accurate result?

In summary, although fingerprint comparisons are inherently subjective, there are methods available to minimise the subjectivity in a recordable and transparent manner that can be demonstrated to a court. Annotations of an image of the mark at the analysis stage, without previous sight of any fingerprint reference forms, would provide a robust foundation for Fingerprint Examiners to demonstrate their findings. The same methodology would assist in establishing which reported ‘identifications’ are secure and which might be unsafe or unreliable.

References


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