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- Measurement as the Basis of Forensic Identification

"Not all that counts, may be counted
and not all that can be counted, counts"
(A. Einstein)

At the turn of the 20th century, the popularisation of DNA-based identification in courts has coincided with intensive discussion on the "unscientific" nature of most of the classic forensic identification methods (such as the identification of tools, firearms or footwear on the basis of the marks left by them, identification of persons on the basis of handwriting, bite marks, voices, or even fingerprint identification). These techniques have been disputed as lacking theoretical and practical scientific foundations, resulting in the groundlessness of the assumptions made so far, and as trying to compensate these drawbacks with individual experience and highly subjective expert opinions.[1]

An additional, strong argument for the critics has been supplied in the form of numerous and often-publicised court mistakes in cases based on expert opinions. According to some data, erroneous opinions are the second most frequent cause of incorrect court decisions.[2]

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[1] See an extensive report on the status of forensic science "Strengthening Forensic Science in the United States: A Path Forward", prepared by the Committee on Identifying the Needs of the Forensic Sciences Community and the National Research Council (https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf), as well as: M.J. Sacks, J.J. Koehler, The Coming Paradigm Shift in Forensic Identification Science, Science vol. 309, 5 August 2005, p. 892-895; E.Murphy, The New Forensics: Criminal Justice, False Certainty, and the Second Generation of Scientific Evidence, California Law Review, vol. 95 no. 3/2007, p. 721-797; M.J. Sacks, J.J. Koehler, The Individualization Fallacy in Forensic Science Evidence, Vanderbilt Law Review, Vol. 61, No. 1/2008 (www.works.bepress.com/michael_saks/1), p. 1-15; W.C. Thompson, The National Research Council's Plan to Strenghten Forensic Science: Does the Path Forward Run through the Courts, Jurimetrics, vol. 50, No 1 (Fall 2009), p. 35-51; D.H. Kaye, Probability, Individualization, and Uniqueness in Forensic Science Evidence: Listening to the Academies, Brooklyn Law Review 2009-2010, vol. 75:4, p. 1163-1185 (Penn State Law eLibrary, Scholarly Works. Paper 16, http://elibrary.law.psu.edu/fac_works/16); J. Koehler, M.J. Saks, Individualization Claims in Forensic Science: Still Unwarranted, Brooklyn Law Review 1187/2010, vol. 75 (Northwestern Public Law Research Paper No. 11-18, http://ssrn.com/abstract=1755684), p. 1-15.

[2] The analysis of 86 cases involving serious crimes in the USA, where the "perpetrators" had been convicted (and some sentenced to death), and then acquitted in 1995-2005 on the basis of DNA analyses not used previously, proved that the second most frequent cause of incorrect decisions in these cases were faulty expert

As a result of this wave of criticism, a large-scale initiative has been launched with the aim of improving the quality of the "product" offered by experts (or forensic laboratories, to be more precise) to judicial authorities, consisting in the standardisation of the applied methods, laboratory accreditation, and certification of experts.

Another action that many scientists believe should contribute to solving the problem of the "unscientific" nature and subjectiveness of the traditional methods of forensic identification is the development and widespread adoption of measurement methods. The latter idea is not at all new; it has been about 150 years since the first attempts at elaborating measurement-based forensic identification methods were undertaken, and in the history of forensics, one may notice that those who devise identification methods (both suggested in theory and actually applied) are returning to the notion of measurement with a degree of regularity, every once in a while recognising this type of method as the main or even the sole basis for identification worthy of scientific attention.

Adding this to the fact that some measurement methods have been abandoned or significantly reformed after a period of intensive application (the best known examples being Bertillon's anthropometry and Locard's graphometry), while others have not found any wider recognition among practitioners, it is worth questioning if measurement is in fact a cure-all for the current problems of forensic identification.

It is beyond discussion that the idea of research result objectivisation – e.g., by replacing subjective expert opinions with objective measurement results – is obviously correct just as it is. In Poland, in recent years, it has gained a particular importance with the emergence of an increasing number of undereducated, incompetent experts on the "expert services market", who often

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opinions (63%). The only more frequent cause were errors in witness testimonies - 71% (M.J. Sacks, J.J. Koehler, The Coming Paradigm…, op. cit., p. 892-893).

acquired this name following short, theoretical courses, not supplemented with any apprenticeship with a master, and giving expert opinions according to the WIELOBE theory[3].

The shift towards measurement methods might seem the more justified, as owing to the development of science, we are able to measure an increasing number of objects and their properties, and the available measurement tools are becoming more and more precise.

A fact of lesser significance, but still worth mentioning, is that determining analysis results in an objective manner (particularly through calculating probability, e.g., according to the Bayes theorem), without worrying how this information may be used by the court, would be, to some extent, beneficial for the experts themselves. On the one hand, it would relieve them of the burden of "moral responsibility" for the final conclusions and their consequences, and on the other – it would indemnify them against the possible liability for erroneous opinions.

The problem with employing measurement methods for identification purposes lies in the fact that it may only bring the expected objectivised results if the analysed features of the identified object are unchangeable[4] – which is an extremely rare situation in forensic science. In the above-mentioned discussion on the value of forensic identification methods, DNA-based identification, strictly relying on statistical data and probability, is set as a model to be followed by the traditional methods; it is emphasised in the literature that traditional forensic methods can and should adopt analogous solutions.[5] According to some opinions, the only task of an expert, regardless of the field of specialty, should be to determine the level of similarity between the properties

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[3] The theory comes down to the claim that nowadays, an expert opinion may be given by *"anyone, as long as it is fast and cheap",* and the clients receive *anything, anyhow.*
[4] In this paper, invariable features also refer to properties that cannot be modified intentionally.
[5] M.J. Sacks, J.J. Koehler, The Coming Paradigm…, op. cit., p. 893.

of the studied objects (as it is the case in genetic identification), rather than to formulate conclusions that a given trace was left by a specific person or object.[6] However, the authors of such recommendations overlook the fact that the vast majority of classic methods of forensic identification are necessarily based on features that are not unchangeable – as it is their very nature that cannot be altered. Unlike DNA structure, the parameters of the human voice, the graphic features of handwriting, the scope of shoe sole damage, etc., are subject to changes of a very broad scope and over a short time. Because of this difference – though many proponents of traditional methods of forensic identification, realising their defects, see the need for change – it is unrealistic to think it is possible for the standards set by DNA analysis to be achieved within this capacity.[7]

If the properties of an identified object are not unchangeable, the possibility of their precise measurement is not equal to the possibility of making correct and legally useful conclusions, as the inconsistency of measurement results does not necessarily indicate that different objects are studied; on the other hand, consistent results need not mean the identity of the studied objects. Consequently, providing an objectively measured "similarity indicator" with reference to objects (features) under study makes sense mostly in the case of identification methods that are based on invariable properties, whereas analogous information referring to variable properties is either useless or useful only to a minor degree.

Great examples illustrating the said problem are, e.g., the handwriting and toolmarks identification. In both cases, even the absence of any common

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[6] Ibidem, p. 895.

[7] An additional limitation in the pursuit of achieving the standards adopted in DNA analysis is the often low level of definability of features used in identification, defined as the degree of non-ambiguity of their definitions (J. Moszczyński, Subiektywizm w badaniach kryminalistycznych, Olsztyn 2011, p. 41). The low level of definability greatly hampers or even blocks the recommended "development of measurement methods, collection of data about the frequency of occurrence of individual features, testing their mutual independence and calculating and explaining the probability of occurring the same set of features in different objects" (M.J. Sacks, J.J. Koehler, The Coming Paradigm…, op. cit., p. 892). Accusing forensic scientists of alleged negligence in this field is only partially justified.

features between two marks – i.e., complete inconsistency of the results of measurement that the marks might be subject to – does not necessarily exclude the possibility of these marks having been left by the same object. This may occur if handwriting is deftly disguised, the health of a person changed drastically between the production of two writing samples, or if an edge of a tool has been sharpened. Another possibility – though less frequent – is the opposite situation, with the properties of two marks (measurement results) being in agreement despite having different origins. In handwriting identification, this may occur especially in the case of abbreviated signatures and initials that may prove indistinguishable because of purposeful action or coincidence. Neither should one rule out incidental consistency of marks left by different copies of the same (in the category sense) or similar tool, if the marks are uncomplicated and include a small number of identification features.[8]

In the above-described examples, and other, similar ones, identification difficulties are inevitable, but the postulated subjection of opinion-giving to strict mathematical principles (instead of experts' referring to imprecise values such as their own "knowledge and experience") will still not eliminate these difficulties in the case of most methods. The mentioned variability of properties serving as the basis for identification, and the sometimes very limited degree of their definability, exclude the possibility of creating comprehensible databases containing information about the frequency of occurrence of individual properties[9] – the existence of which is a prerequisite for replacing conclusions referring to probability in the psychological sense (especially categorical ones)

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[8] It is thus not fully true to say that in traditional forensics, it is assumed that if two marks are indistinguishable, they have been made by the same object (M.J. Sacks, J.J. Koehler, The Individualization Fallacy…, op. cit., p. 7. The assumption is only made if the marks are characterised by such a wealth of features (in terms of quantity and quality) that the probability of the same set of features in two different objects is negligible. The main problem is that in the case of most traditional identification methods, a clear determination of the number (quality) of features is the limit making a mark "unique", is impossible.

[9] It is possible to create partial databases, and such attempts – though small scale ones so far – are being made. However, these databases will never be complete, i.e., they will not include data about all features, as the catalogue of the feature is, by nature, open. It should also be taken into consideration that the possible data on the frequency of occurrence of specific features in the population will have fundamental importance for the identification of natural objects; in the case of artificially produced features (e.g., in disguised handwriting), the degree of usefulness of this data will be much lower.

with probable conclusions expressed in numerical form, taking into account the error rate, etc. The chances of success in such projects only exist in a few classic methods of identification, those in which the studied features are – in terms of properties – as close as possible to the features analysed in genetic identification, and primarily the invariable ones (as it would appear, mainly in fingerprint identification).

Otherwise, if the features of the identified objects – unlike DNA – undergo changes, the assessment of the need for measurement, selection of its type, and the interpretation of the results, require consideration, both on the part of the experts themselves, and the authorities ordering expert opinions. Performing measurements when it is not justified, due to the properties of the measured object, may sometimes do more harm than good. The strong pressure for the widespread use of quantitative methods, noticeable in recent forensic literature, may lead to unfounded glorification of all results provided in "mathematical", numerical form, eventually leading to the expansion, rather than the reduction of subjectivity. The results of quantitative analyses, if properly presented (e.g., in the form of graphs, tables, indexes calculated by computer programs), have a strong illustrative appeal. An expert using them in front of an unprepared audience (the court) will probably make an impression of being more objective, and his or her opinion more "scientific" – and thus more valuable – than the opinion of an expert formulating his or her conclusions in a traditional manner[10] – when in fact, the risk of each of them making a mistake is the same. It will be easier for an expert to persuade the court to his or her own opinion, if it is based on the results of measurements, which by no means makes this opinion correct (it is even possible that an expert who is overly trusting in

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[10] The problem was aptly put by L.H. Tribe who stated that using mathematical methods in court proceedings "demonstrates the power, but not the wisdom of science" (L.H. Tribe, Trial by Mathematics: Precision and Ritual in the Legal Process, Harvard Law Review, vol. 84, no. 6/1971, p. 1393); the author warns about overestimating mathematical methods and indicates the dangers stemming from their use by the justice system.

"objective" indicators demonstrating low or zero level of measurement result consistency, may have a higher tendency for making second-type mistakes, or "false negatives", i.e., giving untrue negative opinions).[11]

On the other hand, abandoning the traditional mode of providing forensic expert opinions – as proposed by some authors[12] – and replacing conclusions such as "the disputed signature has/ probably has/ probably has not been produced by the defendant" with information about the "index of consistency" of the disputed and comparable material may, at worst, lead the court to an incorrect decision (as in many classic identification methods, a higher consistency index is not commensurate with higher probability of a mark being made by a specific object), or, in the best case scenario, will require a supplementary comment from the expert (as the court does not have specialist knowledge, as a rule, they will not be able to independently evaluate the weight of the numbers they are presented with).

Conclusions

1. The widespread adoption of measurement and measurement methods may contribute to the reduction of subjectivity of classic identification methods, but itself it will not eliminate their defects. Measurement should be used reasonably, i.e., when it can in fact increase the level of rationality of expert opinions.[13] The

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[11] It should not be forgotten that even the best computer program is only a tool, like a set square, or protractor, it facilitates work, sometimes to a great extent, but it cannot replace an expert (nor court) in thinking. Thoughtless faith in computers, in the case of some forensic opinions, may prove as dangerous as subjective opinions of mistaken experts.

[12] Following this train of thought, to be consistent, medical opinions provided to the court should include "objective" information about the patient's symptoms, such as measurements of the heart rate, body temperature, blood pressure, etc., leaving the diagnosis to the judges.

[13] The goal of this conclusion (and the whole paper) is not to mask the methodological shortcomings of traditional methods of forensic identification, nor to justify the "laziness" of their proponents, who make insufficiently enthusiastic use of measurements and quantitative methods in the process of identification, but rather to demonstrate that in most identification methods, limiting the analysis to measurements cannot be reasonably justified.

postulates to replace "intuitive" methods with quantitative ones (such as topology or differential geometry) should thus be treated as a direction worth exploring, rather than as a goal to be achieved, and achieved fast.

2. The recommended change of the formula for presenting expert opinions by providing the court with an "index of similarity" between identified objects (instead of a subjectively assessed psychological probability of their identity) may produce positive effects in the form of increased objectivity only in the case of identification methods based on invariable features – such as DNA analysis. In identification methods that necessarily employ features subject to variation (i.e., in the majority of classic identification methods), measurement results do not translate into the probability of object identity, so they require an interpretation by a properly qualified and experienced expert. Limiting conclusions to a "similarity index" presented before the court in situations when it would be unjustified due to the properties of the measured object would only simulate objectivity and the "scientific" nature of the findings, without actually increasing the correctness of the opinion or judgement.

3. As the vision of eliminating or at least significantly limiting the role of the "human factor" in forensic identification, recently widespread in the literature, does not seem achievable in the near future (it probably cannot be achieved at all), in pursuit of improving the current situation in using the traditional identification methods, one should nevertheless pay particular attention to this very factor:

- ensuring rational foundations for subjectively expressed psychological probability (particularly by using quantitative methods wherever it is possible and reasonable),

- ensuring a proper level of qualification of experts, and training judges in assessing opinions,

- eliminating random persons from opinion-making activities (e.g., by using appropriately designed and properly conducted proficiency tests),
- remembering that in the end, "every expert opinion is as good as the expert giving it".