ENFSI GUIDELINE FOR EVALUATIVE REPORTING IN FORENSIC SCIENCE

A PRIMER FOR LEGAL PRACTITIONERS

This document is a primer on the ENFSI Guideline that can be downloaded from:

http://enfsi.eu/sites/default/files/documents/external_publications/m1_guideline.pdf

The ENFSI (European Network of Forensic Science Institutes, http://www.enfsi.eu/) is a key organisation in Europe bringing together more than 60 laboratories with a vision to share common quality standards and exchange knowledge and expertise. Twenty years after its foundation, ENFSI is now a pre-eminent voice on forensic science in Europe with privileged relationships with institutions such as the European Commission (with the privileged status of an EU-monopolist), Europol, CEPOL, Eurojust and Interpol.

European Network of
Forensic Science Institutes

With the financial support of the Prevention of and Fight against Crime Programme of the European Union European Commission - Directorate - General Justice, Freedom and Security

A project funded by the EU ISEC 2010
Agreement Number: HOME/2010/ISEC/MO/4000001759

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(version 0.10 - 2016)

Alex Biedermann and Joëlle Vuille gratefully acknowledge the support of the Swiss National Science Foundation through respectively the grant No. BSSGI0_155809 and the *Ambizione* grant PZ00P1_154955.

Purpose of the Guideline

In Europe, there currently is no common framework for evaluating and reporting scientific findings to mandating authorities and parties. The practice is diverse, varies among countries and across forensic disciplines. It may even vary within institutions and laboratories.

A diversity of approaches in the assessment of the scientific findings

Compare these two statements taken from practice:

(1) The matching glass fragments recovered on the garment of Mr S. are consistent with coming from the broken window.

(2) The matching glass fragments recovered on the garment of Mr S. are more likely to be found if Mr S. broke the window rather than if he had nothing to do with the incident.

The first statement only considers the results given one version of the events and thus is unbalanced and potentially misleading. The second statement offers a relative assessment of the findings given two stated scenarios.

Such diversity is easy to observe among the members of the European Network of Forensic Science Institutes (ENFSI). The ENFSI working groups deal with areas of practice such as firearms, drugs, biological traces (DNA), marks (fingerprints, footwear), documents, microtraces (glass, fibres, hair, soils, plants), explosives, audio (voice), video (face, gait) and digital information, crime scene investigation, road accidents and fire investigation. These are the areas targeted by the ENFSI Guideline.

This diversity has adverse consequences. First, the lack of declared common criteria – and adherence thereto – for assessing and reporting scientific findings offers no guarantee that the scientific findings are assessed consistently and within a logical framework. For example, the same findings could lead practitioners to express conclusions that convey drastically different messages: from an undefined and prone to misinterpretation "match and consistent with" to a transparent disclosure of the weight to be attached to the findings. Ambiguous wording of scientific conclusions has been recognised as a factor leading to miscarriages of justice.

A diversity in formulating conclusions

Depending on the jurisdiction or practitioner, the reporting associated with the examination of a footwear mark against a pair of shoes may take the following forms:

- *The footwear mark found on the crime scene could have come from the right shoe belonging to Mr S.*
- *The findings in relation to the footwear mark strongly support the view that the mark on the scene was left by the right shoe of Mr S. rather than by an unknown shoe. By "strongly support", we mean that the scientific findings are approximately 2000 times more likely if the mark had been left by the right shoe of Mr S rather than by another unknown shoe.*
- *It is very likely that the footwear mark recovered from the scene originated from the right shoe belonging to Mr S.*
- *The footwear mark found on the scene matches the features of the sole of the right shoe of Mr S.*
- *The right shoe of Mr S. cannot be excluded as the source of the mark found on the crime scene.*

In addition, this variability in the expression of conclusions makes it more difficult to share forensic reports across the various European jurisdictions.

The ENFSI Guideline for evaluative reporting has been prepared in order to give forensic practitioners working within ENFSI laboratories guidance in reporting scientific findings in manner that is balanced, logical, robust and transparent.

Scope of application: evaluative reporting

Evaluative reporting, as it is understood in the Guideline, provides assessments of the relative weight to be attached to scientific findings in light of the hypotheses of interest to the instructing party or the investigating judge. As soon as the authority has to arbitrate between at least two opposing versions of events with the help of forensic science, the reporting of the scientific findings shall follow the principles of evaluative reporting expressed by the Guideline.

The Guideline does not apply to technical, investigative or intelligence reports that are purely technical or factual. Evaluative reports include some assessment of the weight to be attached to the scientific findings. Technical, investigative and intelligence reports do not offer such an evaluation of the scientific findings, but may also be probative in certain circumstances. Evaluative reports are generally produced to be used in court, and often also contain elements of technical reporting, whereas the other types of report are used throughout the other stages of the investigation.

Evaluative reporting differs from the above types of reporting in that it considers the findings given competing accounts of the events. It indicates the relative weight to be given to the findings.

Technical, investigative and intelligence reporting

Technical reporting gives results of a factual nature, e.g.:

- *The beige powder seized on Mr S. is composed of cocaine at a concentration of 27% (± 2%).*
- *A concentration of 1.9 gr/ml (± 0.1) of alcohol has been detected in the blood sample obtained from Mr S.*
- *The photograph on the questioned visa document is partially torn.*
- *The chemical processes applied to the seized firearm reveal a serial number that has been photographed.*
- *Attendance of the crime scene examiner allowed collecting and securing the following marks and traces.*

Investigative reporting will provide a list of possible sources or explanations, e.g.:

- *Particles compatible with gun shot residue have been found on the hands of the suspect. This could be explained by Mr S. having recently fired a firearm; by Mr S. having stood near somebody who discharged a firearm; or Mr S. having recently handled firearms.*
- *The fibres recovered on the victim's body are black acrylic fibres with physical features compatible with carpets found in cars.*

- *The paint flakes recovered on the street showed 3 layers typical of the paint systems used for cars. A list of potential makes and models is attached.*
- *The toolmarks found on the door and the footwear marks observed on the floor suggest the following ways by which entry was gained in the premises.*

Identifying key issues

The Guideline encourages forensic practitioners to identify the key issue(s) in the case and assess, before undertaking any examinations, how forensic science can help address these issues. The effective application of this Guideline thus seeks to ensure that forensic practitioners deliver the services, and only those services, that are suitable to help resolve the key issues within a given case in court. This requires the gathering by forensic practitioners of relevant case information from the instructing party, investigating judge or parties.

Case example: Identification of the key issue

The following case example will serve to illustrate aspects of the recommendations made in the Guideline. It is based on real circumstances but has been simplified.

A mobile phone shop has been burgled during the night. Access had been gained by smashing the front window using a large hammer. The hammer was left at the scene. A large bloodstain is recovered on the frame of the broken window. No CCTV was in operation. The same night, based on a description provided by a witness, the police arrest Mr S. A reference DNA swab has been taken from him and his shoes and garments have been seized. Belongings from his home have also been seized.

The items submitted to the laboratory are the hammer, a sample of the broken glass, the reference DNA swab and the garments (pullover and jeans) worn by Mr S., with the following request: (i) carry out DNA analysis on the bloodstain and the handle of the hammer and compare it with the DNA profile of Mr S. (ii) examine the clothing for glass and compare with glass from the smashed window.

After discussion with the instructing party or investigating judge, and in the

light of the account given by the defence, it transpires that the key issue is whether or not Mr S. smashed the window using the hammer.

To help with addressing the key issue, the forensic practitioner will have to consider the potential findings in the context of this set of activities.

It means that the forensic practitioners will not only focus on the comparative analyses of the biological samples and glass fragments, but will need to also consider their expectations to find such an amount of glass or DNA if the alleged activities occurred.

Evaluating scientific findings

The Guideline is based on scientific principles and methodological best practices that are fostered through fundamental and applied research by academics and practitioners and on insight drawn from confirmed cases of miscarriages of justice in various jurisdictions.

No scientific finding provides certainty. Even with the strongest associations such as the ones derived from DNA profiles or fingerprint comparisons, uncertainty is inevitable. The assessment of scientific findings is, hence, a matter of logical reasoning in the face of uncertainty, which, in turn, is governed by the rules of probability.

Probability is an expression of partial belief. For forensic practitioners, it quantifies, between 0% and 100%, the degree of belief they should have in the occurrence of scientific observations. Probabilities are assigned using numbers (or orders of magnitude). Forensic practitioners will not limit their notes to vague verbal qualifiers (e.g. this set of observations is 'very rare').

For example, the forensic practitioner may express the opinion that, based on the scientific data available to him, the probability of observing the number of glass fragment if the person broke the window is 80% or that the observed DNA profile will correspond to an unknown unrelated individual with a assigned probability of 1 in 1 billion.

The probabilities used by the forensic practitioners will be based on data (as defined in the Guideline) and both the probabilities and the data must be available in the forensic practitioner's case file.

Data used to evaluate

Contrary to the common misconception that probability assignment necessarily requires hard statistical data, probability, as used in the Guideline, is informed by various sources of specialised knowledge that can range from statistical surveys, experiments under controlled conditions and, in the absence of the above, opinions based on training and experience. The word "data", as used in the Guideline, embraces that large spectrum of knowledge. The forensic practitioners have a duty of transparency regarding the basis upon which their probabilities have been assigned. The data used by the forensic practitioners and its limitations must be clearly stated as should any assumptions made. For example, when a claimed probability is based upon experience and anecdotal evidence, it is important that it be reported in a way that does not give the spurious impression of scientific and technical accuracy (i.e. of being based on published statistical data).

Case example: Data used by the forensic practitioner

Regarding the evaluation of the bloodstain recovered from the head of the hammer, the forensic practitioner will, in case of matching DNA profiles, make use of data from population genetic studies to assign the probability of a coincidental correspondence between the DNA profile obtained from the bloodstain and the DNA profile of Mr S.

The deposit of trace quantity of DNA on the handle of the hammer is the consequence of complex transfer mechanisms. Their evaluation goes beyond the mere assessment of the probability of a given DNA profile. The forensic practitioner will consider published research mimicking, in controlled conditions comparable to the case at hand (in terms of timing, nature of surface, donors), the transfer of DNA on manipulated objects such as a hammer. In the absence of such studies, the practitioners may conduct case specific experiments to assess the potential of transfer of DNA. In the absence of any structured documented research (published or unpublished), the practitioner may resort to expressing an opinion regarding the DNA transfer based on his experience. The basis and limitations of such opinions must always be clearly explained.

In relation to activities that may lead to the transfer of glass fragments, the forensic practitioner will take advantage of studies showing how many glass fragments are transferred, retained and recovered on garments. The known

circumstances of the breaking under investigation will be considered, including the type and size of the window, the way it was broken, the time elapsed and any intervening activity between the breaking and the seizure of the garments. In addition, they will consider data regarding the adventitious presence of glass fragments on garments of individuals coming to the attention of the police.

Note that the word transfer may refer to either primary transfer (direct contact between the hand and the hammer, or direct transfer of glass from the broken window to the garments), secondary transfer (the DNA from the individual has been transferred on the hammer through, for example the gloved hand of another individual, or the glass fragments were first transferred onto the garment of an unknown person who subsequently transferred them to the garment of Mr S) or even tertiary transfer.

"Data" is one example of terms used in the Guideline in a very specific way, often different from the common usage. The Guideline offers a glossary to help define common language not only among forensic and legal practitioners. Attention is drawn to the following terms: case file, data, evidence, explanation, findings, conditioning information, key *issue(s), probability, pre-assessment, (alternative) propositions, hierarchy of propositions, strength of support of the findings.*

The requirement for propositions

The weight to be attached to scientific findings cannot be assigned solely by looking at the probability of these findings given one account of the events. For example, saying that finding gunshot residues on the hands of a suspect is consistent with the account that the suspect fired the gun is useless from an evaluative point of view until the findings have been considered given at least one alternative account, for example that the suspect was in the close proximity to the shooting incident. Hence, the weight assigned to the scientific findings is relative. It is obtained by comparing the probability of observing the findings given at least two accounts of the events. In the Guideline, these accounts are referred to as propositions. The first will generally state the position of the prosecution; the second (the alternative proposition) will reflect the position of the defence. These propositions are based on case information

that is generally not available to the forensic practitioner in its entirety. Thus, it is not the duty of forensic practitioners to set these propositions, which are formulated by (or elaborated in discussion with) with those commissioning forensic testing. In the absence of clearly defined propositions, the Guideline invites forensic practitioners to limit themselves to technical reporting, limited to observations made on the analysed material, and hence abstain from evaluative reporting.

Forensic practitioners can assess their findings in the light of propositions that focus, for example, on the source of the material or on the activities leading to the traces. Neither of these levels (source or activity) determines the ultimate issue of guilt or innocence. Source level propositions concern who (or what object) left a given trace. Activity level propositions pertain to the mechanisms or behaviour through which the traces were deposited. Stated otherwise, source level is guided by questions such as 'Where does this trace come from?' whereas activity level is concerned with questions such as 'How did this trace get to where it was found?'. This distinction is crucial because the strength of forensic results given different kinds of propositions may vary drastically.

Case example: Source or activity level proposition

At this stage of the inquiry the issue in relation to the bloodstain is one of source. The forensic practitioner will assess his findings considering that either the blood originated from Mr S. or that the blood came from an unknown person unrelated to Mr S.

For the potential DNA profile that could be obtained from the handle of the hammer, the propositions considered will depend on the account given by both parties regarding the alleged activities. The prosecution alleges that Mr S. used the hammer to break the window while the defence asserts that he has nothing to do with the incident and has no knowledge of the recovered hammer. However, he indicates that he was in the area early that night, had a fight at the local pub, had a nosebleed, broke a couple of bottles and must have encountered the real offender.

With regards to the glass, the propositions put forward by the parties will also refer to alleged activities, either that Mr S. broke the window in the course of

the burglary or that Mr S. has nothing to do with this incident.

These propositions depend critically on the accounts given by both parties and may be subject to changes as the case progresses. Evaluative statements will then indicate for example: "My conclusions are based on the results of my laboratory examination and the information made available to me at this time. If any aspects of the case should change (in particular the propositions), then I am prepared to review my conclusion in the light of such changes".

The Guideline recommends that forensic practitioners assess findings at activity level whenever the assessment of the findings requires expert knowledge or information that the fact-finder does not possess. For example, in a case where three particles typical of gunshot residues are found on the right hand of a suspect, it is impossible for a layperson to know what these particles mean in relation to the shooting incident compared to other activities (e.g. being transported in a police car that might be contaminated with gunshot residues). The evaluation has to account for the number of particles obtained (in this case, three) and requires specialised knowledge regarding the quantity, distribution and persistence over time of particles on hands of people who discharge a gun as opposed to individuals who are transferred in a police car. The Guideline requires forensic practitioners to inform the fact-finder of the need to resort to specialised knowledge, and its impact on the evaluation of the findings, so as not to leave the assessment of such findings only to the uninformed intuitive judgement of the layperson.

Weighing and reporting scientific findings

Comparing the probability of the scientific findings given each of at least one pair of propositions, in the form of a ratio, generates what is known as a likelihood ratio. The likelihood ratio expresses the weight to be attached to scientific findings, that is the extent to which scientific findings provide support for one proposition against the stated alternative. For example, a likelihood ratio of 10,000 means that the findings are 10,000 times more probable if the first proposition is true than if the alternative is true. A likelihood ratio of 1 means that the findings do not change the relative probabilities of the two propositions (i.e., the findings are neutral). A likelihood ratio below 1 provides support for the alternative proposition against the first proposition. Evaluative conclu-

sions should take the form of a likelihood ratio. They should be expressed in the report. The likelihood ratio is sometimes complemented by a verbal equivalent. These verbal qualifiers are chosen by convention and may be ordered in the form of several levels that comprise a verbal scale. For example, a likelihood ratio on the order of a million may be translated on a verbal scale as describing findings that will provide "extremely strong support" for the first proposition rather than the alternative. It is important to keep in mind that this conclusion of "extremely strong support" has been reached on the basis of information, data and assumptions that may be subject to revision. Hence the Guideline suggests that all statements should indicate that any change in the conditioning information may require assessments, conclusions or propositions to be reviewed.

The number of qualifiers and the range of likelihood ratios covered by them is a matter of convention. The scale and associated numbers should be made available to the report.

Case example: Weight of scientific findings and reporting

In the burglary case, the forensic practitioner reported his findings as follows:

The DNA profiling results obtained from the bloodstain found on the frame of the broken window provide extremely strong support for the view that the stain originated from Mr S rather than an unknown unrelated individual. The profile is more than a billion times more probable if Mr S left the stain rather than if an unknown unrelated person did.

The DNA finding is on the order of 400 times more likely if Mr S was the person who handled the hammer rather than if someone else handled the hammer and Mr S's DNA transferred by secondary means.

The glass findings provide strong support for the proposition that Mr S broke the window rather than Mr S has nothing to do with the incident. 'Strong support' means that the findings are on the order of 2000 times more probable given the proposition that Mr S broke the window rather than the proposition that he had nothing to do with the breaking incident.

A key principle of the Guideline is that forensic practitioners should only express opinions regarding the probabilities associated with the scientific findings given (conditional on) the propositions. That is to say, probabilities relate to the evidence, not to the propositions themselves. Propositions of fact in issue in the proceedings are and must remain within the sole province of the fact-finder. This precept encapsulates the principle according to which scientific findings should be placed by the fact-finder in the general context of the case.

Case example: What the results do not mean

In the burglary case, it would be fallacious for the forensic practitioner to conclude that:

- *There is a probability below one in a billion that another unknown individual unrelated to Mr S is the source of the bloodstain.*
- *It is very likely that Mr S touched the hammer.*
- *There is a very high probability that Mr S smashed the window with the hammer.*

Conclusion

Adopting the likelihood ratio approach to the evaluation of scientific findings does not derogate from the principle (familiar to most modern Civilian legal jurisdictions) of free evaluation of evidence by the fact-finder ("free proof"). Besides, the Guideline does not make suggestions on how the approach is to be used for assessing evidence types other than forensic science findings. Ultimately, the Guideline sets the scientific framework that should prevail in the evaluation of forensic findings and provides a guide for the practice of all ENFSI forensic practitioners.