

The Siege of the Fingerprint Comparison

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This paper introduces the challenges of the fingerprint comparison field, which started in the middle of the nineties with the Daubert Trilogy and went on by the NAS report and PCAST report, and the responses from the expert community to these. Philosophic bases of the old terms 'uniqueness' or 'individualization' are also covered.

Keywords: forensic science, fingerprints, ACE-V, validity, reliability

I. Introduction

Forensic science is under siege², and so the fingerprint comparison is. Some classic phenomenons, like 'uniqueness' and 'individualization', were extensively criticized³ and finally have already been dismissed by professional organizations.⁴ Some boastful claims, like the „zero error rate”, or the expert statement about the „millions” of fingerprints that they examined, are not referred to any more recently. Old fingerprint „myths”, like the „1:64 billion variabilities” from Galton⁵, are still in the public mind. And some new „myth”, like the „1 error from 18 cases” from the PCAST report⁶ is nowadays emerging.

Nonetheless, many points of the critics may be not well-founded and may be explained by a different philosophical approach. In this study, I try to outline the history of the siege, some of the questions, and some possible answers.

II. The Daubert Trilogy

In the USA, the so-called Daubert trilogy had a paradigm-changing impact on forensic evidence: three landmark precedent decisions from the federal Supreme Court. The Daubert-trilogy are *Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁷ in 1993, *General Electric Co. v. Joiner*⁸ in 1997, and the *Kumho Tire Co. v. Carmichael*⁹ in 1999.

In 1993 the US Supreme Court established the Daubert Standard for evaluating the admissibility of scientific evidence in US courts. The case addressed at the beginning whether or not Bendectin, an antiemetic medication taken during pregnancy, caused severe birth defects. Jason Daubert, the son of the plaintiff, was born with serious birth defects. In 1989, the Daubert and the Schuller family sued Merrell Dow Pharmaceuticals (producer of Bendectin) in the US Federal District Court for the Southern District of California. Daubert and Schuller alleged that their mothers' ingestions of Bendectin during pregnancy caused their birth defects of shortened limbs. The plaintiffs' expert witness used in vitro experiments, in vivo animal tests, and a meta-analysis of several medical studies, and found a significant connection between Bendectin and

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² Pyrek (2007)

³ Cole (2009)

⁴ SWGFAST (2012) CanFRGW (2017)

⁵ Galton (1892) 110-111

⁶ PCAST (2016) 10, 95, 101, 149

⁷ <https://supreme.justia.com/cases/federal/us/509/579/> (2022. 09. 28.)

⁸ <https://supreme.justia.com/cases/federal/us/522/136/> (2022. 09. 28.)

⁹ <https://supreme.justia.com/cases/federal/us/526/137/> (2022. 09. 28.)

birth defects. The District Court found that all of these scientific methods did not meet the wide acceptance by forensic experts. The case was dismissed, and, after appeal, so the Ninth Circuit Federal Court decided the same. The base of the dismissals was the Frye standard from 1923, which defined the criteria the expert witness opinions: the wide acceptance by the forensic expert society. After a second appeal, the federal Supreme Court in the Daubert decision established new rules for scientific evidence and expert testimony. (After the Supreme Court precedent, the Ninth Circuit court dismissed the case again for lack of admissible evidence, under the newly defined evidential rules.)¹⁰

The Daubert Standard states that the judge of a case is responsible, as a gatekeeper, for determining what claims are admissible as scientific knowledge and as evidence in the case. After the Daubert decision, the Federal Rule of Evidence was also changed, and the precedent was incorporated into the act. The admissibility should be determined by the falsifiability of the claims, by whether or not they had passed peer review, by the general scientific acceptance of the claims, and for techniques, by their error rates of the techniques. Furthermore, an important question could be, whether the research, on which the evidence was based, was done only for the case, and, equally, an important issue, what financial source supported the research. Daubert v. Merrell Dow Pharmaceuticals, Inc. set a landmark precedent in the US judicial system and influenced most subsequent legal cases that appealed to science to establish facts in trials.

Another precedent of the trilogy is the GE Co. v. Joiner, which concerned whether the abuse of discretion standard is the correct standard an appellate court should apply in reviewing a trial court's decision to admit or exclude expert testimony. Being a gatekeeper, following the Daubert standards, grant a right to the judge to decide whether expert testimony is admissible or not, and this decision can not be challenged by the abuse of discretion.

III. The Fields of the So-called Classical Criminalistics

As it should be obvious in the Daubert Standards, the falsifiability, the known error rate, and the general acceptance by the scientific community should be the hallmark of a valid forensic field, and, on the other hand, many of the old, well-known forensic fields can not cross this threshold. Pattern evidence, like tool marks, shoeprints, and bite marks, furthermore, the analysis of locks, firearms examination, handwriting comparison, fingerprint comparisons, and questioned documents are not able to cross the threshold of the rigid interpretation of the Daubert standard. According to Kertesz¹¹, there are five fields of the so-called classical criminalistics: the handwrote evidence, the questioned document evidence, and pattern or mark evidence. And from this third, the fingerprint evidence and the firearm evidence became separated. (Today we can conclude a sixth field, face recognition, but here this will not be detailed.)

None of the classical criminalistic fields are part of any science. All of them use some of the results of the science, like fingerprint comparison uses some elements of anatomy or dermatology, but is not part of any. All of the classical criminalistic fields are based on the visual comparison of depicted information, or, less precisely described: observing small lines. Since the classical fields are not part of any sciences and are based on a highly subjective methodology, which strongly relies on the experts' experience, the strict interpretation of the Daubert Standards may exclude them from the forensic evidence. The third pillar of the Daubert Trilogy is the Kumho Tire precedent. It nails down that the Federal Rule of Evidence uses the „scientific, technical, or other specialized knowledge” term, and the Daubert precedent

¹⁰ Abboud (2017)

¹¹ Kertesz (2002)

concerns only scientific knowledge. So technical, or other specialized knowledge, like fingerprint comparison, can be admissible in front of courts.

The Kumho Tire precedent or the Daubert Trilogy itself is not universally accepted in the United States. Some federal states are applying the above-mentioned Frye Standard, some are applying other regulations. On the other hand, after the Daubert, scholars from the academic sphere, without forensic expert backgrounds, started an extensive attack against the fingerprint comparison methodology, and other, not strictly scientific forensic fields. Most of the academic papers fueled the defense attorneys in front of the courts, and have more modest effects on the courts themselves.

DNA analysis started its impressive forensic carrier in the nineties, the same years as Daubert. DNA analysis is demonstratable sound, based on genetics, biochemistry, and biostatistics, uses Bayes analysis, and, more importantly, seems to be very scientific even for laymen jurors, and attorneys. Furthermore, in 1997, the Scottish police authorities made a false positive fingerprint identification on Shirley McKie, and in 2004, the FBI made one on Brandon Mayfield. So, the fingerprint comparison, which has claimed itself infallibly, made two false identifications, and, more problematically, could not ever present any mathematical formula to support its conclusions. DNA could present and has been presenting it in every case, where forensic genetics are involved.

Along with the above judicial precedents, fingerprint and handwriting identification fared much better against the challenge posed by the Daubert criteria, although many cases attempted to exclude expert opinions in the field. (The Mayfield case and the subsequent official FBI explanation provided good ammunition for this.) Efforts to exclude the two areas of expertise until 2003 are well summarized in the *U.S. v. Crisp*¹² precedent, where the defense's appeal sought to exclude the fingerprint and handwriting expert opinions, citing the Daubert criteria. Typically, a member of the appeals court wrote in his dissenting opinion that the expert opinions of fingerprint and handwriting experts do not meet the Daubert criteria; of course, he does not rule out that the correspondence could be verified, he only claims that the correspondence did not take place. Along with this, there is a known judgment from 1995 that excluded the writing expert's opinion as unscientific; The Fuji case from 2000 and the Salee case from 2001, in which the expert opinion on printed handwriting was excluded. Then the Prime case from 2005, when the court matched the handwriting identification methodology in detail, point by point, to the individual Daubert criteria.¹³ In the field of fingerprint experts, the 1999 Mitchell case¹⁴ was the first in which the first-instance court conducted a five-day hearing of the experts to determine whether the expert opinion met the Daubert criteria. The experts proved to be adequate, and this was upheld by the second-instance court, after another detailed investigation; its decision is precedential for the federal courts of the Third Circuit (concerning the federal states of Delaware, Pennsylvania, New Jersey, and the Virgin Island). Another important case was the Llera Plaza case, in 2002, where the trial judge excluded the fingerprint expert's opinion, then "changed his mind" two months later and allowed it to go to trial. Another important case is *Commonwealth v. Patterson*¹⁵ from 2005, in which the court concluded that there was no need for widespread acceptance of dactyloscopy by the scientific community outside of experts and judicial actors; it is sufficient if the community of experts accepts it.¹⁶

¹² 324 F.3d 261 (2003), <https://www.leagle.com/decision/2003585324f3d2611557> (2022. 05. 28.)

¹³ Karman (2017) 129-131.

¹⁴ Cr. No. 96-407-1

¹⁵ 445 Mass. 626 (2005)

¹⁶ Moenssens – Meagher (2012) 13-17 – 13-22.

IV. The Siege of the Fingerprints

Reviewing the literature¹⁷, the concerns about fingerprint comparison can be classified into three main categories. First, the fingerprint is not unique. Second, even the fingerprints can be unique, but the latent print is partial or distorted and, therefore, it is not unique enough, and/or not suitable for comparison. And third, even though the latent prints can be suitable for comparison, the expert has biases.

A *On the uniqueness*

The term „uniqueness” can have different meanings, depending on the context. As Leibnitz stated, every object of the real world is unique, because can only be identical to itself. Two objects can seem to be identical, but could never be identical in total. This approach of uniqueness is not useful in forensic science, since every object is unique, so why fingerprint should have a distinguished role?

We can, however, approach uniqueness as having more or less power to distinguish objects from each other. The ability to be distinguishable is based on the peculiarity and the complexity of the characteristic of the object. Every object has many features, an uncountable amount of features, and every feature can be characterized by practically uncountable values. The complex values of the complex features mean the distinct characteristic of the object. Some of the features are irrelevant in forensic sciences, and some have a crucial role.

The correct interpretation of the „uniqueness of fingerprints” does not mean that every square millimeter of human skin is theoretically different from any other square millimeter of skin – this is true but has no forensic value. The problem of uniqueness comes into view when we want to distinguish the prints of those specific square millimeters of skin from the prints of other square millimeters of skin, and, at the same time, we also want to associate the different prints of the same square millimeters of skin with each other. „There are likely no two fingerprints alike anywhere in the world.”¹⁸

As I claimed above, even some square millimeters of skin and the print of this size of skin as well, have practically uncountable features, and each feature could have practically uncountable values. Features include size, shape, color, temperature, pH, conductivity, etc. Most of them are irrelevant. The relevant is the pattern, which is formed by the friction ridges, and only the friction ridge pattern.

Fingerprint comparison methodology uses to claim to have the competence to distinguish the prints of a specific friction ridge skin surface from the prints of every other friction ridge surface, and to associate the different prints of the same friction ridge surface. Because of the variability of the friction ridge patterns. The exact character of the friction ridge patterns occurs in so many variations that could be distinguished from every other friction ridge pattern. This variable character is based on the so-called Level II details, or minutiae, which are the ending or the bifurcation of the friction ridge. The distribution, location, and type of some minutiae can be extremely distinct, and practically unique in the world.

Practically unique means that the same location, distribution, and type of minutiae would occur on another friction ridge skin with an extremely low probability. It all depends on the number of minutiae in a cluster. More the minutiae, the higher the distinct power, and the lower the probability of accidental repetition.

During the past decades, many efforts were taken to weigh the individuality of fingerprints.¹⁹ The first estimation was made by Galton himself, the above-mentioned 1:64 billion, which was

¹⁷ Cole (2005), (2006), (2009), (2012); Cole – Roberts (2012); Mnookin (2003), (2008a), (2008b); Haber – Haber (2008); Ulery et al (2011); CMU (2017)

¹⁸ Moses Daluz (2015) 29.

¹⁹ Stoney (2001) 327–387.

only a naive statement in his book, not a detailed or sound calculation. Unfortunately, the number of 1:64 billion persists even in the law enforcement community and among legal scholars. Cummins and Midlo, in their milestone handbook of dermatoglyphics, presented a much more reliable calculation. According to their research, the probability of the accidental repetition of two friction ridge skin clusters depends on the exact number of minutiae in the cluster. The probability of a particular configuration of N minutiae is $P(C) = (1/50)^N$, and if we know the pattern type, then $P(C) = (1/31) \times (1/50)^N$. For ten minutiae, which is a threshold for sufficient fingerprints, the probability is 1:97.656.250.000.000.000 (without knowing the pattern type). So it is more than 9 and sixteen pieces of zero. This exceeds the recent human population by eight orders of magnitudes. (The estimation of the number of humans who have ever lived on Earth is around 117 billion²⁰)

These calculations of probability do not work only for exemplar prints. The same principles can be utilized with latent prints as well. The latent prints are formed unintentionally, by the contact of the friction ridge skin and the surface. The oily coverage of the skin is deposited from the friction ridges, drawing them out on the surface. The crucial question is, how accurate the drawing of the friction ridge pattern is. To consider this issue we need to know the dialectic theory of ontologic reflection.

B The Theory of Reflection

Philosophically, according to dialectical materialism, all material objects and events are defined by their interactions with other material objects and events and only by them.²¹ Everything in this world is constantly moving, interacting with other things, and changing by the interactions. Everything in this world is a result of the interactions that have happened to it. Because of the determined nature of the material reality, if the actors of the interaction are known, and the interaction itself is also known, the result will be predictable. With more noticeable forensic relevancy, if the result and one actor are known, for example from a crime scene, and the possible interaction can be supposed, for example from the literature, training, or experience, the other actors can be determined.

Ontological reflection means, in every result, the actors of the interaction are reflected. The reflection can be noisy, distorted, partial, etc., but can not be anything, which is not determined by the actors and the interaction. If a hammer is used against a human head, the result of the interaction can only be blunt force trauma. In a lucky situation, the size and shape, and other morphologic features of the hammerhead can be determined by observing the wound. In an unlucky situation, no morphologic features can be determined. But obviously, there is no situation, where the hammer causes a burn pattern. Going on this idea, when a friction ridge skin contacts a surface, no friction ridge patterns may be drawn out, or only blurred oily stains may be deposited without any visible characteristic. In lucky situations, the friction ridge pattern may be drawn out more or less clearly. But never could happen that a clear, sharp, detailed pattern of a different friction ridge skin is drawn out. The reflection can be good quality or poor quality, but can not be a fake one by nature.

In the eastern part of Europe, based on some historical issues, dialectical materialism uses to be well-known, and part of the forensic literature and practice. The idea of using a philosophical school as a methodologic background also occurred in the international literature²², but, understandably, no dialectic materialism was suggested.

Summarizing the thread, there are two cases when latent fingerprints are found. First, the print contains enough information from the friction ridge. Information in this meaning can be the

²⁰ <https://www.weforum.org/agenda/2022/04/quantifying-human-existence/> (2022. 09. 30.)

²¹ Muller (1979) 176.

²² Vanderkolk (2002)

visible, sharp minutiae, like bifurcations and ridge endings, in a cluster. Second, there is not enough information from the friction ridge skin, so there are only too few clear minutiae or no sharp and clear minutiae at all. A third case, like a distortion forming another existing pattern of friction ridge skin, can never happen.

C On the biases

It is extremely difficult to defend against criticisms that refer to expert error. To err is human, and the fact that the "zero error rate" was the paradigm for decades, really does not improve the situation. Academic comments related to expert errors can also be grouped. On the one hand, the unscientific nature of the ACE-V methodology, on the other hand, the error or bias of the expert, and finally, errors following the violation of the methodology.

The simplest is to refute the comments belonging to the third group. Errors resulting from violations of the methodology are certainly not attributable to the error of the methodology itself. The two infamous, above-mentioned false-positive identification can be traced back to the violation of the defined expert methodology. Following the existing methodology would have prevented the error.

The ACE-V²³ is the methodology of fingerprint experts. The acronym stands for Analysis, Comparison, Evaluation, and Verification. Estimating, how „scientific” it is, strongly depends on which definition of „scientific” is used. Visual comparison of depicted features, and human pattern recognition, which is usually based on tacit knowledge, can hardly be expressed in mathematical formulas. Despite this, the ACE-V is still a rational reasoning method, which always ends in a well-based decision.

According to dialectic materialism, every knowledge, which can be utilized in practice, should be considered truth. This, so-called practical approach to the theory of the truth helps to shortcut many, theoretically undecidable epistemic problems. In the United States, on contrary, the so-called NAS report²⁴ was born in 2009, which specifically states that before the first judicial use of DNA in 1986, according to many members of the law enforcement and expert community, the ability of the expert to defend his position during cross-examination in front of the court, also made the expert methodology reliable and credible. No special attention was paid to examining them; moreover, the possible error rate of the classical fields was not estimated at the time of the report.

Following the methodology helps to avoid errors. Clear recommendations help to reduce the chance of bias like the comparison phase can only be started after the analysis, and the steps and results of the analysis should be properly documented. Usually the latent should be compared to the exemplar, only in one way, and not reversed way. The GYRO system²⁵ is a good tool for documenting the analysis phase. GYRO is an acronym for green, yellow, red, and orange. Practically it is a color coding methodology. During the analysis, the green color is for the clear, good-quality minutia. The yellow is for the mediocre quality minutia, and the red is for the uncertain, poor quality one. Reverse comparison is usually not recommended, but sometimes it can happen. The orange color is for the minutia, which was marked only during the comparison stage, during a reverse comparison, when the expert finds a minutia first on the exemplar, and after he or she searches it on the latent.

According to a novel Finnish method,²⁶ the phases are the registration, the screening, the identification, and the statement production. During the registration, the lab gets the request, and experts decide if the latent prints have value or not. During the screening, the expert does the analysis and the comparison from the ACE-V method and can decide on exclusion. In the

²³ ENFSI 2016, OSAC 2020

²⁴ NAS (2009)

²⁵ Langenburg – Champod (2011)

²⁶ Mustonen et al (2015)

identification phase, two experts need to compare the latent and the known print, and if they achieve the same findings, it is identification. If they achieve different results, a discrepancy meeting needs to be held. The last phase is the statement production: all latent prints are no value, or not identified, or identified by both experts, or the results of the discrepancy meeting. If the examiners still diverge in their opinions after the discrepancy meeting, the divergence is not revealed to the customer in the report, but the lower (weaker) category will be applied in the statement.

Estimating the error rate of the experts is a very complicated issue. The PCAST report cites a 2014 study by the Miami Police Department (MDPD) on estimating the error rate of fingerprint experts, which showed a value of between 3-4.2% for false identifications, which the report interpreted as one in eighteen fingerprint expert identifications being wrong.²⁷ A later published article²⁸ revealed serious methodological errors in the statistical calculations; from the same data, instead of 4.2%, 1.7% of false identifications were detected (and then there was no mention of the faulty test method itself). Any proficiency tests are not suitable to estimate error rate or validation.²⁹ Anyway, the PCAST report got serious critics.³⁰

The verification phase at the end of the ACE-V methodology means to eliminate personal error, by repeating the analysis, comparison, and evaluation by a second expert. Problems can occur if the second expert knows the results of the original evaluation, and it affects his or her decision. Especially when the error could have a serious effect on the experts' carrier, perhaps a colleague in such a case would not yield the problem, and endorse the false testimony after the review. I find this unimaginable. Despite the academic scholars calling this „bias” as well, this is a crime.

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²⁷ Wilkinson et al (2018)

²⁸ Ausdemore et al (2019)

²⁹ Christensen et al (2014); CanFRGW (2016)

³⁰ Kaminar (2018); https://theiai.org/docs/8.IAI_PCAST_Response.pdf ; <https://www.fbi.gov/file-repository/fbi-pcast-response.pdf/view> ; <https://www.justice.gov/opa/pr/justice-department-publishes-statement-2016-presidents-council-advisors-science-and> (2022. 09. 28.)

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