Position Paper on Court Evidence

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Introduction

Friction ridge examiners are increasingly being challenged in court with respect to the opinions they present when a questioned crime scene impression has been compared to the known fingerprints of a suspect. In the past, this type of testimony was accepted with very little objection from defence attorneys. However, possibly driven by the type of testimony given by DNA scientists, defence experts are now starting to question how friction ridge comparisons are conducted, how an opinion is reached, and how that opinion is presented in court. Some of the critics of how friction ridge comparisons are conducted have shown their lack of knowledge of the process with the criticisms they put forward, but some of the critics make good points that should be addressed. In some instances, they have asked excellent questions that friction ridge examiners have not thought to answer in the past.

This position paper concentrates on points raised by Dr. Simon Cole. Dr. Cole is not a fingerprint examiner so he may not fully appreciate the process used to compare a latent crime scene print to known impressions, but he raises some legitimate concerns about how the process of friction ridge comparisons were carried out in the past and how they are carried out today.

Method

Dr. Cole has stated that fingerprint examiners only count ridge characteristics.[1]

All forensic identification examiners in Canada are taught to detect reliable features such as ridge events, creases and scars in friction ridge impressions methodically following the flow of one ridge before proceeding to the next until all discriminating features have been analyzed within the crime scene impression. This information is documented prior to following an identical process to determine the discriminating features within an impression from a known source. A side-by-side, ridge-to-ridge comparison of the two impressions from the unknown to the known, will then determine whether there is corresponding features within tolerance.[2] Training in the comparison process occurs at the Canadian Police College (CPC) or the Ontario Police College (OPC). In addition to overall ridge flow, ridge path, ridge events and shape (where appropriate), additional contributing factors will be assessed during the comparison process including clarity of the impression taking into consideration any dissimilarities (defined as a difference in appearance between two friction ridge impressions)[3]. Canada does not rely on a minimum point standard as statistical studies do not support a specific number[4], and current practice is to use a Quantitative-Qualitative approach. Please refer to comments on statistical models under Sufficiency.

[1] Thompson WC, Cole SA. Psychological Aspects of Forensic Identification. In Expert Psychological Testimony for the Courts. Ed. Costanzo M, Krauss D, Pezdek K. Lawrence Erlbaum Associates, New Jersey, USA, 2007.

[2] Ashbaugh DR. Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology, CRC Press, Boca Raton, Florida, USA, 1999, page 141. "*Comparison of where the ridges started and stopped, the route of the intermediary ridge paths, and the spatial location of any bifurcations along the length of the ridges would be carried out. The next ridge over would then be compared in the same fashion.*"

[3] Dissimilarities as defined by the Scientific Working Group on Friction Ridge Analysis, Study & Technology (SWGFAST) in Standard Terminology of Friction Ridge Examination, Ver. 4.1 (posted 2013-04-27).

[4] Neumann C, Evett IW, Skerrett J. Quantifying the Weight of Evidence from a Forensic Fingerprint Comparison: A New Paradigm. J. Royal Statistical Soc. (Series A) 175;2012:1010-1025.

Dr. Cole has claimed that the acronym ACE, used by fingerprint examiners to describe the method of analysing, comparing and evaluating fingerprint impressions, was not widely used prior to the Daubert challenges and was rapidly adopted to survive Daubert.[5]

In Canada the terms Analysis, Comparison and Evaluation (ACE) were not created in response to *Daubert* but have been used since 1959/60[6] and were republished in 1972 when RCMP police officer RA Huber described their meaning in the RCMP Gazette[7]. ACE was further described with respect to the examination of footwear evidence by RCMP police officer MJ Cassidy[8]. The specific details of the method were outlined by RCMP police officer Dr. Ashbaugh whilst he worked in the Forensic Identification Research & Review Section (FIRRS) from 1988 to 1996. His research was later published in a comprehensive book[9] which thoroughly describes the foundational scientific knowledge upon which fingerprint examinations are based as well as the factors considered during each stage of the identification process including the final stage of Verification (ACE-V).

The *Daubert* factors have not, strictly speaking, been incorporated in Canada. The test governing the admission of expert evidence in Canada is set out in Mohan, 1997 SCC and recently refreshed in White, Burgess, Langille and Inman 2015 SCC. In particular, the reliability considerations and points related to verifiability of the science discussed in *Daubert* do not apply – except where the science is "novel": see JJ, 2000 SCC; and Trochym, 2007 SCC. Fingerprint comparison evidence is well-established, accepted and utilized in Canadian criminal jurisprudence.

Dr. Cole has claimed that fingerprint examiners do not keep bench notes which makes it impossible to determine the root cause of errors such as misidentifications.[10]

The need for analysis notes (also known as bench notes) and/or check-off sheets to record information observed during the analysis is described on page 136 of Ashbaugh's book. Bench notes is one of the first elements of friction ridge comparison process taught at both of the Canadian police colleges. They form part of the intelligence gathering process from an objective view and are made at the time of the analysis of the fingermark. They are completed prior to any comparison of the known impression and are later used to complete a Friction Ridge Analysis Report. The Ottawa Police Service developed an electronic bench note which creates a date stamped copy of the analysis of the fingermark before allowing the forensic identification (FI) employee to analyze the known fingerprint. The system allows for a blind verification process where details that could identify the original examiner are hidden from the version forwarded to the second examiner. The basic information captured during analysis automatically populates the Friction Ridge Analysis Report with the option to add further detail as desired. A version of this electronic bench note was also created by the RCMP using the Ottawa Police Service version as a starting point. It is available on the CanFRWG website as the 'ACE-V Form'.

Any form of bench notes will help to determine the possible cause of an error.

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[5] Cole SA. Comment on 'Scientific Validation of Fingerprints Evidence under Daubert'. Law, Probability & Risk 7(2);2008:119-126.
[6] Huber RA. Expert Witness. Criminal Law Quarterly 2;1959-60:276-295.
[7] Huber RA. The Philosophy of Identification. RCMP Gazette 34(7) and (8);1972:9-14.
[8] Cassidy MJ. Footwear Identification. Public Relations Branch RCMP, Ottawa, Canada, 1987.
[9] Ashbaugh DR. Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology, CRC Press, Florida, USA, 1999, pages 108-148, page 196 and 197.
[10] Cole SA. More than Zero: Accounting for Error in Latent Fingerprint Identification. J. Criminal Law & Criminology 95(3);2005:985-1078.

Dr. Cole states that fingerprint examiners are police officers without science degrees and should not be considered scientists.[11][12]

There are two flaws in this point by Dr. Cole, as it is raised in this context. First, there is no requirement in Canada for an 'expert' who is tendered to provide opinion evidence in court to be a 'scientist'. 'Expertise' refers to 'special or peculiar knowledge' that is gained through study or experience. Classification as a 'scientist' is not a prerequisite to qualification as an 'expert' to permit an opinion to be provided.

Second, the fact that the 'expert opinion' evidence may be provided by a police officer is not a bar to admission. In White, Burgess, Langille, Inman, 2015 SCC, the Supreme Court noted that impartiality may be a factor related to admissibility or weight. It did not, however, preclude expert evidence from being provided by police officers.

There is no requirement or need to be a scientist to receive fingerprint examiner status in Canada. Fingerprint examiners in Canada are known as forensic identification (FI) employees and are overwhelmingly police officers. A university science degree is not a requirement for employment though many do possess some form of post-secondary education.[13] They receive training on the ACE-V method at either the CPC or OPC where trainees are taught to look for discrepancies (defined as the presence of friction ridge detail in one impression that does not exist in the corresponding area of another impression)[14] in their comparisons rather than similarities. The CPC and OPC have a consistent approach to teaching ACE-V which results in presentation of uniform fingerprint evidence across Canada.

The forensic identification employee is a practitioner, rather than a scientist, who will present opinion evidence derived though an objective process based on documented method. For example, RCMP FI employees receive a rigorous standardized training program, coordinated by Integrated Forensic Identification Services-Service Delivery (IFIS-SD), which consists of: Basic FI Course at CPC or OPC (2 months); FI Apprentice Training Program (FIATP) at the FI section (12-18 months); and, qualification as a Specialist (22 months). Continued education is provided through the Advanced FI Training Course (AFITC) which requires successful completion of a proficiency test for re-certification (during a 2-3 year cycle) for the remainder of their career in FI services. Other police agencies have similar training programs. FI employees receive sufficient knowledge to understand the scientific basis behind the method. It is the role of the court to establish expert status by reviewing the individual's resume which would list education, training, experience, etc.

Dr. Cole is critical of the practice of simultaneity[15] *where examiners assess fingermark clusters to be created by the same hand and thus ridge formations from each fingermark within the cluster are accumulated during ACE.*

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[11] Cole SA, Roberts A. Certainty, Individualization and the Subjective Nature of Expert Fingerprint Evidence. Criminal Law Review 11;2012:824-849.

[12] Cole SA. Out of the *Daubert* Fire and into the *Frye*-ing Pan? Self-validation, Meta-expertise and the Admissibility of Latent Print Evidence in *Frye* Jurisdictions. Law, Science & Technology 9(2);2008:453-541.

[13] Criminal Code of Canada, section 667(5) – Definition of Fingerprint Examiner.

[14] Discrepancy as defined by the SWGFAST in Standard Terminology of Friction Ridge Examination, Ver. 4.1 (posted 2013-04-27).

[15] Cole SA. Out of the *Daubert* Fire and into the *Frye*-ing Pan? Self-validation, Meta-expertise and the Admissibility of Latent Print Evidence in *Frye* Jurisdictions. Law, Science & Technology 9(2);2008:453-541.

This practice is not taught by either police college within Canada and is not practiced within Canada.

Dr. Cole has contributed extensively to the Post-Daubert debate on whether fingerprint examiners in the US have overstated uniqueness to create the perception that the term relates to the crime scene impression rather than the friction ridge skin.[16]

CanFRWG in 2019 published a position paper on "Removing the Term Uniqueness". The philosophy was modified because friction ridge skin uniqueness cannot be scientifically supported and therefore it's inclusion in the philosophy of friction ridge identification can be misleading to the courts. Furthermore, uniqueness is not a required element for an examiner's opinion of identification.

Dr. Cole has stated that ACE-V is not scientific[15] *and that verification is not infallible.*

In response to the US-led post-*Daubert* debate on whether ACE-V is a scientific methodology, RCMP FI employees, when providing expert testimony in court, describe ACE-V simply as a method.[17] ACE-V is a logical, rational practice that can be clearly described and demonstrated to the court. Whether one describes this as scientific or not, is a matter of semantics that does not alter the resulting opinion but may influence how the jury assesses the value of the opinion.

Although verification is not infallible, its use does reduce the chance of errors. Verification involves a second examiner repeating the ACE process and is part of a peer review[18] or quality assurance process. If there is a difference of opinion, then a form of conflict resolution is required. For example, in 2019 the RCMP policy stated that an Independent Evaluation Group (IEG) consisting of three experienced FI employees should review and evaluate a questioned opinion.[19] Other Canadian law enforcement agencies have adopted blind verification[20] as recommended by SWGFAST to reduce bias by verifying all types of opinions, not just identifications, and preventing the verifier from knowing the identity of the original examiner.

Sufficiency

When "Insufficient correspondences result in a conclusion of 'inconclusive'" and "'Sufficient' correspondences result in a conclusion of …source attribution." Dr. Cole asks the latent fingerprint community "where the boundary lies between insufficient and sufficient correspondences"[10]*.*

Forensic Identification employees in Canada use the ACE-V method. During the evaluation phase, a determination is made resulting in one of three opinions: identification, exclusion or inconclusive. To

[16] Cole SA. Forensic without Uniqueness, Conclusions without Individualization: The New Epistemology of Forensic Identification. Law, Probability & Risk 8(3);2009:161-167.
[17] RCMP Communique 2012-003 "The ACE-V methodology is a widely accepted method for comparing fingerprints. Recently there has been some debate whether this is a scientific methodology or not. Friction Ridge Comparison is an applied science, but to avoid getting into philosophical arguments it is recommended that FIS members simply remove the word "scientific" when talking about the ACE-V methodology." (Distributed 2012-10-02).
[18] Ashbaugh DR. Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology, CRC Press, Florida, USA, 1999, page 174. "Verification is not a part of the identification process but it is part of the scientific process in the form of peer review… The Verifier then repeats the steps taken by the initial examiner to establish individualization."
[19] RCMP Integrated Forensic Identification Manual (IFIM – ch.2.8 Verification and Erroneous Opinions. 1.10. Independent Evaluation Group (amended 2019-10-01).
[20] SWGFAST Standard for Application of Blind Verification of Friction Ridge Examinations (posted 2012-11-24).

reach an identification opinion, the examiner must decide that there are sufficient features in agreement to conclude that two areas of friction ridge impressions originated from the same source[21]. The question arises of how to determine sufficiency.

Currently in the international fingerprint community, there are two positions on determining sufficiency; empirical and holistic.[22] The empirical approach is based solely on a quantitative threshold, while the holistic approach is based on a quantitative and qualitative assessment of the latent impression. The empirical method has a minimum numerical standard. Above the minimum number of ridge minutiae, the identification of the latent is considered beyond doubt.

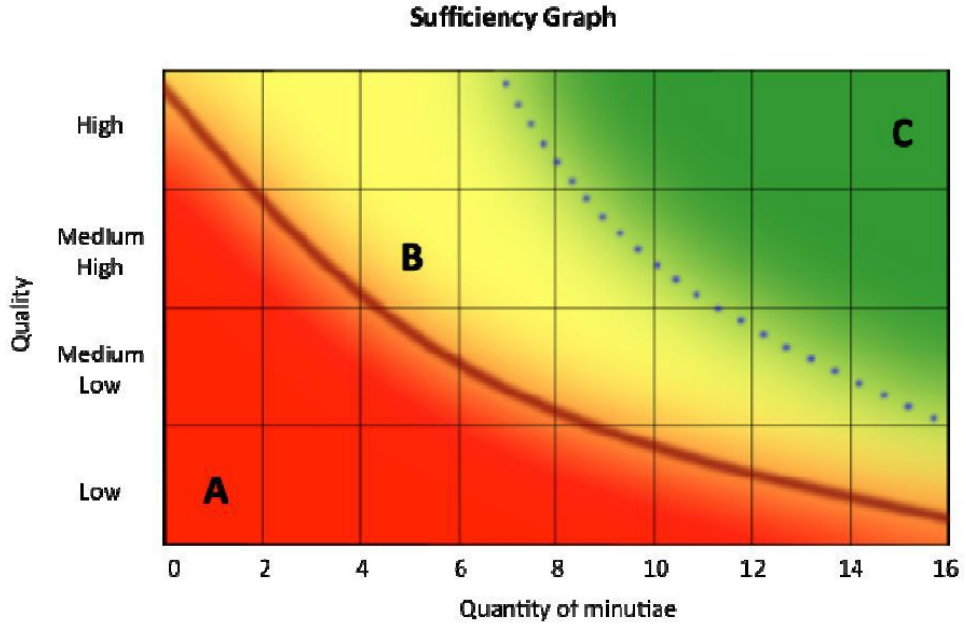
Historically the first numerical standard was set in place by Dr. Edmund Locard who set up three rules. "*1) If more than 12 concurring minutiae are present and the fingerprint is very clear, then the certainty of identity is beyond debate. 2) If 8 to 12 concurring minutiae are found then identification is marginal and certainty of identity is dependent on; a) the quality (clarity) of the fingerprint, b) the rarity of the minutiae type, c) the presence of a core and delta in a clear area of the print, d) the presence of pores, and e) the perfect agreement of the width of the ridges and furrows, the direction of the ridge flow, and the angular value of the bifurcation. 3) If a limited number of characteristic features are present, the fingerprint cannot provide certainty for an identification, but only a presumption proportional to the number of points available and their clarity.*"[23]

A number of countries adopted minimum numerical standards ranging from 7 (South Africa) to 16 (UK) although the UK abandoned the 16-point standard in 2001 as it failed to safeguard against errors. Canada never had an official numerical standard. The Canadian courts never imposed a numerical standard but sometimes requested experts to provide a 'point count' as part of their testimony.

In 1970, the International Association for Identification (IAI) set a committee of experts to study the question of having a fixed numerical standard. As a result of that study, the IAI passed the following resolution in 1973: "*The International Association for Identification, based upon a 3 yr study by its Standardisation Committee, hereby states that no valid basis exists for requiring a predetermined minimum number of friction ridge characteristics that must be present in two impressions in order to establish positive identification.*"[24] In 1995, the IAI passed a slightly different form of the original resolution: "*No scientific basis exists for requiring that a predetermined minimum number of friction ridge characteristics must be present in two impressions in order to establish positive identification.*"[25] In 2006, the IAI set up a second Standardisation Committee to investigate whether the original resolution passed in 1973 was still valid. The Standardisation 2 Committee reviewed scientific and legal literature and in 2010 reached the following conclusion: "*There currently exists no scientific basis for requiring a minimum amount of corresponding friction ridge detail information between two impressions to arrive at an opinion of a single source attribution.*"[26]

[21] SWGFAST Standard Terminology of Friction Ridge Examination (posted 2013-04-27).
[22] Neumann C. Statistics and Probabilities as a Means to Support Fingerprint Examination. In Lee and Gaensslen's Advances in Fingerprint Technology. Ed. Ramotowski R, CRC Press, Florida, USA, 2013, pages 428-431.
[23] Champod C. Margot P. Lennard C. Stoilovic M. Fingerprints and Other Ridge Skin Impressions, CRC Press, Florida, USA, 2000, page 28.
[24] International Association for Identification Standardisation Committee Report, FBI Law Enforcement Bulletin, 1973, 7-8.
[25] Champod C. Margot P. Lennard C. Stoilovic M. Fingerprints and Other Ridge Skin Impressions, CRC Press, Florida, USA, 2000, page 29.
[26] Polski J, Smith R, Garret R, Ashbaugh D, Meagher SB, Leben DA, Babler WJ, Vanderkolk J, Champod C, Zeelenber A, Moenssens AA, Martin KF, Norman J, Langenburg G, Chamberlain P, Taylor M, The Report of the International

While the empirical method of explaining sufficiency is clearly defined (a set number), the holistic method is a more difficult concept to explain or articulate. SWGFAST describes the sufficiency as the "*product of the quality and quantity of the objective data under observation (e.g. friction ridge, crease and scar features). As the quality of an impression increases the need for quantity of friction ridge features decreases, as well as the inverse.*"[27] The language that SWGFAST uses parallels that developed by RCMP officer Dr. Ashbaugh in his book.[28] SWGFAST defines quality as an assessment of the clarity of ridge features and provides a Quality Table to categorize the levels of quality: High, Medium-High, Medium-Low, and Low. Quantity is described as the number of ridge endings, bifurcations, and dots (minutiae) in contiguous ridges. A sufficiency graph is provided to assist with forming an opinion (see below). The graph was developed to illustrate the intellectual process involved with the examination of friction ridge detail and ensuing opinions. "*The axes used to plot the decision of the examiner, the positions of curves, and the underlying regions were created based on a consensus of experienced examiners (SWGFAST). Considerations in establishing the graph are related to actual casework and include international practices, general awareness of longstanding, as well as current literature and trends in ongoing research.*"[29] The quality categories are placed along one axis, while the quantity of minutiae is placed along the second axis of the sufficiency graph. One problem with the sufficiency graph is that it can seem to imply that minutiae counts are the sole criteria for making an opinion. The SWGFAST document provides such a warning, stating that the graph does not suggest or endorse such an approach.



Association for Identification Standardisation II Committee, https://www.ncjrs.gov/pdffiles1/nij/grants/233980.pdf (accessed 2016-09-06)

[27] SWGFAST Standard for Exaqmining Firction Ridge Impressions and Resulting Conclusions, Section 6.1, page 5 (posted 2014-04-27).

[28] Ashbaugh DR. Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology, CRC Press, Florida, USA, 1999, page 8. "…ridgeology has gained acceptance as a word describing a friction ridge identification process based on a quantitative-qualitative analysis as opposed to the old static threshold (sp) method."

[29] SWGFAST Standard for Examining Friction Ridge Impressions and Resulting Conclusions, Section 6.4.1.2, page 6 (posted 2014-04-27).

Ultimately "*for an individualization conclusion, sufficient agreement of information must exist so that the likelihood the impression was made by a different source is so remote that it is considered as a practical impossibility.*"[30]

The US Department of Justice (DOJ) recently released a proposed Uniform Language for Testimony and Reports (ULTR). The ULTR statement on Identification "*is the determination that two friction ridge prints originated from the same source because there is sufficient quality and quantity of corresponding information such that the examiner would not expect to see the same arrangement of features repeated in another source.*"[31] The ULTR does not provide a definition for sufficiency. In the supporting documentation for their uniform language, the DOJ states that "*The conclusion is supported by the examiner's ability to assess the frequency of features and the rarity of configurations present within the print.*"[32]

Within the holistic method of determining sufficiency, the examination of the friction ridge features considers the type and shape of ridge minutiae and features, the sequence in which those are found and the spatial relationships between them as an assessment of their rarity.[33] Also considered are the presence of any discrepancies. Neumann states "*The notion of sufficiency in the holistic approach has no defined scientific support and does not relate to any objectively measurable quantity. It remains a very personal and subjective decision and is subject to differences between examiners.*"[34]

A possible consequence of the rejection of the empirical approach in the post-*Daubert* era has been the development of an anti-'point' counting environment. The idea of counting 'points' has been demonized to such an extent that FI employees refuse to acknowledge any accumulation of minutiae observed during ACE. Although all ridge detail (path and minutiae) must be compared the idea of analyzing a latent impression and not knowing the quantity of minutiae involved seems odd to the non-expert. Even in a holistic approach knowing the quantity of minutiae present should be an important component of the comparison process. Practitioners who follow the holistic approach should not place too much reliance on level 3 detail which has been shown by researchers to not always transfer from the finger to the substrate reliably.[35] SWGFAST cautions practitioners that "*Level 3 details cannot be the sole factor in …decisions. Level 3 details have to be considered in conjunction with Level 1 and Level 2 details.*"[36]

Sufficiency should not be considered a static threshold. Personal thresholds are set through a fingerprint examiner's experience of observing a similar number of minutiae between two impressions from different sources. Even with considerable experience, most examiners have observed a low number of matching minutiae between impressions from different sources. Since the advent of AFIS and statistical research on fingerprint identification, those thresholds may not be as safe as once thought. AFIS has the ability to find exceptionally close non-matches from large donor populations. So to have the same level of confidence with an identification opinions made from an AFIS donor population, the examiner may want

[30] SWGFAST Standard for Examining Friction Ridge Impressions and Resulting Conclusions, Section 6.4.3.2.2.2, page 9 (posted 2014-04-27).
[31] www.justice.gov/forensics/olp/file/861911/download (accessed 2016-07-07).
[32] www.justice.gov/forensics/olp/861906/download (accessed 2016-07-07).
[33] SWGFAST Standard for Examining Friction Ridge Impressions and Resulting Conclusions (posted 2014-04-27).
[34] Neumann C. Statistics and Probabilities as a Means to Support Fingerprint Examination. In Lee and Gaensslen's Advances in Fingerprint Technology. Ed. Ramotowski R, CRC Press, Florida, USA, 2013, pages 430-431.
[35] Anthonioz A, Egli N, Champod C, Neumann C. Puch-Solis R, Bromage-Griffiths A. Investigation of the Reproducibility of Third –Level Characteristics. J. Forensic Ident. 61(2);2011:171-192.
[36] SWGFAST Standard for Examining Friction Ridge Impressions and Resulting Conclusions, section 6.4.3.2.1.4 & 6.4.3.2.2.3, pages 8-9 (posted 2014-04-27).

to consider raising their level of sufficiency. The possibility of different thresholds for sufficiency for a comparison of a latent of a provided suspect versus a suspect provided through AFIS should be considered.[37] Statistical research focused on likelihood ratios as a viable method to assess the evidential value of comparisons and studies have shown that the weight of evidence increases with the number of minutiae observed in the fingermark.[38] However, the range of evidential values for various numbers of minutiae overlapped significantly with some low number configurations showing high evidentiary value and vice versa. These results support claims that fingerprint comparison can provide valuable evidence, that there is no scientific basis for a numerical standard and that the weight of each fingermark must be assessed on its own merits.

As described under the Method section of this paper, current Canadian practice is founded on a holistic process. While initially articulated as quantitative-qualitative analysis by Dr. Ashbaugh in the 1980's and 90's this approach continues to evolve and is taught by the CPC and OPC.

How to Express Opinions

Dr. Cole has criticized the forensic identification discipline for using terminology such as "exclusion of all others"[39], "individualization"[40], "identification"[41] and "practical impossibility" in relation to fingerprint evidence since these terms imply that the expert is absolutely certain that the fingerprint originated from one suspect.

The FI discipline has transitioned away from expressing opinions using language that implies absolute certainty[42] such as "match" and "exclusion of all others". This is in part due to the work of critics such as Dr. Cole.

In Canada, identification was defined in 1959-60 by RCMP police officer RA Huber and republished in 1972 as follows: "*When any two items contain a combination of corresponding or similar and specific oriented characteristics of such number and significance to preclude the possibility of their occurrence by mere coincidence, and there are no unaccounted for differences, it may be concluded that they are the same, or their characteristics attribute to the same cause.*"[7]

In 1994, Harold Tuthill and Graeme George, instructors at the OPC, promoted the term individualization[43] and over the years many Canadian FI sections adopted SWGFAST guidelines and started to use the term. A 2015 RCMP Communique[44] instructed FI employees to stop using individualization and return to using

[37] Ron Smith & Associates, Understanding Exclusion and Sufficiency Decisions Course, 2016, Edmonton, Alberta.
[38] Neumann C. Statistics and Probabilities as a Means to Support Fingerprint Examination. In Lee and Gaensslen's Advances in Fingerprint Technology. Ed. Ramotowski R, CRC Press, Florida, USA, 2013, pages 449.
[39] Cole SA. More than Zero: Accounting for Error in Latent Fingerprint Identification. J. Criminal Law & Criminology 95(3);2005:985-1078. "Exclusion of all others" on page 992.
[40] Cole SA. Individualization is Dead, Long Live Individualization! Reforms of Reporting Practices for Fingerprint Analysis in the US. Law, Probability & Risk 13(2);2014:117-150.
[41] Cole SA. Who speaks for science? A response to the National Academy of Sciences Report on forensic science. Law, Probability & Risk 9;2010:25-46.
[42] SWGFAST Guideline for the Articulation of the Decision-Making Process for the Individualization in Friction Ridge Examination, section 11.2.3, page 6 (posted 2013-04-27).
[43] Tuthill H, George G. Individualization: Principles and Procedures in Criminalistics. Lightning Powder Company Inc., Oregon, USA, 1994.
[44] RCMP Communique 2015-001 "To assure consistency, FIS employees are to immediately start using the term identification on their reports and while testifying." (sent 2015-03-13).

identification. The Ontario Provincial Police (OPP) has included the following statement on their Friction Ridge Comparison Reports: "*Limitations: It is acknowledged that friction ridge individualization cannot provide a conclusion that would exclude all other persons.*", to prevent overstating the evidence in court.

Dr. Cole has stated that fingerprint evidence is opinion and not fact[45] *and that fingerprint examiners should be excluded from providing an opinion as to the source of the fingermark to the court*[46].

In Canada a witness may provide 'expert opinion' evidence where the party tendering their evidence satisfies the court that first, the evidence is (i) relevant, (ii) necessary, (iii) not subject to any exclusionary rules, and (iv) that the expert is 'properly qualified'; and second, that the probative value outweighs the prejudicial effect[47]. A 'properly qualified expert' means a witness who has developed 'special or peculiar knowledge through study or experience' including training and qualifications[48]. In Canada, 'examiners' are qualified, trained and gain experience through case work and testimony. In turn, they develop the knowledge that allows them to become 'properly qualified experts' and thus permitted to provide opinion evidence in court[56]. Once qualified, experts are permitted to provide an opinion, beyond mere fact. Once admitted, the court assigns value to that opinion by assessing the competency, knowledge and professional development of the examiner.

Dr. Cole has stated that fingerprint evidence, like DNA, should calculate the rarity of corresponding detail observed between the crime scene sample and the known population.[49] *He criticises fingerprint evidence for using subjective estimates of rarity rather than reporting a numerical value.*

Many police agencies in Canada support the work of the Organization of Scientific Area Committees (OSAC), formerly SWGFAST, in developing new approaches to assessing the confidence associated with an opinion and expressing this opinion and the reasoning behind it using clear and simple terms that are understandable to a non-expert. Although some Canadian police agencies are aware of the modified language used by the US Army to express an identification that reflects the strength of the evidence[50] no Canadian police agencies have adopted probabilistic opinions as of yet.

The concern is that current statistical models for latent fingerprint comparisons are based on counting minutiae (also referred to as points or ridge characteristics) which ignores significant detail available in the impression. Point counting has been criticised by Dr. Cole who accused fingerprint examiners of "only counting points". Please refer to the Method section where this argument is addressed under the title 'Dr. Cole has stated that fingerprint examiners only count ridge characteristics'. For Canadian police agencies to adopt a probabilistic framework for fingerprint comparisons a strategy must be developed for combining statistical models with the ability of the human examiner to incorporate the highly discriminating features observed along the ridge paths into the process. The work of statistician and forensic scientist, Dr. Neumann, into the use of likelihood ratios as a means of quantifying evidence

[45] Cole SA. The 'Opinionization' of Fingerprint Evidence. Biosocieties 3(1);2008:105-113.
[46] Cole SA. Toward Evidence-Based Evidence: Supporting Forensic Knowledge Claims in the Post-Duabert Era. Tulsa Law Review 43(2);2007:263-283.
[47] White, Burgess, Langille, Inman, 2015 SCC.
[48] Mohan, 1994, SCC at para 31.
[49] Cole SA. The 'Opinionization' of Fingerprint Evidence. Biosocieties 3(1);2008: page 111.
[50] Swofford HJ. Information paper on 'Use of the Term Identification in Latent Print Technical Reports. Department of the Army, Defense Forensic Science Center, 2015-11-03. "The revised language is as follows: "The latent print on Exhibit ## and the record finger/palm prints bearing the name XXXX have corresponding ridge detail. The likelihood of observing this amount of correspondence when two impressions are made by different sources is considered extremely low.""

supports this notion that "*sufficiency cannot be justified by data alone*".[44] The use of a statistical model may well support the expert opinion but not replace it.

A major challenge for the adoption of statistical models for fingerprint comparisons by police agencies is the validation of the models. DNA statistical models rely on easily quantifiable variables such as allele designations which allowed statisticians to perform population studies and estimate expected model outputs. The precision and accuracy of the model could then be measured to validate the model against these theoretical predictions. There are so many variables that influence the development of fingerprint patterns that estimating the frequency of particular fingerprint features is far more challenging. In addition, simply validating the new approach by comparing its performance against previously validated techniques is not possible because there are no previously validated fingerprint models. Unlike DNA, which has a sound theoretical foundation upon which to build, validation of statistical models for fingerprints will require a significant endeavor using current AFIS technology and large databases to empirically estimate the frequency of various fingerprint features.[51]

Errors

Dr. Cole criticizes internally administered (FBI) proficiency tests for fingerprint examiners as being too easy or flawed.[52]

The RCMP's proficiency tests (PTs) are meant to test proficiency of an examiner with respect to doing their job. The level of difficulty does not have to be extremely challenging, but should be at a level that will satisfy an objective observer that the examiner can competently carry out their duties. If an examiner makes an error in a PT, it does not automatically imply that they will make the same mistake in actual casework. The conditions under which PTs are carried out are generally very artificial, unless great care has been taken to make the test sample appear to be actual casework. It should be noted that PTs are not meant to determine a measure of error.

The RCMP have been performing PTs for FI employees since the early 1990's. The PTs are used to assess the competency of the FI employees in all aspects of physical evidence (friction ridge, footwear, physical match) comparisons including the analysis, comparison, evaluation and reporting of opinions. The PTs are internally administered by IFIS-Service Delivery through the Advanced Forensic Identification Training Course (AFITC) on a 3-year cycle. During the last session of the AFITC the FI employee was provided with a package and instructions for completing the certification exercise in the normal working environment. A 6-week time period is allowed and each package contains samples that have been randomly selected from a collection so that FI employees working in the same location would not have the same comparison exercise. The certification exercise could involve fingerprint, footwear or physical matching. Successful completion of the PT is required for re-certification of FI employees.

Until the most recent AFITC cycle (2015-17), no historical pass/fail data has been recorded, but anecdotal evidence suggests occasional failures. The PTs have not been used to estimate error rates.

The Ontario Provincial government started PTs for all Ontario-based fingerprint examiners in 2010. The PT is administered by the OPC in a 3-year cycle through an online process. PTs are also administered by

[51] Neumann C. Statistics and Probabilities as a Means to Support Fingerprint Examination. In Lee and Gaensslen's Advances in Fingerprint Technology. Ed. Ramotowski R, CRC Press, Florida, USA, 2013, page 451-453.
[52] Cole SA. More than Zero: Accounting for Error in Latent Fingerprint Identification. J. Criminal Law & Criminology 95(3):2005;985-1078. "Internally conducted proficiency test" pages 1031-1032.

some municipal law enforcement agencies such as Edmonton PS which has been administering internal PTs since 2010.

Dr. Cole states that publicized erroneous fingerprint identifications were discovered by extraordinary means rather than the safeguards in place to prevent such mistakes i.e. verification, certification, defense access to subject matter experts etc.[10]

Until recently, FI employees within the RCMP and many other Canadian law enforcement agencies would be reassigned to other duties if the verification revealed an erroneous identification. As a result of this zero tolerance for error, FI employees are encouraged to be cautious and to follow the proper method. RCMP policy[53] establishes a thorough root cause analysis on a case-by-case basis, and depending on the result, FI employees (the original examiner or the verifier) may receive additional training, mentoring or may be re- assigned to non-FI duties. In 2011 Tangen *et al.* compared the performance of completing fingerprint comparisons between qualified fingerprint experts and novices.[54] While not infallible, the experts were significantly more accurate than the novices, especially with the close non-match comparisons; false positive rate for the experts was 0.68% compared to 55.18% for the novices, and the false negative rate was 8% for the experts and 25% for the novices. This data which was published two years after the NAS report, supports the notion that trained, qualified examiners can produce largely accurate and reliable opinions.

Dr. Cole has been critical of the attempts by the FBI to measure error and he has stated that there is a need for ground truth studies where the fingerprint examiners are given challenging comparisons where the source of the impression is known.

Since the 2009 National Academy of Sciences (NAS) report on forensic science[55] several studies have been published that focus on performance and accuracy of latent print examiners (LPE). Langenburg *et al.* had six LPEs participate in a series of 60 ACE and 60 ACE-V trials.[56] For the ACE trials the analysts repeated 60 comparisons and were shown to be 100% and 86% accurate where an identification (n=268) and exclusion (n=14) opinion was reported, respectively. In a separate ACE-V trials, all 9 false identifications (7 deliberate and 2 resulting from the initial examiner) were detected by the verifier (n=271) but none of the 6 false exclusions were caught by the verifier. Ulery *et al.* presented 169 fingerprint examiners with approximately 100 image pairs.[57] For fingerprints determined to be of value for identification when the examiners reached an identification opinion they were correct 99.9% of the time and when they reached an exclusion opinion they were right 92.5% of the time. Six false positives were observed out of 4,083 opinions and 450 false negatives occurred out of 5,969 opportunities. A further study tested repeatability and reproducibility involving 72 examiners and comparisons of 25 image pairs.[58] Repeatability and reproducibility were lower for difficult comparisons and when differing opinions were observed it was

[53] RCMP Integrated Forensic Identification Manual, Chapter 2.8. Verification and Erroneous Identifications.
[54] Tangen JM, Thompson MB, McCarthy DJ. Identifying Fingerprint Expertise. Psychological Science 22(8);2011:995-997.
[55] National Research Council. Strengthening Forensic Science in the United States: A Path Forward. National Academy Press: Washington, D.C., 2009, http://www.nap.edu/catalog/12589.html.
[56] Langenburg G. A Performance Study of the ACE-V process: A Pilot Study to Measure Accuracy, Precision, Reproducibility, Repeatability and biasability of Conclusions resulting from the ACE-V Process. J. Forensic Ident. 59(2);2009:219-257.
[57] Ulery BT, Hicklin RA, Buscaglia J, Roberts MA. Accuracy and Reliability of Forensic Latent Fingerprints Decisions. Proceedings of the National Academy of Sciences 108(19);2011:7733-7738.
[58] Ulery BT, Hicklin RA, Buscaglia J, Roberts MA. Repeatability and Reproducibility of Decisions by Latent Fingerprint Examiners. PLoS ONE 7(3);2012:e32800.

mostly about whether there was enough information to reach an opinion rather than the opinion itself.

Trying to develop a test that will fairly and objectively test the method used in friction ridge comparison is extremely difficult. If the experiment is set up with samples that are too difficult or too easy, the results will be called into question. The methods used by the volunteer examiners will always be somewhat artificial with imposed time limits, obvious test samples, no consequences, no background case information, etc. Whatever the results, it will be easy to criticize them, one way or another. In court, it can be pointed out that the results of a test given to several volunteer examiners does not mean that the examiner in the case before the court has a 20% chance of being incorrect.

Trying to determine an error rate based on actual cases is also fraught with difficulty. If you simply look at documented cases of erroneous identifications, will you be missing the ones that were never caught? How does one evaluate false exclusions or missed identifications? One definition of a missed identification is to say it occurs when the majority of other examiners would declare it an identification. However, while that is possible in a test situation with several volunteers, it is not practical to have a large number of examiners look at every casework comparison. In the case of an erroneous exclusion, it would require that every exclusion be verified. The ground truth is never known in casework, further complicating the declaration that one examiner's opinion is incorrect.

The RCMP is collaborating with Dr. Christophe Champod on a ground truth study to observe the consistency of feature selection during analysis and comparison and the accuracy of the source attribution opinion within FI employees. The study will provide the RCMP with valuable baseline data for development of evidence-based policies and training. It is the first step in developing a probabilistic framework for the communication of expert opinions provided by RCMP employees in Canadian courts. However, as mentioned above, this type of study will address problems in the system being used, but should not be used to try to assign an error rate that can be applied to an individual examiner in a particular case.

Verification of every possible identification opinion has been in place in Canada for many years. At present, this tends to be a complete re-examination of the comparison by a second examiner, with the goal of ensuring that an erroneous identification is not presented in court. In order to address criticism of bias, some agencies have implemented various forms of blind verification to further ensure that any identification is thoroughly vetted. An opinion of exclusion has in the past not been subjected to verification. While this might allow a guilty party to go free, it was always seen as less serious than an erroneous identification that could result in the conviction of an innocent person. The tendency now is towards verifying exclusions as well, to ensure that this type of error does not occur.

Dr. Cole has been highly critical of historical claims of "zero error rate" for ACE-V.[10]

Friction ridge examiners were criticized in the past for declaring that there was no error rate associated with positive identifications. This type of testimony is no longer advocated, with examiners now being very careful to try to communicate the very small possibility of errors being committed. Positive identifications are described in terms that allow for the possibility of another person having left the questioned impression at the crime scene. The whole question of how to articulate opinions is still being debated (see section on How to Express Opinions).

Bias

Bias can be described as: "*…an inclination of temperament or outlook; especially: a personal and sometimes unreasoned judgement (prejudice)".*[59]

In forensic work, bias can be introduced in a number of different forms, examples are:

- Contextual bias when emotional aspects arising from examining the crime scene trigger stressors when performing comparisons of evidence found at the scene.
- Situational bias when details of the case are relayed from investigators to the FI employee that have no bearing on the comparison process.
- Poor verification/ consultation techniques where results are known by the FI employee prior to evidence examination and/ or comparison.

Dr. Cole has stated that many examiners and forensic professional bodies have been reluctant and resistant to acknowledge, accept and take proper action to counter biases.[60]

Contextual bias and situational bias have been quoted in a number of studies.[61][62] Most Canadian FI employees are trained as crime scene examiners as well as fingerprint examiners. By being exposed to the scene, the emotional toll or severity of the case can weigh in when conducting comparisons. FI employees must be aware of the bias and in cases where the crime scene examination/crime is abhorrent, they should consider handing off the comparison to another examiner without providing contextual or situational bias.

Situational bias is where unwanted or irrelevant details of the case can weigh on the emotional state during the comparison process. FI employees and law enforcement agencies alike can put in place blocks or mitigation strategies to ensure that only details of the forensic evidence are shared for the comparison process, and that extraneous information is only passed on when the comparisons are completed, or to a case lead/file manager in the interim.

AFIS bias is a concern where the results from an AFIS search are provided to the FI employee for comparison purposes – without vetting. AFIS searches are an investigational aid where a search of the database provides a suggested candidate for comparison by the examiner. There is the possibility that a suggested candidate from AFIS is not the correct one. Some agencies vet the information of an AFIS search prior to providing materials to the examiner for a comparison, thereby removing this bias. In cases where this is not possible, a hypothesis driven approach to the comparison is essential. Starting with the hypothesis that 'these two are dissimilar' and coming to another opinion only after full comparison of the unknown to the known, thereby subjectively disproving the initial hypothesis. This will reduce the potential for bias but not completely remove it. The approach taught by the Canadian police colleges is to look for differences when performing comparisons, rather than similarities, which should fundamentally reduce bias.

While this may have been cause for concern for Canadian police agencies in the past, many have

[59] Webster's Dictionary http://www.merriam-webster.com/dictionary/bias (accessed 2016-05-30).
[60] Cole SA, Dror IE. The Vision in "Blind" Justice: Expert Perception Judgement and Visual Cognition in Forensic Pattern Recognition. Psychomonic Bulletin and Review 3(1);2010:162.
[61] Dror IE, Charlton D, Peron AE. Contextual Information Renders Experts Vulnerable to Make Erroneous Identifications. Forensic Science International 156;2006:74-78.
[62] Dror IE, Charlton D. Why Experts Make Errors. J. Forensic Identification 56;2006:600-616.

embraced the need for recognition of bias, and where possible, reduction and/or elimination of some bias with the implementation of blind verification, and reducing exposure to emotional or situational bias where possible. Blind verification is the process in which a second complete ACE method is applied to the evidence and results are then compared against the first for agreement. The method involves removing documentation or any markings to suggest an identification or exclusion. This method removes bias that could be introduced by the ACE-V method being applied improperly. Agencies such as Calgary PS, OPP, Ottawa PS have implemented blind verification processes which reduces the exposure to bias significantly. In recognition of the harmful effects of bias the RCMP has presented high profile errors resulting from bias as part of the AFITC since 2004 in an effort to raise awareness of bias and help employees make adjustments to mitigate its effects. All examiners must acknowledge the existence of the potential for bias in their work, and the steps they take to reduce exposure, or counter its effects, regardless of their organization's policies or procedures.

Although most agencies see the need for such policies as blind verification and/or the verification of all types of opinions the practical issue of balancing workloads with the need to develop policies that address some of these issues must be considered.

Additionally, Dr. Cole contends that all examiners are influenced more by context and other extraneous information when the pattern matching is objectively "hard to call".[68]

All examiners must acknowledge the existence of the potential for bias in their work, and the steps they take to reduce exposure, or counter its effects, regardless of their organization's polices or procedures. Agencies such as Ottawa PS have implemented additional procedures where more candidate prints are compared[63], and others have policies where high profile cases or those with low minutiae counts are sent through blind verification processes. In Canada FI employees will examine the crime scene for the purposes of gathering physical evidence so it is hard to reduce all the task irrelevant information to which they are exposed. However, the FI employees typically do not interview witnesses, victims or suspects and with awareness can take whatever steps within their control to reduce the impact of bias.

[63] Kerr S, Garneau U. Ottawa Police Services Blind Verification, Presentation to the General Meeting of RCMP Divisional Managers, Ottawa, April 14, 2016.