Harmonisation in Forensic Expertise

An inquiry into the desirability of and opportunities for international standards

Edited by

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Of all the branches of criminal procedure, evidence is probably the most vital and certainly the most complex and, as a result, the least fixed.

Evidence, in fact, finds itself at the junction of two antagonistic logics: on the one hand, the rights of the individual (corporal integrity, private life), and on the other hand the rights of society, those rights which one attempts to defend with the use of modern technologies while building a system of important powers for the benefit of police and judicial authorities.

When we said that this was a complex matter, we had in mind the content of the laws of evidence, but this complexity also affects the sources of these laws. This matter is dealt with in the most important sources imaginable, and this confirms the huge importance of evidence. Principles relating to evidence are found in constitutions (USA Bill of Rights, Italy, Portugal, Canada with the Charter of 1982, formerly the USSR), but also in international treaties (the European convention on Human Rights, which assumes convergencies between countries and even within countries such as Switzerland, with its mosaic of cantons, and international pacts relating to civil and political rights). Almost everywhere the details are dealt with in a law, or to be more precisely, in a code of penal procedure; that of Italy 1989 devotes an entire chapter to proof (arts. 194-243) in addition to which, certain principles are found in other parts of this code. In common law countries, the theory of sources arises in a different way. The matter is dealt with essentially in case law, especially in England and in Canada, more rarely in the law itself, although England has produced an important statute, the Police and Criminal Evidence Act 1984, which states the limits of police powers, and in the United States the Federal legislator has codified the federal rules of evidence, based on case law and this is how, in 1975, the Federal rules of evidence were promulgated. This text is so important that it serves not only as an exclusive reference for federal judges, but also as an important reference point for state judges (even though about 30 states have their own codes). In addition to this, of course, one should not forget practice usages which are so difficult for the student of comparative law to learn.

Thus, the theory of penal evidence, complex as to both its sources and its contents, must be examined under different aspects. This will be done

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1 This contribution is a translation of 'La preuve penale', Chapter V of the book: Proce- dure pénéale comparée dans les systèmes modernes: Rapports de synthèse des colloques de l'isisc, No. 15, Association Internationale de droit penal, 1998.
by using an approach which may be trite but which has the merit of clarity. Thus we will look at (1) the burden of proof, (2) the collection of evidence and (3) the appreciation of evidence.

1 The burden of proof

The law relating to the burden of proof is dominated by one principle, that of the presumption of innocence. However, in spite of its importance, this principle does have some exceptions.

A The affirmation of the presumption of innocence

This principle has its roots in history, for example, in the Habeus Corpus of 1679, and then in the Déclaration Francaise des droits de l'homme of 1789. This principle has become a commonplace of penal theory, having been dealt with in several congresses (e.g. the sixth congress of the International Association of Criminal Law in Vienna 1953).

1) This principle is set out in many different ways. Italy, Portugal and Brazil, for instance, include it in their constitution, the European Convention lays it down in its article 6-2 – 'every person accused of wrongdoing is presumed innocent until his guilt has been legally established' – France and Great Britain lay it down only in their case law. One will recall that the House of Lords in the Woolmington case, 1935, compares the principle to a thread of gold and states that in the cloth of English criminal law, this golden thread will always be found. A striking way of giving this presumption all its majesty.

It may also be noted that before its split, Czechoslovakia, in article 40 line 2 of its Charter of rights and fundamental liberties (of 9th Jan 1991), included this presumption in terms virtually identical with those of the European Convention on Human Rights (art. 6-2). Since 1975 the Portuguese constitution has stated that any person under suspicion is assumed to be innocent until such time as a sentence of culpability had been rendered (art 32-2).

China does not set out the presumption of innocence in a legal text, but lawyers in that country state that it does exist in fact, and in particular that there is no presumption of guilt.

2) The affirmation of this principle gives rise to important consequences, some are general: it is up to the prosecutor to prove culpability and if he is not able to do that the accused must be acquitted (in dubio pro reo). In this regard, a verdict of not guilty must be definite. The new Italian Code of 1989 has abolished acquittal on grounds of lack of proof. It will be noted that if in principle it is up to the prosecutor to bring proof – in Germany the public prosecutor has to extend his investigation to elements which are favourable to the accused – the independent and substantial role of the
judge is recognised in certain legal systems. Thus it is in France (notably with the examining magistrate), and in Portugal, where the procedure has a "combination of accusatorial procedure and inquisitorial procedure" and where the judge has the "the right and the duty to investigate in an impartial manner". In Germany they apply the famous principle of 'material truths' which enables the judge, particularly at the trial, to seek elements of proof so that he may be convinced without necessarily being swayed by statements made during the trial.

Other consequences are more specific, more technical. For instance, in the USA during the jury selection phase (*voir dire*), the accused may ask those jury candidates if they accept the presumption of innocence and if they consider the accused to be innocent until proven guilty. As a result of this, if a candidate shows any doubt (s)he is excused. Still dealing with the US, at the end of the trial the judge reads the jury a text (jury instructions) which specifically refers to the presumption of innocence. One should also mention another consequence, a rather technical one, namely the impossibility, laid down in a great number of laws, to compel a witness to testify against himself, the accused for this purpose being regarded as a witness, (see e.g. art. 11-c of the Canadian Charter of Rights and Liberties).

3) However, some nuances should be made regarding the principle of this presumption.

The first is a limit admitted in the interests of society. The body which has to consider the charges before they are brought to judgement cannot dismiss or excuse a case if the evidence shows that the fact does not exist or that the accused has not committed it or that it does not constitute a crime or if the person charged is one who cannot be charged (art. 425 of the criminal procedure of the Italian CPP). However, the presumption is not rebutted because the facts mentioned have not done so and therefore it is still possible to acquit.

The second nuance consists of a limit in the interest of the accused. In theory, the brutal application of the presumption would force the prosecution to assume the burden of proof. In reality, neither the judge nor the accused will always play a passive role. Portuguese law insists on the judge playing an active part. French, Belgian and Dutch law are familiar with the *juge d'instruction*, — examining magistrate — who, after the police investigation and before the trial, interrogates the accused and the witnesses and may request expert testimony or a (house) search. Article 190 of the Italian CPP mentions a 'right to proof' for the benefit of the accused, and article 38 of the law dealing with the application of this Code of 1989 provides the notion of an investigation on behalf of the defendant which enables the lawyer to seek out evidence as well as witnesses. In its first works, the French commission "Penal justice and the rights of man" had considered the introduction of a similar text. It withdrew this proposal however, when it was faced with fairly general hostility (1989).
But that is not all, for there are actual exceptions to the presumption of innocence:

**B Exceptions to the presumption of innocence**

There are in fact some real presumptions of guilt. These exceptions are dictated by public interest and particularly by the fact that in certain cases it is difficult for the accuser to bring complete proof, even though there may be little doubt concerning guilt. However, the presumption of guilt is always simple and the accused may contradict it. Every legislation has such presumptions and the European Court has even given its approval to the existence of certain presumptions (the case of Salabiaku, 7 Oct 1988). Here are a few examples of presumptions of guilt which exist in most legislative systems except, for instance, Germany.

1) One may first of all mention very small offences often known as petty crimes when the moral element is assumed. This is the case in Canada and the Netherlands where the accused may be able to plead that no offence was committed or that there was no intention. Canadian law speaks of offences of strict responsibility, and this responsibility may be negated by evidence on the part of the accused that he used reasonable diligence, which he has to establish by strong proof. In the Netherlands the judge may acquit even if the accused is absent or does not take advantage of claiming that he was not in default since art. 350 CPP gives him the right to establish whether there really was guilt.

Sometimes proof is more difficult to establish. In France a person who is taken to court for a petty crime can only invoke force majeur or insanity to be released. It is the same in Canadian law, with the offences known as offences of absolute responsibility (see the famous case of Sault Sainte-Marie, judged in 1978 by the Supreme Court of Canada which compared absolute responsibility and strict responsibility). In such cases one often speaks of material infractions, i.e. those which are proved by the simple fact of having committed the prohibited deed.

2) Almost everywhere a defence which relies on causes of subjective or objective non-responsibility must be raised by the accused himself. This is the case in Belgium and also in France and England, in the case of insanity. In the same spirit, it should be noted that in England, when the law forbids a certain thing but also lays down an exception to this prohibition, it is up to the defence to prove that he can benefit from this exception: this rule was created by the Magistrates Court Act of 1980, (art. 101) for the procedure following a summary trial and has now been extended by case law to trials of indictment.

3) Sometimes the law itself assumes the presumption of guilt; one may compare art. 30 of the Sexual Offences Act of 1956 (English) with art.
225-6 CP (French) which assumes that a man who is living with a prostitute and who cannot justify his lifestyle is a pimp (see in the same way art. 222-39-1 of the CP on drug traffickers in their relations with other traffickers). There is also a presumption of contraband in England, Canada, Italy and France which applies to someone who has in his possession prohibited merchandise coming from abroad (drugs for example) and who cannot prove a legitimate source. However, in the United States this presumption is rejected because it conflicts with the presumption of innocence, except in the case of contraband involving heroin or cocaine. The Canadian Supreme Court holds that any alteration to the burden of proof concerning a material element of the offence or relating to the means of defence is a violation of the presumption of innocence guaranteed in art. 11d) in the Canadian Charter of Rights and Liberties, although it is justified according to art. 1 of the above mentioned Charter, according to which the rights and liberties “can only be restrained by a legal rule of which the limits are reasonable”. Egyptian law has a presumption in the case of the sale of adulterated milk. Article 529 of the Moroccan CPP states that anyone having been condemned within the last 10 years for a crime or an offence against property, being found in possession of cash or (bonds) or valuables which are not in relation to his status and who cannot justify that they have come to him legitimately, may be punished. Article 207-2 of the Japanese CP states that when several people have used violence and have wounded a third party and when it is impossible to determine the relative gravity of their actions in relation to the wounds, or even when it is impossible to know who has caused the wounds, those people will be deemed to be co-actors even if they are not accomplices. The same rule exists in France, but in that instance it is part of case law.

2 The collection of evidence

The central point in the theory of evidence, that is to say the gathering of the evidence, may be divided into several subsections. One must first ask if certain types or means of evidence are admissible or receivable: that is the question of the admissibility of evidence. Next arises the question of the administration of (admissible) evidence. Finally one must deal with sanctions in the case of violation of the preceding rules, or non admissible evidence that was presented or admissible evidence that was badly administered.

A Admissibility of evidence

Is evidence free? Can the judge accept any kind of evidence? The answer depends on where one puts the accent. If one puts the accent on the freedom of appreciation of the judge, it is possible to admit a system of the freedom of evidence. If one puts the accent on the risks of judicial error or on the respect of a person, then one will keep strictly to the system of le-
gality of the evidence. However, as we shall see, the distinction is not absolute.

1) First one should note that the question of the freedom or legality of evidence does not always arise. In those systems which accept that a guilty plea results in an admission of guilt, and which authorise the judge to pronounce a sentence, the problem of evidence does not really arise. This is the case in common law (England Canada, USA) and in Portugal, subject to certain details with which we shall deal later.

2) When the question of evidence arises, i.e., when in a common law country, the accused does not make any admission, or when in the judicial system his admissions do not have absolute effect, the solutions can be extremely complex. One may try to classify these systems in 3 categories.

   a) First of all, there are systems which favour a very wide application of the principle of the freedom of evidence, but not an absolute application. A very revealing example of this point of view is art. 427 of the French CPP, according to which, "except in cases where the law rules differently, offences may be established by any means of evidence". Article 125 of the Portuguese CPP states similarly that all evidence which has not been forbidden by law is admissible. The Belgian point of view is very similar, where the code of criminal procedure enumerates types of evidence (art. 154) but it is accepted that the judge may accept any kind of evidence which the parties may put forward. In Italy, art. 189 of the CPP states that the judge may accept evidence which is not regulated by law if he considers that it is fit to assure the verification of the facts. However, in these countries, in the meantime correspondence between the lawyer and the accused is not permitted, nor are personal acquaintance with the judge and hearsay evidence.

   b) The Netherlands and Germany fall into the second category. The codes in these two countries list types of evidence. In Dutch law, art. 339 concerns the observation of the judge himself, declarations by the suspect, the witnesses, statements by the experts, and any documents presented in evidence. For its part, German law includes the declarations of the accused, those of witnesses, those of experts, ‘view of something’ (means of proof which consists of what can be perceived by the senses at the scene of the crime) and also documents (arts. 48, 71, 72, 85, 86, 92, 249 and 256). As will be seen, indications are not mentioned as we are dealing only with factual data.

   In practice, however, these two systems of law are moving towards a system of freedom of evidence. Thus in the Netherlands the Court of Cassation (Hoge Raad) has admitted hearsay based on a document ever since 1926, thus hearsay can be contained in a legal statement and legal statements, according to art. 344 CPP, may be a variety of documents. In the
same way in Germany hearsay is admitted although the judge is free to look for further evidence and in his appreciation of it the hearsay with the further evidence. German case law has had to deal with evidence that was very unusual, such as facts drawn from a private journal and conclusions drawn from expert comparisons of voices. The general tendency is to refuse this type of evidence; first because it is breach of privacy and second because it assumes an active collaboration by the suspect (which is not the case, for instance, with fingerprinting).

c) There is a third group of countries where evidence is even more restricted; these are mainly countries of common law. Let us say at once that as far as common law is concerned, the rules dealing with the admission or exclusion of evidence only concern the question of the guilt of the accused. When it comes to the determination of the sentence in the second part of the trial all evidence is admissible, even that which has been obtained by illegal means.

- The principal evidence that is explicitly excluded (also in Italy as has already been said, in Japan by art. 320 ff. in the CPP, in Portugal by art. 129 of the CPP and also in Egypt), is hearsay evidence or evidence given by a witness before the judge about events of which he has not personally been a witness or evidence he has obtained by a third party who did not appear before the judge. According to the supreme court of Canada it is a 'Well-established legal doctrine that evidence in the form of a declaration made in front of a witness by a person whom has not testified is 'hearsay' evidence' (the O'Brien case 1978).

The reasons for this exclusion are clear: the person from whom the information originated, being absent, cannot be sworn in and cannot be interrogated or cross-examined, while this technique is the very essence of procedure in England, Canada, USA, Portugal and Italy. (See art. 130-1 of the CPP of Portugal and 195 of the Italian CPP). The Portuguese Costa Andrade has shown the link which exists between this prohibition of hearsay and the accusation procedure.

However, this prohibition is not absolute, but the exceptions are difficult to classify since the matter is a difficult one in case law. An English author states that there are twelve exceptions and an American author enumerates forty-five! For instance, it is certain that a confession by the accused outside the tribunal given in evidence by a policeman at the trial would be admissible. In order to see the matter more clearly it is useful to read the case of Khan rendered by the Supreme Court of Canada in 1990, which is based on the non-admission of hearsay and comes to see in it two criteria which correspond to inadmissibility; necessity and reliability. In principle hearsay is not necessary (there are other forms of evidence) and not reliable (no interrogation is possible) and therefore it is rejected. On the other hand, if hearsay evidence is both necessary and reliable, it is then necessary to declare it admissible. The judgement applied both these ideas
in a case of indecent assault committed by a medical doctor on a 3 year-old girl who had immediately described the facts to her mother but who had become incapable of remembering at the time of the trial a year later. The little girl's statement to her mother was the only evidence and it appeared truthful. Hearsay by the mother was therefore accepted. In the same way in the US, judgements of the Supreme Court of the state or state laws declare hearsay evidence admissible in the case of a complaint made immediately after rape. Generally speaking, in common law, hearsay is accepted in certain cases; deathbed statements (one does not lie at the moment of meeting God), declarations which are against the interest of the person making it and spontaneous statements.

— Another type of evidence which is excluded, especially in common law countries and in Japan, is the accused's bad reputation, whether this is his criminal record or dishonest acts committed in the past. It is thought that such evidence would negate the presumption of innocence and would incline the judge to allow a guilty verdict too easily. An accused person should be judged for what he is accused of and not for what he may have done in the past. It should be noted that Italian law, although it has come very close to common law does admit evidence of bad character.

Here again there are exceptions. First of all, if the accused furnishes evidence of his good reputation, the prosecutor can bring up evidence of his bad reputation (art. 666 of the Canadian Criminal Code). Secondly, if the accused casts doubts on the reputation of witnesses, then the prosecutor can attack his reputation. Finally the prosecutor can bring up identical precedents. For example, in a rape case the prosecutor cannot mention a rape committed previously or even a rape under different circumstances, but he would be allowed to bring up a rape committed at the same place and in the same way. This is the theory of 'similar facts', as the Americans would say, 'bearing the same signature'.

In Portugal, evidence relating to personality 'is permitted only insofar as it is strictly necessary to prove the components of the crime and in particular the guilt of the accused or for the application of the hereditary guarantee' (art. 128-2, 140-2 and 145-3 CPP).

— A third exclusion, which appears to be inherent to the USA, deals with admissions made by the accused during plea-bargaining with the prosecutor during which he admitted his guilt. This prohibition is intended to make negotiated settlements easier.

We now know what evidence is admissible by taking away, as it were, that evidence which is not admissible. It is therefore necessary to look into admissible evidence and see how it can be administered.
B The administration of evidence

This administration is regulated by various rules, some of which are unique to certain types of evidence and others are common to all types.

1) Those which deal with specific types of evidence are complex. We will therefore deal only with the most important.

a) The first concern statements by the person suspected or accused. With the exception of French, Belgian and Chinese law, almost all jurisdictions recognise the right to silence as well as the right to a lawyer and these rights are granted by law (except in Switzerland where it is a matter of case law). However, this apparent unanimity is only a façade where the obtaining or the effects of the confession are concerned.

- When the police obtain statements, the suspect is informed that he has the right to remain silent. This right is linked to the presumption of innocence and, as Prof. J Figueredo Dias has noted, there is a 'connection' between the right to silence and the famous presumption. Generally speaking, however, this right deals only with statements regarding facts, not with statements regarding identification.

The Police and Criminal Evidence Act of 1984 (in English law) states that silence is not an infringement and that it does not constitute any proof of guilt, except, since a law of 1994, under certain conditions (see below, statements by a person at the trial). However, in economic matters, the accused must speak, and on other matters (s)he usually wishes to make a statement. The lawyer is present at the police interrogation but does not see the file. The lawyer may be excluded from the interrogation in certain cases as, for instance, that of the necessity of evidence.

In the US, a similar system exists, which is built up on the Miranda (1966) case law, where the accused refuses to give a statement. The same applies in Canada. As a matter of fact in both countries the right to silence is stronger than in England. Thus, since the Miranda case, if the accused claims his right to silence, the police cannot ask any questions. In the US and Canada, therefore, 'it is not only a right not to answer, but also a right not to be interrogated' (S. Schulhofer). In Italy the system is similar and it goes even further because in the absence of council for the defence, no statements are admissible, whatever the circumstances.

In the Netherlands, the accused is notified of his right to silence and his counsel may see the dossier except for exclusions necessitated by the evidence, but he does not assist his client during the police investigation.

In Portugal the right to silence is granted 'in every phase of the trial' (art. 61-1 c CCP) that is to say, from the moment when the accused is considered indicted, which happens automatically for instance when an investigation is opened against a named person.
In France, a double right to silence and to counsel in the strict sense does not exist, there is nothing to stop the accused from talking, but since the laws of 4 January and 24 August 1993, counsel may visit his client for 30 minutes after the 20th hour of custody. However, counsel has no access to the file and may not attend the interrogation.

— Insofar as the trial is concerned, the right to silence is respected everywhere, but in common law there is some argument about comments relating to the accused's silence. In England the prosecutor may not comment in any way, but the judge is allowed to regard the silence of the accused a proof of guilt. This possibility, which was originally admitted by certain decisions of case law, has now been confirmed under certain conditions by the Criminal Justice Act of 1994, in order to stop the activities of accused persons tried for serious offences. In Canada neither the prosecutor nor the judge may comment on the silence of the accused, but the latter cannot insist that the jury be enjoined not to draw any conclusions from that silence. In the USA and in Italy, silence may never be held against the accused and the latter may even ask that the silence must not be unfavourably interpreted.

Thus, in common law, the accused has the choice of saying nothing or of speaking, but in the latter case he has to take the oath.

When we come to the effects of a confession before the judge, the countries we have considered usually admit that the whole procedure may be simplified. In the US, England and in Canada, after a guilty plea, the judge can go directly to the sentence. The Portuguese code is a little more subtle, since it makes a distinction according to the penalty which may be incurred. For sentences of up to 3 years, a plea of guilty is immediately followed by judgement, except in cases where the tribunal may consider the plea doubtful and take a different line. Beyond 3 years a guilty plea leaves it open to the tribunal to go directly to judgement or to ask that the case be proven.

Another difference concerning the effects of a guilty plea relates to the sentence: in Portugal the only effect is probative, whereas in Italy a guilty plea legally brings a reduction of the sentence and in England there is also a reduction in fact.

b) The second form of evidence is testimony. Before the trial, or more precisely, when dealing with the police, the general rule is that the witness does not have to make a statement. In front of the judge the situation is more complex.

To begin with there are certain constant facts: the witness who is called must appear, must take the oath and must make a statement. In the same way, witnesses are called by the parties but may also be called by the examining magistrate (in Switzerland, the Netherlands, Belgium, Portugal and France) or by the trial judge. As for professional secrecy, this is always allowed in the case of doctors (except in the USA), lawyers or ministers of
religion. It is almost never allowed for journalists (see art. 200 of the Italian CPP). Professional secrecy for the police has given rise to much debate, but it is generally admitted either by law (art. 201 of the Italian CPP) or by case law (France and England where public interest immunity is recognised and the police officer concerned may refuse to give the name of his source). It is almost universally accepted that parents, children and spouses may be exempt from testifying.

On other points there is no unanimity. First of all, some legal systems, but not others, admit that the witness who may incriminate himself has the right to remain silent, this advantage is recognised in Germany (art. 55 of the CPP), in the Netherlands (art. 219-28.4 CPP), in Portugal (art. 132-2 CPP), in Italy (art. 198 CPP), in common law countries and in Japan (art. 146, 147 CPP) (privilege against self-incrimination). There is nothing similar in France or in Belgium for example.

Secondly, the famous question of the anonymous witness also varies between legislatures. On the whole there is a general tendency not to admit it especially in common law, but in the Netherlands, case law allowed it under the influence of the European Court which is very strict, (the Unterpertinger case of 24 November 1986 and the Kostovski case of 20 November 1989) and has laid down very rigid conditions for such cases. The statement containing an anonymous declaration may be used only if the judge who is interrogating the witness knows his identity and if the defence may cross examine which rather takes away the use of such evidence.

Third, the examination of a witness may be done by the judge (examining magistrate in France and Belgium, by the judge of the preliminary enquiry in Italy ) or by the tribunal (France, Belgium, Switzerland) or by the parties, that is to say, according to the method custom to common law countries of examination, cross examination and even re-examination (countries of common law Portugal, Italy and Germany during the actual trial but it is very little used in Germany where most questions are put by the president). In addition, English case law accepts that the judge may examine a witness when it is necessary to ensure an equitable trial on the part of the defence.

Fourth, in the USA the judge interviews a child witness before the trial to satisfy himself that he is capable of taking the oath.

Fifth, in common law the witness is always heard at the trial, but this is not always the case in France, especially in serious crimes. In Germany the witness must be given a chance to make a statement. The only exceptions, (where the trial is replaced by the reading of a statement), are in certain cases specified by art. 251 of the CPP (death or illness, distance or the fact that the domicile of the witness is not known). In fact the principle of a witness appearing at the trial corresponds to the two principles of cross examination and of oral hearings and that is why it is admitted almost universally in countries of common law and in Italy (which since 1989, as is
well known, has become a part of the family of common law countries). However, this principle brings with it quite a few problems, especially in the case of organised crime. Thus it is actually in retreat. Italian law gives us a good example. A decree of 8 June 1992, which has since become the law of 7 August 1992, provides that in a case of organised crime, the interrogation of a witness by an accused person is allowed by the judge only if he considers it absolutely necessary (art. 190/2 of the CPP). This is done to protect “collaborators of justice”.

Finally, in certain legislations, if the witness is under threat, he may be allowed not to reveal where he lives (art. 68 CPP of Germany, 62-1 and 153 of the French CPP). This possibility is particularly important in the cases of organised crime and in family matters.

c) The third kind of evidence to be discussed concerns that which can be obtained by searches and by expert witnesses.

— Insofar as searches are concerned, the conditions vary. We shall give three examples which show increasing complexity. In France the police may proceed to a search when it is necessary and where it may lead to the seizure of objects useful to the inquiry (art. 56 of the CPP). In Italy the search is undertaken by the police alone but has to be confirmed by the public ministry or by the police on the basis of a decree of the prosecutor which has to show sufficient reasons (art. 247 of the CPP). Egypt has a similar system. In the USA, England and Canada, searches must be authorised by a judge on the basis of “probable cause” which is a requirement rather stronger than in Italy, except after catching someone in the act, but this notion is interpreted very strictly (the case of a policeman who is pursuing a wrongdoer who he has seen committing a crime and who takes refuge in a house). Of course, where there is agreement, the three legal systems find themselves on an equal basis, no other conditions being required. In addition, French law comes close to common law when it insists that in certain cases (fiscal for example ) the judge's authorisation has been obtained, but a search may be undertaken by a person other than a police officer.

Insofar as taking samples from a person, which is a very special kind of search, the regulations vary. In England no intimate sampling is allowed except with the consent of the person concerned, but if there is a refusal without a reasonable excuse the judge consider this as an indication of guilt. In Italy not only is sampling prohibited, but in the case of a refusal the judge may not draw any negative conclusion. In Germany sampling is possible (and may be ordered by the examining magistrate or by the public prosecutor or, in an urgent case by the police) without permission of the person concerned, unless by so doing a risk to health is incurred or if the medical intervention is a serious one. In Canada sampling is forbidden except in certain special cases (e.g. sampling the blood or urine of a person suspected of having driven a car in a state of drunkenness).
So far as expert witnesses are concerned, one has to put aside those countries like England where there is not a specialised body of judicial experts and where each of the parties may select a specialist of his choice who will testify at the trial. The same system is also applicable in the US and Canada. In those countries where there is a body of legal experts three different systems exist: that where the expert testimony may be challenged where the accused and the judge each choose an expert, and both work together (in France in cases of fraud); second that where the expertise is simple or expert is chosen by the judge (in France in common law); third, in Italy and in Portugal where in addition to the judge naming one or more experts, the two parties can also name ‘technical consultants’ (a system of control expertise).

d) Finally, a few words in the case of a fourth kind of evidence, namely statements made as the result of a telephone tap. All legislations which we have dealt with allow telephone tapping, but Belgium authorises only a summary of the person owning the phone number and the days and hours when the phone number was used (law of 11 January 1991), bearing in mind the law of 30 June 1994, which allows the examining magistrate to give permission for wire tapping in a small number of very serious cases. Three rules which are enforced everywhere are intended to put sensible limits on such procedures. These rules are first, the principle of proportionality as a result of which tapping is limited to serious cases, either with a system of only going below a certain a certain limit (in France) or according to a system of enumeration of offences (Germany, Portugal and Italy); then there is the principal of subsidiarity, tapping being the final technique to be used only as a last resort. Lastly, the principle of judiciary control, according to which only a judge can decide to authorise such methods. Certain legal systems also lay down that the grounds for suspicion must be relatively strong (Portugal).

2) Regarding the limits of each form of evidence there are nevertheless certain general rules.

a) The first concerns the person in charge of the administration of evidence. In the continental European system (except in Italy) the judge has an essential role, especially in France and in Belgium (examining magistrate) and also in the phase of the ruling in Germany, where the search for the material truth is one of the tasks of the tribunal. In common law, on the other hand, the search for evidence is in the hands of the parties. They choose their witnesses and interrogate them (in England the judge may in theory call a witness, although case law restricts this option). This validation of the part played by the two parties means that in the mind of a counsel or a judge in America or in Canada the idea of a penal transaction
is normal, whereas in those countries which belong to the Romano-German group, plea bargaining is always suspect. One should however make clear that even in common law, especially in the US, the judge may ask questions but the exercise of this right is often brought into question by courts of appeal who endeavour to ensure that the judge is impartial (the problem of the influence which his questions may have on the jury).

b) The second rule concerns relevance of the evidence. Evidence must be relevant in order to influence a reasonable person. As a consequence it is not necessary to prove what is evident or what is well-known. In addition and more importantly, the judge has the discretion to exclude any evidence which is irrelevant to the case under consideration or which might unduly influence the court. This right is very important in Italy where the president may set aside statements which have no relation to the object of the case, and where he can refuse to allow the accused person to speak if he goes beyond the object of the trial (art. 494). He can forbid the parties to put non-pertinent questions (art. 499) and he may exclude testimonies that are too detailed (art. 468). These measures remind one of article 309 of the French CPP where the president of an assize court has the right to reject anything which might impair the dignity of the proceedings or which might prolong them without there being a possibility of a greater certainty in the results.

c) The third rule is that of the legality of the evidence, and here we touch upon the problem of the agent provocateur which gives rise to other solutions. In principle such an individual has no place in the trial, but case law, particularly in Belgium admits “passive” provocation especially in cases of drug trafficking. The attitude of the Swiss federal court is identical. In France, which is more tolerant, a law of 19 December 1991, complemented by another of 16 December 1992, (arts. 706-32 of the CCP) allows the infiltration of customs officers or police officers in drug-rings provided this is authorised by a magistrate. In the US the police are fairly free and require no such authorisation.

Legality also implies the exclusion of any process which infringes the liberty of the individual (narco-analysis, torture, misleading interrogations). In England precise rules are laid down in code C (application text) of the Police and Criminal Evidence Act of 1984: the exclusion of pressure to obtain replies, the exercise by the accused of his right to silence which, since the law of 1994 can be used as evidence against him; the obligation of the police officer to stop the questioning as soon as he is satisfied that he has obtained proof of guilt (par. 11-3 and 11-4). From another point of view, there is some doubt regarding the use of a fellow suspect as an informer. This procedure is allowed by American case law at least up to the time when there is an actual indictment, but Canadian case law does not allow it, and the same applies in Italy.
In the same way, evidence cannot be obtained through using physical or moral pressure on a person even if such a person gives his consent (see arts. 126-2 of the Portuguese CPP).

d) The fourth rule deals with the communication of evidence. Here again there is no great similarity between systems. The general idea is that the defence has the right to know the contents of the dossier which is being brought against him except in regard to certain limitations dealing with the necessities of the investigation.

In systems which have an examining magistrate, the most liberal system is that which exists in the Netherlands where, except in certain cases, defence counsel is able to see the contents of the dossier from the beginning of the enquiry and right throughout the trial (arts. 30 and 51). In France, counsel has no rights during the investigation but he is allowed to see virtually the whole of the dossier during the trial, the accused having the same right under certain conditions since a law of 31 December 1996 (art. 114ff CPP). In Germany, although the 'classical' examining magistrate as normally understood disappeared in 1975, art. 147 is fairly restrictive: the accused who has no defence lawyer does not have access to the dossier; during the period of the investigation the lawyer may see the dossier only with the agreement of the court. Once the accused is indicted by the examining magistrate, the lawyer may consult the dossier without any limitation.

In systems where there is no examining magistrate, disclosure of the dossier is more complicated. In Italy where in principle the investigation lasts for 6 months, secrecy is the rule. However, there is a procedure of discovery or anticipated discovery which is at the discretion of the public prosecutor, or in case of a probative incident, or in the case of provisional detention. At the end of a preliminary enquiry counsel may see the dossier seven days before the trial. In the US the defence does not have the right to obligatory disclosure in the case of federal trials, save that the prosecution is obliged to inform the defence of any possibilities of innocence. The prosecutor has the right not to communicate statements made by witnesses other than the accused himself and in most jurisdictions, including federal jurisdictions, he is not even obliged to disclose the names of prosecution witnesses in advance. Later statements by these witnesses are not communicated to the defence until after the interrogation by the prosecutor. English law is clearly more favourable to the defence. Communication of evidence to the defence is made between eight weeks and fourteen days before the trial, except in the case of 'summary offences'. In Canada the rights of the defence are equally safeguarded but the procedure is a little different. The evidence is communicated either during the preliminary enquiry or when the defence requests that the evidence be disclosed. All this deals with the communication of evidence to the defence but there is also a system of communication to the prosecution being developed. For instance, in English law the Criminal Procedure and Investigations Act
1996 obliges the defence to communicate the expert testimony which it may have received to the prosecution in case of a trial before the Crown Court, since it may otherwise not be allowed to do so at the trial.

C Sanctions on evidence

Whether evidence is not admissible by its very nature or because of the way in which it is administered, the question of sanctions arises. Everywhere there are disciplinary or civil sanctions and particularly procedural sanctions. From this last point of view we will study just the most interesting, but the idea is the same: evidence will not be excluded unless there is a serious or fairly serious fault. That being so it does not always present itself in the same way. Three observations must be made:

1) The principle is that illegal or irregular evidence must be rejected if the fault is a serious one, although one makes an effort to reduce cases of nullity. Here are some examples. In England, where one speaks of exclusion of evidence (exclusionary rule), after a long period where rejection was not allowed (“even if you have stolen the evidence, that evidence is still admissible” said a judge in 1861) the PCEA of 1984 allows the exclusion of evidence in serious situations. Thus under article 76, a confession in front of a police officer will be rejected if the prosecutor cannot prove that it was obtained freely. According to article 78, evidence may be rejected if it appears that to accept it would have a prejudicial effect on the equity of the trial which in effect gives discretion to the court.

US law also admits nullity in the case of an investigation which is carried out in contravention of constitutional rights but includes two important restrictions. First of all, illegally acquired evidence may be used if the person against whom the illegality has taken place is not the accused because the latter is not entitled to question the rights of a third party. Additionally, if the illegally-obtained evidence would have been discovered in any case, that evidence will be admissible.

In Canada, although in principle the irregularity of evidence is of little importance, the case is different if the evidence has been obtained in violation of a constitutional provision or in violation of the charter and if the use of such evidence ‘might reflect badly on the administration of justice’ (art. 24-2). This is a somewhat original concept which allows the judge to consider the equity of the trial, the gravity of the violation and also the fact that excluding evidence, even if irregularly obtained, may do more harm to justice than to allow it to be used. This of course supposes a very serious crime and virtually certain guilt based on questionable evidence.

In France nullity is possible in only two cases. If the violation is contrary to a rule of public order (such as competence), or if it is to the detriment of the accused (art. 802 CPP). The same applies in Switzerland where one distinguishes irregularity (which has no consequences because
the formality which has been violated could have been fulfilled) and illegality which brings in its wake the rejection of the evidence.

Belgium follows the same line. The matter is dealt with almost exclusively by case law. These cases tend to disapprove procedures where the evidence has been obtained through an illegality or by ignoring the rules of administration. An important cause of nullity is the violation of the rights of the defence or of general principles of procedure, such as an investigation carried out through narco-analysis, even if the subject had consented.

In Italy the law is stricter. The authors of the code of 1989 invented a different notion of nullity, that of non-admissibility (art. 191). The authors stressed the regularity of the procedure whatever the price. Thus any irregularity may bring about the rejection of evidence and such an irregularity can even be a case for rejecting the verdict altogether. With the help of the dossier the judge who is dealing with facts will be aware of illegal evidence but he is not able to make use of it, as has just been said, and the possibility for a superior judge to control the reasons of his decision is a way of respecting this principle of non-admissibility.

The Supreme Court of Japan, whilst it lays down the principle of exclusion of evidence which is illegally obtained, endeavours not to annul procedures especially where the illegality is not serious.

2) One restriction to this rule of rejection of evidence in a case of serious error is the acceptance of cases of necessity which enables certain procedures to be retained. For instance, Belgian case law has allowed a procedure in cases which could have come before the court in spite of a violation of professional secrecy.

3) One further point to consider is that sometimes the irregularity of the evidence will also apply to derived evidence: a revolver was seized as a result of an irregular search and its seizure led the accused to confess. If subsequent evidence is linked to the original evidence, then both pieces of evidence must be rejected. This is the theory of “the fruits of the poisonous tree” an American expression and a concept which is accepted in the US, England, the Netherlands, France but not in Germany, at any rate in principle. In Portugal the law holds that in cases of hearsay, the evidence is inadmissible only in that part which derived from facts the knowledge of which was invalid, which is a way of limiting the extent of nullity.

3 The Appreciation of Evidence

The general rule is that of the freedom of the judge in the light of which, as explained in the Portuguese doctrine, is based on “a pure instinct”, “a pure intuition”, on “the voice of his conscience”, the Portuguese code invoking on his behalf that he will judge according “to the rules of his experience” (art. 127) but this rule has its limits.
Chapter V: Comparative Law

A The principle of the freedom of the judge

This is the rule which is accepted practically everywhere, though it is expressed in different ways. In continental Europe one speaks of intimate conviction and in common law (such as in Italy) one speaks of guilt beyond a reasonable doubt. Intimate conviction has been defined by the legislature as the impression on reason (compare art. 353 of the French CPP and 342 of the Belgian CIC). As to the notion of common law, it arrives at the same result, remembering that in the US it is linked to the concept of the due process of law which is a kind of regularity, a kind of procedural legality.

A consequence of this principle, for instance, is the fact that a judge may accept an extra-judicial confession rather than one arising out of the trial interrogation or that he can prefer one testimony even when faced with ten opposite testimonies, etc...

The principle of freedom is, however, not synonymous with arbitrary judgement or with disarray/disorder. Though free, the judge has to give a reason for his decision and has to do so solely on the basis of evidence which has not been rejected. As the Italian doctrine lays down, it would not be possible to "recuperate" evidence which was forbidden or illegal and therefore unusable because of an intimate conviction. It is almost a limit on the judge's freedom. There are more specific ones where it appears that the principle is seriously effected.

B Limits on the freedom of the judge

We will quote three limits, leaving aside the necessity of motivation which is recognised almost everywhere and in common law the absolute obligation for the judge to convict when the accused has pleaded guilty (but this is less an appreciation of the confession on the part of the judge than an official recognition of the declaration of guilt).

1) First of all we must note the existence of summonses which "oblige" the judge to convict. In France and Belgium one distinguishes ordinary summonses, which are simple statements and which leave the judge all his freedom. Summonses will stand until the contrary is proven, since summonses will only be withdrawn if no proof is brought. Finally summonses are valid until such point where they may be found to be fraudulent. Such documents may only be invalidated by bringing an action for forgery.

2) There is also a theory known as corroboration, as a result of which the judge can convict only if there are at least two or more pieces of evidence. In Italy although one statement is sufficient, two incidents are necessary because article 192-2 of the CPP reminds one that the existence of a single fact cannot be deduced from one incident unless the fact is extremely serious, precise and of the same nature. The incident is a minor piece of evidence. Corroboration applies in Scotland as a general rule but only excep-
tionally in England (in cases of perjury add the obligation for the judge to warn the jury that it is dangerous to convict on the statement of a single witness in certain cases, such as those of sexual offences). German case law has decided that hearsay alone cannot be the basis for conviction and therefore other evidence is necessary. In Japan even confession alone is not sufficient.

In The Netherlands the judge cannot use confessions obtained by the police if they have not been corroborated by other evidence, (testimony or statements). An extra-judiciary confession alone is not sufficient (art. 341). Still dealing with the Netherlands, article 344 deals with evidence, statements to the police, reports of experts and ‘other documents’ (notes, newspapers) and in mentioning such documents, article 344 insists that these documents be accompanied by other means of evidence.

3) In Portuguese law the “technical judgement” of an expert is not liable to be derived from the judge (art. 163 of the CPP) unless the latter can justify his objection on a technical basis or he challenges the basis of the facts used by the expert. This is a way of obliging the judge who is an amateur to follow the expert who is a professional.

Thus the law relating to evidence in criminal cases is far from uniform even when one is dealing only with the old continent. The idea of a “European logic” (J Y Chevallier), is not one which will surface tomorrow. It is true that in the end, agreement between different legislations is closer than the means of getting there. The guiding principles are based on a vast consensus if, for instance, one is reminded of the presumption of innocence (as well as the exceptions) or the freedom which the court has to reach a decision, but when it comes to technical matters and especially the parts played by the judge and by the parties, different systems in law always diverge and will continue to do so for a long time. The Romano-Germanic system and that of the common law are like two brothers watching each other, both convinced that they are the best even though they are coming closer and closer.

4 Methods of Investigation and Exclusion of Evidence

A Comparative and Interdisciplinary Perspective

Johannes F. Nijboer

1 Summary and conclusions

This paper will look at the rules governing evidence that have evolved under different legal systems in the European Union. It is far from being a comprehensive study, for the subject is very complex and goes beyond the scope of this review. As Jean Pradel remarked:1 "Proof is the most vivid and also the most complex of all the subjects related to criminal procedure. Consequently it is uncertain and not very fixed."

A traditional legal analysis of the rules of evidence would reveal a large variety of rules in the different legal systems of the European Union. Such a mono-disciplinary study of the field would probably conclude that unity in the common rules of evidence is far away and that any attempt to make uniform or harmonize the variety of regulations in this area is a hopeless enterprise. From a more theoretical perspective, unity is not that far out of reach: legal rules commonly concern particularities rather than generalities. It is precisely in the scarcely regulated area of underlying cognitive and methodological principles that we find much in common across borders. In this paper we apply a transnational comparative legal perspective combined with an interdisciplinary perspective to the notions of evidence and proof that figure so prominently in the fact-finding process. We will also examine the mainly, but not exclusively, Anglo-American 'New Evidence Scholarship'.

Finally, the rules of evidence in different countries are characterized as incomplete systems of rules tending to exclude categorically unreliable or illegal (illegally obtained) forms of evidence, thus including most forms of information in both common law systems and continental (or civil law) systems. We take the position that the rationes legis are identical in both systems, namely the exclusion of unreliable and illegal evidence. The ma-

major differences relate to the stage of proceedings to which the rules apply: common law systems seek to regulate the presentation of evidence to the decision-maker, whereas continental systems emphasize the regulation of the decision itself and eventually the reason for the opinion given in the (written) decision. Applying the well known epistemological distinction between the context of discovery, the context of pursuit and the context of justification, this means that common law rules of evidence aim to regulate only the context of pursuit - the trial in criminal cases. Continental systems, on the contrary, seek to regulate only, or mainly, the context of justification - the reasons given by the court for the decision presented in the motivation (argumentation).

Case law of the European Court of Human Rights (ECHR) is an important factor in harmonisation or compatibilisation of the law of evidence. Nevertheless, at the basic, fact-finding level, perceived as the primary function of the criminal process and its actors, so much generality already exists that the situation is quite reassuring to advocates of greater European unity in spite of the superficial variety of rules.

2 Conclusion—also related to the Corpus Juris

The team of authors who produced the book *Procédures pénales d'Europe* conclude in their evaluation of different systems of proof (Germany, Italy, France, Belgium, England and Wales) that on the surface the five systems are very different indeed and diverging. They also consider this a *vue trompeuse* (misleading vision) and point out that historically the different systems are similar. Their analysis (which corresponds with my own view) looks back on some two hundred years. Most of the examples they present concern France and England, which have imported elements of each other's procedure. We are growing towards greater compatibility of procedural systems, in particular with regard to their primary, fact-finding function. Since the enforcement of European criminal law, as defined in the *Corpus Juris* project, is primarily a matter for the national court systems, it is important to stress the capability of all systems to establish the facts in a proper and fair way. Examples of generally accepted principles of criminal evidence are: (1) the prosecution bears the burden of proof; (2) the standard of proof beyond reasonable doubt or justified conviction (*raisonnée*); (3) the presumption of innocence.

2 The distinction goes back to the work of Hans Reichenbach. More about this subject can be found in J.F. Nijboer, *De waarde van het bewijs* [The value of the evidence], Deventer 1996.


5 Art. 27 Corpus Juris (footnote 3).
The law of evidence is not only an incomplete system of rules, it is also a hybrid system. It is a composite of common legal ‘ethical-normative’ rules and ‘methodological and logical-normative’ rules. Especially with regard to the latter, Western countries have much in common. Valid reasoning is the binding factor for compatabilisation rather than the case law of the ECHR in Strasbourg, which has been shown to be important elsewhere.

### 3 Prolegomena

Evidence and the law of evidence form a domain of enormous complexity. All too often the importance and complexity of the law of evidence in particular, are neglected by jurists. Legal scholars are attracted by problems of substantive law and constitutional matters related to procedure rather than by evidentiary aspects. Practitioners are only slightly better, mainly because they cannot afford to be totally uninterested in matters of proof. Whenever jurists discuss problems of evidence, the first excuse they offer for their lack of interest is that the subject is ‘too trivial’. Evidence is pictured as being something simple. However, as soon as these same jurists delve deeper into the problems of evidence they have a second excuse for their lack of interest, namely, that they find the material ‘too difficult’. This paradox is perceptible throughout the Western world in common law countries. There are signs that this is changing: comparatists are focusing more on matters of evidence nowadays than they did in the past. In addition, jurists see that national legislators, courts and legal scholars are devoting more attention to evidentiary matters. This increasing attention is not limited to common law countries.

### 3.1 A comparative perspective

As we mentioned at the outset, the present contribution is the product of the combination of two different perspectives: comparative legal studies of criminal procedure and interdisciplinary studies of evidence and the law of evidence. This section offers some preliminary remarks on comparative law. Section 7 will define and explain some basic notions of the theory of evidence.

Comparative law not only satisfies curiosity, it is useful as well. It provides additional knowledge about other legal possibilities, enabling us to avoid mistakes or to adopt better solutions in practice elsewhere. (It inspires creativity in theory and practice. Last but not least, it generally helps us to better understand the system we have been educated and/or trained in.) In many sciences comparison is an essential element. This is the case in pure science and scholarship; it is also the case in the applied sciences such as criminalistics. Fingerprints are a good example. Criminalistics accepts the

7 Pradel op. cit., p. 13.
Chapter V: Comparative Law

axiom that there are virtually no two identical objects in many domains and that individual weapons (or bullets, tools, fingerprints or DNA-profiles) are unique. Vast population studies in the field of DNA, for instance, support this principle.

The situation in comparative law is not very different: we assume that no system of law is identical to that in another state. For this reason, comparative projects generally concentrate on finding similarities and differences. Finding similarities as a rule means finding "look-alikes". For jurists and legal scholars who are not well-versed in comparative law, some conclusions offered by comparatists seem awkward.

For example, some three or four years ago, the issue of negotiations in the pre-trial stage of criminal proceedings arose in the Netherlands. Many jurists and legal scholars approached the debate from the assumption that plea-bargaining does not exist in the Netherlands. From the standpoint of written law they were absolutely right: neither the Dutch Code of Criminal Procedure nor Dutch case law mentions plea-bargaining. However, the operation of the "opportunity principle" (the principle of prosecutorial discretion) in criminal procedure allows the prosecutor selectively to determine which cases to bring before the court. Legislation created the 'transaction' which makes it possible to dispose of certain cases out of court, providing the defendant accepts the terms of settlement proposed by the prosecutor. We can therefore conclude that the Netherlands does not have 'plea-bargaining' as such, yet it does have a look-alike. This is not as surprising to a comparatist as it is to a nationally-orientated lawyer.

4 Concepts

The concepts addressed here need to be explained with more than the usual precision in writing about criminal procedure. The words "evidence" and "proof" are words used in common parlance as well as in legal language. Evidence and proof are usually treated as synonymous. It is probably true that these words can be used interchangeably without any loss of meaning for about 80% of the time, but in the remaining 20% of cases these terms have widely differing connotations. Proof is variously used to refer to a test, a final decision, a process of convincing, and so forth, and evidence is used for hard evidence, traces, materials used as proof. This distinction is important. Another rather common concept in English legal language that has no well-known equivalent in continental languages is the term 'inference'. An inference is a logical consequence of earlier premises.

Much misunderstanding exists about the term 'admissibility' of evidence. I feel that admissibility is a concept that does not fit well in civil law sys-

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tems. This has to do with the fact that the common law countries tend to regulate the presentation of evidence rather than the decision itself, whereas civil law systems do the opposite. For this reason, I find the translation into French as recevable incorrect. I prefer to leave the term untranslated, but if translation is preferred, I believe that Pradel, who uses the term admissibilité in French, offers a better alternative.  

Treatises on evidence in English tend to distinguish between relevance of evidence and materiality of evidence. Relevance is a concept belonging to the science of logic: every issue or piece of evidence is relevant that contributes to rendering a proposition more or less probable. Materiality is a legal concept rather than an analytic concept: evidence is material when it can be related to the probandum, that is when it legally matters for the things that have to be proven. Materiality is therefore linked to the probandum which is in turn linked to the substantive (or material) law, and to the various crime definitions in particular.

5 Comparative studies on the law of evidence in criminal cases

This paper does not present a detailed overview of the different systems and their peculiarities. This would not be possible because of the constraints of time and space, but there is another, better, reason: several comprehensive studies have been published in recent years. All of these works devote attention to the law of evidence, but those by Walter Perron and Jean Pradel are the most comprehensive and the only ones to focus solely on evidence. These works support my conclusion that certain evidentiary principles are generally accepted: (1) the prosecution bears the burden of proof; (2) probability beyond reasonable doubt; (3) presumption of innocence.

This indicates that the abstract principles, do not differ greatly across borders. Here we mention only the presumption of innocence with some of its consequences: (a) the prosecution bears the burden of proof of guilt and (b) the State has to prove its case against the accused to a high degree of probability (beyond reasonable doubt). The differences between countries

9 See Delmas-Marty et al. Procédures pénales d'Europe, op. cit.
10 Pradel op. cit.
11 See the already quoted work of a writers group under the direction of M. Delmas-Marty (What kind of criminal policy for Europe?, The Hague 1996) (Germany, Italy, France, Belgium, England and Wales.), and also the study edited by W. Perron (Die Beweisaufnahme im Strafverfahrensrecht des Auslands [Hearing Evidence in Foreign Criminal Procedure], Freiburg 1995), the special issue of the Revue Internationale de Droit Pénal under the editorship of J. Pradel et al. and also the study by J. Hatchard et al. (Comparative Criminal Procedure, London 1996). Apart from the studies mentioned above, we mention the book under the editorship of C. van den Wyngaert (Criminal Procedure Systems of Europe). This book contains an analysis of 13 systems in twelve countries: Scotland is treated as a separate jurisdiction.
Chapter V: Comparative Law

concern details of legal rules, of specific doctrines, and of national case law. The *Revue Internationale de Droit Pénal* and other international journals, comparative law journals in the main, publish many detailed studies and general reports based on surveys designed to obtain information about aspects of the law of evidence (e.g. expert evidence or hearsay) or allied subjects, such as trial procedure or the treatment of witnesses (especially intimidated witnesses) in different countries. Most of the available studies are based on a combination of literature reviews and reports prepared in response to a questionnaire. In a sense the methods used are empirical. What we lack are empirical studies of day-to-day practice. Forensic psychologists have performed many studies on the cognitive capacities of people, especially witnesses, but mostly in experimental settings. Few empirical studies have focused on evidence at case level in practice. I will come back to this when I discuss some recent modest attempts at case by case comparison.

6 Theory I — The legal contexts

Comparative law has been a serious scholarly enterprise for about 100 years. In studying theoretical aspects, many legal scholars have tried to relate different systems on an abstract level. Without going into detail, I would like to draw attention to several interesting examples of this kind of research: J.H. Merryman investigated what he calls "the civil law tradition"; M. Cappelletti examined, among others, trends in responsibility for decisions by officials in the judiciary in different countries; M.R. Damaška developed an analytic framework for examination of the different emphasis placed on matters of evidence in common law and civil law countries, and K. Zweigert and H. Kötz came up with the idea of families. Damaška's work bears the most relevance for a discussion of evidence and the law of evidence, since he focuses on that special area of the law. In his famous book *The Faces of Justice and State Authority*, Damaška develops a matrix of four fields based on two distinctions.

On the one side he puts the contrasts between a tendency in the court system to emphasize conflict solving as opposite to a tendency to implement state policy. On the other side another distinction is mentioned: the


distinction between coordinates and hierarchical studies of the court system.

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At about the same level of abstraction, but focusing not only on the procedural system in which adjudication takes place, I have developed the idea that one of the most striking differences between continental and Anglo-American systems of law, at least in classical fields like civil law and criminal law, might be the degree of emphasis placed on procedural or substantive law and the functions attributed to them. In civil law systems the tradition of developing laws on the basis of abstracts, concepts and principles that have been set apart in a general part of a codification assumes a logical anteriority with relation to of substantive law over procedural law. The latter is therefore perceived as 'mere application'. This emphasis on substantive law coincides with the importance of legislation as the primary means of developing and/or establishing the law.

By contrast, the common law tradition places more emphasis on case by case development of the law. According to tradition, procedural law should include guarantees of justice, and substantive law is primarily the product rather than the basis of procedure. As I have written elsewhere, these traditions reflect broader cultural differences: those steeped in the civil law tradition tend to reason from the abstract to the concrete. Treatises on any one of a wide variety of subjects will proceed by first putting forward general principles and then going on to derive concrete aspects from them. The following example illustrates this well.

You need only observe negotiations between a small group of Frenchmen and another group of Englishmen to perceive the difference. You will note that after hours of negotiations the French are satisfied to have drafted a fairly precise text on a rather abstract level. By the time the French are content that their work is done and are beginning to think about food and wine, the English will have started renegotiating the many, many aspects of the written draft, asking an endless round of questions about details ('What if...?'). This difference in approach is fundamental. Maybe it will fade in time as a result of frequent exchanges of ideas and co-operation, but today this difference is still perceptible.

Let us return to the models or frameworks: continental systems of law could be labeled 'substantive dominant' and common law systems 'procedural dominant'. Granted this kind of labeling bears an element of arbitrariness. The same applies to Damaška's model. These models can, nevertheless, be useful tools, helping us to understand the differences. The problem is that such an approach is very abstract. The big advantage of higher levels of abstraction over descriptions of concrete phenomena and details is that we can perceive patterns that we would never discover from a closer vantage point. A helicopter view of the countryside or the city enables us to see other things than we would on a drive in the country or a walk through the streets. There are famous examples of photographs taken from the air of landscapes that reveal prehistoric traces that had previously gone undetected. Abstract models of law help us to better understand where the law is headed. Tendencies can be articulated and laid bare. For example, Damaška's matrix makes it possible to show that the introduction of mediation or consensual forms of procedure brings a continental system of procedural law closer to conflict resolution.

This brings us to another issue: the thesis that the emergence of alternative forms of procedure will automatically lead to a shift in emphasis from substantive law in the sense of traditional codification in civil law countries to procedural law. What can be said of codified law does not essentially differ from the shift in emphasis from abstract substantive dogma to a more concrete approach. The disadvantage of abstract theories is that they say little about concrete instances.

Civil law systems are showing increased attention to evidence and the law of evidence. Although evidence has often been neglected in common law systems, the common law countries traditionally have more legal rules of evidence and slightly more fields of scholarship devoted to evidence.

The construction of abstract schemes and distinctions stems from problems of classification. It is important to understand that it is not so easy today to develop a definitive classification of legal rules, cases, principles and concepts. Even in the German tradition, where scholars like to relate principles and rules to a kind of fixed order of values (feste Wertordnung), scholars today have relinquished the idea of finding or developing some sort of ultimate indisputable classification.

Not only comparative law is important here. The behavioral and social sciences have become important in the study of evidence. In recent decades these disciplines have taught jurists much more about the law than they used to know. Those schooled in the behavioral and social sciences

examine the law in action from day to day, rather than in the legal textbooks, Codes or Supreme Court decisions. Today, combining insights from those disciplines and comparative law makes it possible to gain better insight into the complexity of legal systems. Application of the combined approach to the examination of procedural law enables us to discern various levels.

We need to distinguish four levels of procedural law in order to compare the way law works in practice:

The first level is what is usually referred to as ‘black letter law’: the rules laid down in authoritative texts like treaties and legislation.

The second level is the degree of discrepancy high courts allow between the written law and the law in practice, as well as how high courts refine the system. This level of the law commonly reflects the case law of a court of cassation, especially in countries with the cassation system.

The third level of the law is the level of practical guidelines, court customs and so on. Although the law at this level is not limited to the case law of high courts, it is still normative: district courts within a single country may differ slightly in their court customs. Nevertheless, standing practice can be binding in effect.

The fourth and last level is the law in day to day practice from a more empirical point of view. Within the European context this refers to the way the Strasbourg Court hears individual complaints. The EHCR in Strasbourg looks only at what actually happened. It examines an alleged violation of human rights, say alleged police brutality to a suspect, paying no heed to the rules and principles in effect at the other three levels. The Court will note a violation of human rights only if the applicant has suffered a detriment as a result of an act or omission; it does not consider the quality of that nation’s legislation.

Working with these four levels in comparative criminal procedure classes, I have observed some interesting differences. The French traditionally regard only the first two levels as law in the strict sense and depict levels three and four as “mere practice”. For students from the UK it is difficult to see exactly where the first, second and third levels differ hierarchically. They probably feel confused about the position of traditional common law rules which originated centuries ago.

This approach enables us to show that the almost total acceptance of hearsay evidence in Dutch criminal procedure is not the consequence of the

16 Rules may be codified in one country and be part of the case law in another.
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Code of Criminal Procedure, but a product of the case law of the Dutch court of cassation. Working with levels allows the researcher and the practitioner to give a much more precise picture of the law in a country.

7 Theory II – evidence theory: New Evidence Scholarship

7.1 Hybrid nature of the law of evidence

The way in which jurists and legal scholars set about analyzing the law is one obstacle to a proper understanding of the law of evidence. They begin with rules and combine them with concrete cases and so forth. They often perceive the rules as exhaustive, feeling that these can be refined by other rules, but seldom recognizing that some rules are implicitly assumed. In the law of evidence in all modern Western legal systems, rationality and the rules of sound empirical methodology and logical reasoning are presupposed. They can be found only partly in the rules of evidence established by law. The rules governing evidence, together labeled the ‘law of evidence’, are hybrid in nature. On the one hand they reflect those rules of proper methodology and logic, on the other hand they reflect common legal values. The general pre-legal concept of proof is already a normative concept. It is related to rules of methodology and logic. We talk about ‘valid’ reasoning and not ‘true’ reasoning. Proof cannot be true, only its results in certain contexts can be true. The law picks up this pre-legal concept, this pre-legal normative concept, and combines it with typical legal concepts in rules of an ethical-legal nature. This leads to the hybrid nature of the law of evidence: on the one hand the vast methodological and logical part which is related to reliability and on the other the hand, the part related to the protection of human values. The law of evidence therefore has a methodological and logical side, and an ethical normative side. The problem with traditionally educated jurists and legal scholars is that they are used to dealing with ethical normative rules and phenomena in most fields in which they are working. They find it difficult to understand that the normative character of the methodological-logical part is completely different. The ethical-normative part is subject to discretion in the sense of options and in arbitrary decisions. The methodological-logical part is not. The idea of ‘free appreciation’ of evidence is too often confused with ‘discretion’, at least by lawyers and legal scholars in civil law systems. Such a connotation leads to serious misunderstanding about the nature of the facets of the law of evidence, even the hidden facets. The absence of detailed regulation does not mean no rules exist. Which rules are perceived to be legal rules of evidence and which ones not is another question that arises. The distinction made here can also be used to explain the difference be-

17 Discretion means that the decision-maker has an option: the court can impose imprisonment or a fine. Free evaluation of evidence is not an option: if the court finds that a piece of wood fell from an apartment building, it does not have the option of establishing that it fell from the bottom to the top of the building.
between unreliable evidence and illegal (illegally obtained) evidence. For a proper understanding of the law of evidence, it is essential not to confuse these categories even though it is not always clear in complicated cases which side to take.

7.2 Evidence and the law of evidence

An important distinction was developed by two American scholars at the end of the nineteenth and the beginning of the twentieth century. J.B. Thayer and J.H. Wigmore were well aware of the difficulty their students had understanding the rules of evidence so they developed the following approach to teaching the law of evidence: they started a course on evidence without the rules laid down by law, using examples of daily problems of establishing facts. Only after many, many exercises in reasoning about evidence, did they introduce the rules of evidence. This is a useful method for continental legal education as well.

The development of new thoughts on evidence did not stop with Thayer and Wigmore. There has been a worldwide revival of evidence scholarship during the last twenty years in particular. Four directions can be discerned in the current thought and research known as ‘New Evidence Scholarship’:

- The first is the application of probabilistic models and methods to problems of legal evidence.  
- The second is the more or less solistic approach to evidence, like that found in a concept of stories or narratives. Here the focus is on the story presented to a decision-maker which makes it plausible that the probandum is true.
- The third is the application of argumentation theory to problems of legal proof.
- The fourth is the attention to enhancing cognitive aspects of proof (eyewitness testimony, but also decision-making by jurors or judges).

Of course, combinations of the different approaches exist: in fact, most examples of modern evidentiary theory are interdisciplinary and transcend nationality.

8 The law(s) of evidence revisited

Comparatists interested in similarities and differences between rules governing evidence in different countries usually pay little attention to daily

18 Thayer was Wigmore’s predecessor at Northwestern University, Chicago, IL.
19 There are two main lines: the Bayesian and the Pascalian. See L.J. Cohen, The Probable and the Provable, Oxford 1978.
practice. It is only in the last couple of years that another, complementary, approach has emerged in comparative law. Symposium participants are sometimes given the same case vignette and requested to decide the case according to the law in their own jurisdiction. This exercise produces decisions resembling those that would have resulted had the case actually been adjudicated. I have participated in this kind of exercise on several occasions and never fail to be struck by the fact that the outcomes are really much closer to each other than one would predict from the differences on a more abstract level of the legal systems involved. I think this is very instructive for comparatists, legal scholars and practitioners: other factors may be better determinants of the outcome of concrete cases than the law alone. This may have to do with many unresearched aspects of law in action. For this reason we should not ban social and behavioral sciences or disciplines such as logic and probabilistic theories from the province of law.

Analyzing the English law of evidence, William Twining stresses that the law of evidence resembles Gruyère, a cheese with big holes. He uses this metaphor to explain that the law of evidence is incomplete from a legal point of view. It does not include all existing rules of evidence. Studying the law of evidence using a combined comparative legal and interdisciplinary approach shows how very true this is. Similarly, law in general can be perceived as reflecting an ethical minimum and the law of evidence as a hybrid combination of an ethical minimum and a methodological minimum. When people from different applied disciplines, for example criminologists or forensic psychology, think about the law of evidence, they commonly suggest that we perceive more rules as legal rules, for instance by putting them into legislation, than a jurist would prefer to do. Here we may contrast the option of the methodological minimum to the methodological maximum: I prefer to see the law of evidence as a methodological minimum.

The question arises in what way and to what extent different legal systems are comparable and compatible with respect to the law of evidence. My thesis is that in the Western world and certainly in the European Union, the goals (rationes leges) of all systems are similar: starting from the principle of free proof, all systems tend to include most forms of evidence. The rules governing evidence have a tendency to ban only categorically unreliable or illegal (illegally obtained) evidence. More popularly put: everything is allowed, with exceptions. In common law systems the rules of evidence

23 Thus: also incomplete in logical/methodological respect.
24 Delmas-Marti (footnote 11), p. 523. The authors are mistaken in making a contrast between the hearsay rule as an exclusive rule and the ‘Prinzip der Unmittelbarkeit’ as an
tend to take the form of rules governing presentation of evidence, whereas in continental systems of law rules of evidence consist of rules governing decision and motivation. This means that the principle of free proof which is the point of departure in all systems is also elaborated in a different way: in common law systems free admissibility of evidence during presentation of evidence at trial, and in civil law countries the free evaluation of evidence by the decision-maker.

9 Comparable and compatible? — One law of evidence?

9.1 EHCHR — constitutionalisation and convergence?
Many consider the European Convention on Human Rights and the case law of the European Court of Human Rights as vehicles towards a more efficient cross-border compatibility of legal systems. They are certain to have one effect: the extremes will disappear in the case law of the Strasbourg Court. Caution is nevertheless advised: the Strasbourg Court has emphasized on several occasions that the law of evidence is basically a matter for national legal systems rather than for the Convention. The view of the Strasbourg Court here is particularly narrow, confined to human rights, if and how they are respected in the treatment of people as suspects, witnesses or participants in the process in some other way. The Strasbourg Court therefore is interested only in violations of ethical legal principles such as procedural fairness. The court does not examine the actual reliability of evidence. As for the difference between the methodological and the ethical-normative aspects of the law of evidence, the impact of Strasbourg case law will be limited to the latter. This does nothing to alter the fact that the impact of the case law is such that all of Europe tends to move in the same direction and indirectly this will of course also be reflected in our views on the law of evidence. Compatibilisation and even harmonisation of those common aspects of the law of evidence tied closely to empirical reliability are not all that far off: we share most of the rarely articulated aspects of evidence and the law of evidence. We already have much in common that makes reasoning and fact-finding pretty much the same throughout Europe.

9.2 Relevant dimensions of criminal law?
Three dimensions of criminal law are relevant here: the international dimension, the interdisciplinary dimension and the dimension of different areas of the criminal law. It is probable that we are on our way towards more generalities in international and interdisciplinary aspects, while there is a tendency towards differentiation in the law of evidence in the various

areas of the criminal law and criminal procedure (growing awareness of differences in proving rape and murder, for instance). We are also making more relevant distinctions between child witnesses, intimidated witnesses, victims as witnesses and so on. The same applies to expert evidence: the difference between the psychologist, accountant and forensic scientist is becoming more relevant in the law.

9.3 The era of the expert

This leads to the final point in this chapter: the growing number of forensic experts involved in the investigation and adjudication of criminal cases and the development of an increasing variety of forensic specialties may in the future lead to an even greater dominance of expert evidence. This means that in the primary function of the administration of justice interdisciplinarity will appear on a wider scale and at a fundamental level. This will, without a doubt, become a very important aspect of the law of evidence in the future.

My prediction is that legal scholarship and practice cannot avoid becoming more frequently and profoundly concerned with the work of experts from an enormous variety of applied disciplines. We are already confronted with increasing differentiation in expert witnesses. This will soon be the case in expert evidence as well. With the need to focus more closely on expert evidence and the involvement of experts in the investigation and the adjudication of criminal cases, the law (from the fourth level upwards to the second or first level) will reflect this differentiation. In the near future one expert will differ considerably from another in a legally relevant way. Although most legal systems (both in legislation and in case law) currently treat most experts under the same regime, we will probably see this change. There will be separate and varying legal regimes for forensic accountants, forensic psychiatrists, forensic historians, and forensic natural scientists. As a consequence of this growing differentiation, the actors in the legal system will have to defer to experts and will prefer to be advised by a variety of experts. This will give the national legislators and courts an opportunity to explore the possibility of developing the law in the various countries in Europe in the same direction. Forensic expertise and its legal regulation may emerge as one of the areas of evidence law where harmonisation and unification are closest.

10 A program for the future

Due to the hybrid nature of the law of evidence, it is for the most part not the case law of the Court in Strasbourg or legislation that brings the laws of the various countries closer to each other (convergence). In the law of evidence the general common underground of sound reasoning and the

rules of logic and methodology perform this function. As was briefly mentioned before, this aspect is only partially reflected in the legal rules of evidence articulated in the legislation and case law in the different countries. In order to get a better founded and more precise picture of the comparability of the different systems, as they are practiced, it is necessary to study law in action more closely. One example of what has so far proved to be a very enlightening expedition is the work currently being carried out by the research group on Forensic Expertise and the Law of Evidence. This international group of mainly legal scholars aims to provide a detailed account of how the Dutch criminal justice system deals with complex cases, especially those in which forensic experts are involved. This work is still in progress, but I am able to mention a few of the tentative conclusions: the Dutch criminal justice system, like the English and American systems, can be considered a mature criminal justice system. Even a mature system has strong and weak spots. One strong point is the precision with which the system handles cases in the area of mercy killing, euthanasia, etc. Here the system is very precise and very careful. The reason can be found in the written decisions and is very convincing and most exact.

There is at the same time a weak spot in the system, which becomes apparent in cases in which the police and the other actors in the system lack sufficient experience. They sometimes make methodological mistakes and as a whole the cases are not dealt with very carefully from the point of view of evidence. Examples can be found in the area of sexual abuse cases. I would not dare to say that as a rule cases in this area are dealt with in a ‘lousy’ manner, but it does happen and we can point out examples. To benefit fully from this kind of case study research into law in action, one needs parallel studies in other countries.

11 Conclusions

Three conclusions can be drawn:

1. From a comparative perspective, the national rules of evidence are incomplete, tending to exclude categorically unreliable or illegally obtained forms of evidence.
2. The continental and common law systems of law with respect to evidence are comparable: they share identical rationes legis: Only the point of application varies: the common law systems regulate the presentation of evidence rather than the decision on evidence.
3. The case law of the European Court of Human Rights is a major factor in harmonisation or compatibilisation of the law of evidence. Nevertheless, on the ground of fact-finding perceived as the primary function of the criminal process and actors, so much generality already exists

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that in spite of the supervisual variety of rules the situation is quite re-assuring for the advocates of a greater European unity.

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5 Organisation and Regulation of Expert Evidence

Lia van der Westen

Harmonisation or compatibilisation of the scientific areas of forensic expertise depends not only on the forensic methods employed. There are considerable differences between countries in the way in which forensic scientific services are organised, in utilisation of the results of forensic examinations and in the regulation of expert evidence.

This contribution compares the organisation of expert evidence, the way in which the decision to seek forensic assistance is made and other regulations related to forensic work by experts, as well as the role of the police and the forensic laboratories in crime investigation and presentation of evidence. We will address two topics insofar as they are relevant to harmonisation of forensic expertise:

- The organisation of the police and the forensic laboratories
- Regulations concerning experts

1 The organisation of the police and the forensic laboratories

Generally the organisational structures of the police and the forensic laboratories have developed historically and depend on the size of the country and the system of government (e.g. unitary system, federal state). New administrative insights have brought forth new organisational structures resulting now and then in major changes in organisations. The reorganisation of the forensic laboratories in England and Wales and the reorganisation of police in the Netherlands into regional forces are examples that come to mind. The organisational structure is not of essential importance to the performance of forensic expertise as long as it does not affect the decision to initiate if an expert on the organisation as well as the

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1 This contribution is based on the responses to the following questions:
Organisation of the police and the forensic laboratories: Twenty-seven completed questionnaires were received from 13 countries: Austria, England, France, Germany, Malta, the Netherlands, Poland, Portugal, Russia, Slovakia, Spain, Sweden and Turkey.
Regulation of expert evidence: Twenty-four completed questionnaires were received from the same 13 countries. The questionnaires were filled in by police officers, laboratory personnel and two prosecutors.

2 In the Netherlands, under the police organisation up until 1993 the Gemeentepolitie [Municipal Police] were responsible for policing in the larger cities and the Rijkspolitie [Constabulary] for policing in the smaller town and in the rural areas. As a result of the reorganisation, the police organisation comprises 25 regional forces that have a large degree of independence and in addition one special national force.
(im)possibility in relation to this organisation of serving as an impartial expert.

The responses to the questionnaire have been examined from these perspectives.

1.1 Organisation of the police

The respondents from four countries indicate that their countries only have one police service, divided into regions and/or districts. The other countries have several police organisations existing alongside each other. The organisation of these forces is determined by region in a number of countries. For example in Austria the Bundespolizei in the larger towns, the Bundesgendarmerie in the rural areas and the Stadtpolizei in addition in some towns. France and Spain have military police forces as well as civilian police forces: the Gendarmerie and the Guardia Civil, respectively.

Where the police are organised on a regional basis, the scene of the crime determines which police organisation has the legal authority to investigate. Competency is fixed by law in Spain, France and Turkey. According to the competency rules in Portugal, it is the seriousness of the crime that determines which force has legal authority to investigate: the judicial police investigate serious crimes and the other two police forces in Portugal (those operating in the larger towns and in the rural districts) are responsible mainly for security and public order, although they do investigate less serious offences.

It is unclear from the responses to the questionnaire whether regulations work well in the day-to-day investigation of offences. As J.F. Nijboer notes in his contribution a simple inventory and comparison of the legal regulations provide too little information to get insight into the effect of such regulations. Analysis and comparison at various levels are essential for an adequate picture of the working and application of legal regulations.

1.2 The organisation of forensic expertise

In most countries the forensic laboratories are situated within the police organisation, which generally falls under the Ministry of the Interior. In some countries the forensic laboratories are part of the Ministry of Justice (for example, Portugal and the Netherlands) and the laboratories of the military police forces of the Ministry of Defence (for example Spain and France). A combination is also possible. Poland and Spain have laboratories responsible to the Minister of Justice in addition to ‘police’ laboratories which are responsible to the Minister of the Interior. Laboratories

3 Malta, the Netherlands, Poland and Sweden.
4 The respondents from these three countries did not indicate how jurisdiction is regulated.
5 Johannes F. Nijboer, The significance of comparative legal studies in this chapter.
whose chief task is (bio)medical investigations are sometimes part of a university, as in Slovakia and Turkey.

Several countries with a central forensic laboratory have regional laboratories connected to the central laboratory. Malta and the Netherlands have one central forensic laboratory.

Responses to the questionnaire indicate that in some countries local police departments specialised in forensic work, have technical units that carry out certain forensic investigations independently, without being able to speak of a police laboratory. In England, for example, the police perform fingerprint comparison, chemical examinations of fingerprints and simple document examinations. The police in Austria perform preliminary drug analyses, simple document examinations, toolmark examinations and traffic accident investigations.

So far insufficient information has been received from some countries to make it possible to distinguish between the work done by police technical units and that carried out by the specialised forensic (police) laboratories.

As the present analysis will reveal, the responses show that the specialised police technicians who perform relatively simple or routine forensic examinations are not regarded as 'experts' in all countries. This is related, among other things, to the quality of the police technician, his training and the possibility of influencing the technician's objectivity.

As we mentioned above, which laboratory performs which examinations depends principally on the location of the crime and the organisation to which the forensic laboratory belongs. The availability of the necessary equipment and whether or not a laboratory can perform such an examination are other factors of importance. The Austrian respondent reports that the police laboratories mostly perform the simpler examinations that are possible with a microscope and microchemical tests. Only the central, better equipped, laboratory can employ chemical and physical methods of analysis.

A very different distinction is made in Russia. According to the respondent there, the police laboratories are 'specialised in operative search information'. The forensic (justice) laboratories can, as a result of forensic examinations, prepare expert reports that can be used as opinion evidence in the courtroom.

From the responses to the questionnaires received so far, we conclude that forensic findings obtained during the criminal investigation may be introduced in criminal proceedings without being replicated by another laboratory in another organisation (a justice organisation) provided they meet the standards set for the forensic work in question and provided the examiner is qualified.

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6 See Lia van der Westen in chapter II of this volume.
7 The respondent from Russia indicates that samples must be preserved for later analysis.
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2 Regulations concerning forensic experts

An effort has been made to gain insight into the existing regulations - legal, jurisprudential or other - that apply to or influence the functioning of the forensic expert. We looked at regulations concerning the decision to seek the assistance of experts, who can be considered an expert and whether an expert must have certain qualifications. The influence of the European Convention for Human Rights has already been covered at some length by Petra van Kampen in chapter III. For this reason these aspects will not be discussed in the present contribution.

The following aspects of forensic expertise will be addressed here:
- Who requests forensic assistance?
- What qualifications must the expert have?
- What requirements must the report meet?

2.1 Who requests forensic assistance

As a rule the assistance of a forensic expert is requested if this is expedient or advisable because the investigators involved (police, prosecutor and judge) do not possess sufficient expertise in the area at hand. In most countries this applies during both the criminal investigation phase and the prosecutorial phase. Formally it is the court or the prosecutorial office who appoints an expert when a special examination is deemed necessary. In some countries the appointment of an expert is also possible at the request of the defence. In England (common law system) both parties (prosecution and defence) may seek forensic assistance. The responses to the questionnaire indicate that generally it is the police who seek the assistance of an expert during the criminal investigation phase of proceedings and a higher authority, the prosecutorial office or the court, who does so during the prosecutorial phase. Respondents in Germany and Turkey mention that the police enlist the assistance of an expert on the basis of jurisprudence. This is also possible in the Netherlands.

In our study we also asked whether certain expert examinations may be performed only upon court order if the findings are to be used as evidence in criminal proceedings. In Russia a court order is necessary for all types of examination destined to be used for evidentiary purposes. In Spain the Instituto Nacional de Toxicología of the Ministerio Justicia performs fo-

8 See Petra van Kampen in this volume.
9 The respondents from Austria, Malta, the Netherlands, Poland and Sweden explicitly mention this possibility.
10 Respondents from Poland, Spain and Sweden do not indicate whether the police may request forensic assistance.
11 Although Dutch law does not grant the police the authority to request forensic assistance, in practice this has been the rule rather than the exception for many forensic examination, based on jurisprudence. From February 2000 new legislation is effective which allows the police to seek forensic assistance under certain circumstances.
rensic examinations solely upon court order. In some other countries certain types of forensic examination are subject to restrictions. In Austria, for example, a court order is required for examinations which result in the destruction of evidence. Law in Germany and the Netherlands currently requires a court order for comparative DNA analysis. In the Netherlands an amendment has been introduced that is designed to extend authority to order a DNA analysis to the public prosecutor. A similar regulation is currently "under discussion" in France. In Portugal a court order is required when the forensic examination cannot be carried out by a public organisation or an officially recognised expert. The Portuguese respondent reports that an expert must be utilised for drugs tests. Slovakia requires a court order for analysis of 'dental health status'.

Generally the competent authorities determine which expert to assign. The respondents from Austria and Sweden report that the defence may request a particular expert. In Germany the Kriminal Technische Abteilung of the BKA (the Federal Crime Office) and the LKA's (state crime offices) decide which forensic specialist to call in. In Russia the decision as to whether an expert is to be appointed and, if so, which expert, is made by the management of the forensic institute or laboratory. In the Netherlands the forensic laboratory, as well as the court, may decide which expert will perform the examination. Responsibility for internal case allocation rests with the heads of the various departments. DNA analysis is an exception. In this case the court decides which expert should perform the analysis. In Portugal experts are appointed by the court or the prosecutor only if the public expert lacks the specific expertise required and if no names are on the list of recognised experts. One of the respondents from Malta indicates that the parties may not choose an expert themselves. This apparently holds in France as well. It is striking that none of the respondents reported the possibility of the defence to have experts perform a scientific examination.

Another interesting question is whether the legal regulations grant the defence or an expert of the defence the right to attend the scientific examination performed by the appointed expert or to inspect the results of this examination. The respondents in France, Germany and Malta report that the defence is not allowed to be present at scientific examinations. Although the other countries do have a regulation of this kind, the defence seldom exercises this right.

Permission to inspect the results of the scientific examination depends for the most part on the decision of the court. Inspection of the results by the defence is possible in Russia, only if the person who is to have access to this material has been appointed as an expert and in Sweden only after the police investigation has been closed.

12 The respondent did not indicate which areas of expertise are included in this group.
13 See Lia van der Westen in chapter III of this volume.
2.2 Qualifications set for forensic experts

Training plays a key role in evaluating the quality of experts. The survey asked for information about training requirements for forensic experts. The answers to this question given by persons from the same country show a striking disparity. Perhaps the question as phrased has been interpreted differently by the jurists and the forensic experts. Respondents seldom mention or clearly explain differences between regulation by law, regulation by jurisprudence and regulation within the profession. At any rate it is clear that the profession (generally the laboratories themselves) in most countries has set standards.

Who determines whether someone is a qualified expert for the task is an important aspect that concerns both the training and the quality of the expert. Formally it is the court (and sometimes the prosecutor) in all countries. The organisation that employs the expert is an important indicator. Institutionalised laboratories (as in the Netherlands) set internal standards for those who serve as forensic experts. A scientist may serve as expert for his laboratory only if he meets the laboratory’s standards. The final decision is up to the court (or jury) that evaluates the reports prepared or the testimony given.

Some countries (France and in theory Malta) have a list of recognised experts. In other countries experts are formally appointed without compiling a public register of names. A few examples follow. In France the ‘court of appeal’ (cour d’appel) compiles and maintains a list of experts. Although it is the trial court in Germany that makes the final appointment, forensic scientists may put themselves forward as experts. One German respondent also mentions a “special office which rules the organisation of certain professions”, such as the Chamber of Industry and Commerce, as the entity that assigns the status of permanent expert. Reference is made to the BKA ‘regulations for experts’. In Malta the Criminal Code gives the Minister of Justice the power to appoint a permanent expert. The court is not bound by these suggestions and in practice it is the court in Malta that nominates and appoints experts. According to the respondent from Malta this nomination is sometimes made upon the advice of the director of the forensic science laboratory. In the Netherlands and Poland too, ultimately it is the court that appoints permanent experts, for example upon recommendation by the laboratory. In Turkey the prosecutor as well as the court may make such appointments and the expert’s superiors can recommend a

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14 It is striking that the Austrian and German respondents who are of the opinion that legal regulations exist are jurists; the others are forensic experts.
15 The responses to the questionnaire are too unclear on this point to permit conclusions to be drawn. The responses given by respondents from the same country are also discrepant.
16 See Lydia Bestebreur et al. in this volume.
17 The responses to date indicate that there is no list of official forensic experts or a system of pre-nominated forensic experts in Russia, Slovakia, Spain or Sweden.

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nominee. The respondent from Portugal reports that both the nomination and the appointment is the prerogative of the Government.

It is of course very important to examine the training and quality of the expert before adding him to a list or calling him an officially recognised expert. In most countries attention is paid to the forensic scientist’s experience and special knowledge of the area of expertise (sometimes stipulated; in Austria a minimum of five years of experience is required). Experience in a laboratory is specified in Turkey. The respondents from Germany and Russia also mentioned impartiality, objectivity and competence as requirements. Experts in Austria and Turkey must have a certificate or pass an exam. Spain requires an academic degree.

If no names of experts are found on the list for a certain area of expertise, non-listed experts are often sought. In most countries it is not necessary to be on the permanent list or to have been appointed in order to serve as an expert witness. If there is no known expert within a certain field of expertise an expert from an allied area of expertise is sought. In France forensic experts must be placed on the list of experts before they can perform in this capacity.

The respondent from Poland reports that an expert witness can be removed from the list if he ceases to meet the quality requirements. It is unclear from the responses received from other countries whether similar regulations exist. Nor were we able to learn whether formal appointments are made for the duration of a specified number of years. There are internal controls in place in forensic science institutes to monitor the functioning of experts. These institutes do not allow employees who no longer function well to prepare reports so that these scientists can no longer serve as an expert in the name of the institute. In the Netherlands formally there is no regulation to withdraw an appointment as an officially recognised expert. Because the formal appointment before the court remains the scientists can continue to act as expert witness in the private sector.

Is the organisation to which an expert belongs of importance? This question aims especially to gain insight into a police officer’s possibility of serving as expert. The responses to the questionnaire indicate that in most countries a police officer as expert is not at all problematic. In a number of countries police experts are subject to restrictions. In Germany, for example, an expert who is directly involved in the investigation of the crime is open to challenge. In several countries police officers may serve as experts only in certain specified areas of expertise. The situation in Malta, where certain police officers can be appointed as experts, is an example: these police officers can prepare expert reports only in the fields of photography, fingerprints and ballistics. One of the respondents from Malta notes that some defence counsel have questioned the objectivity of experts from the police laboratory. In France police officers may serve as experts only in
certain areas of expertise: crime scene investigation, fingerprints, impressions and traffic accidents.

In other countries police officers may act as experts only if they have been appointed. This is the case in Austria, Slovakia and Portugal. They then assume the role of expert and are no longer operational police officers. The training and certification of police officers will become increasingly important in the assessment of whether an officer possesses true expertise.\(^{18}\)

Ultimately, it is the court in most countries that decides whether someone can be considered an expert.

2.3 **Reporting requirements**

Does the report have to meet certain requirements and, if so, what requirements have been set for statements or reports?

Malta, the Netherlands and Sweden have no such regulation. Legal regulation exists according to the respondents at any rate in Austria, Germany, Poland, Portugal, Russia, Slovakia and Spain.\(^{19}\) Frequent mention is made of internal regulations and quality requirements.

As for the content of the report, most respondents indicate that the report should follow a logical structure and that it is imperative that there is a logical relation between the conclusion and the descriptive part of the report. The Polish respondent mentions other essential elements of the report: the name of the supervising forensic institute, the date of the examination and the time required for the forensic work, a description of the reason for the investigation (this is not a formal requirement) and a conclusion.\(^{20}\)

The quality of the expert is of great importance in establishing the value of a statement of findings. Is the scientist a true expert in the area in question? Is the expert acquainted with the latest scientific developments in this area? These are questions that are crucial for the court evaluating the report. Does the court enquire about the expert's qualifications? In France and Portugal it does not and in Slovakia it does not usually do so. Although the respondents from several other countries mention this possibility, it is not clear whether this always occurs, is common or is possible.

2.4 **Concluding remarks**

Without better insight into day-to-day practice in the various countries, it is only possible to sketch the framework within which the expert operates in theory. Legal regulations are not always applied in practice. Optimal

\(^{18}\) See Lia van der Westen in chapter II of this volume.

\(^{19}\) Responses from some countries are unclear. The questionnaire asked the respondent to indicate the location of any existing regulations. One respondent replied: "In all bookshops."

\(^{20}\) The information received about the other possibilities (the method used, reasons why this method is used and justification of the statistical basis of the conclusion) is insufficiently clear and cannot be included in this analysis.
legal comparison necessitates study of various levels, from legislation to daily practice.²¹

The information assembled to date indicates that a number of areas related to the functioning of experts in criminal proceedings are regulated differently and in part inadequately. Moreover in a number of countries the limited number of qualified experts is a problem. Under the influence of discussion about quality assurance and accreditation there is much discussion going on about many subjects in the European Network of Forensic Science Institutes (ENFSI) in particular. As a result, the forensic institutes themselves are devoting more attention to training. The ENFSI Education and Training Committee, active for some time now, will establish standards of competence for forensic scientists. In addition, a framework will be designed for training of experts. This framework will be filled in and updated by the other ENFSI working groups to ensure 'state of the art' performance. Once this framework is ready, harmonisation of training requirements in ENFSI countries will be a fact, at least as far as the minimal requirements are concerned.

Regulations related to training of experts are for the most part internal requirements without legal foundation and court approval. A legal framework within which experts operate must create additional prerequisites so that only fully qualified forensic scientific experts – including those from forensic institutes that do not belong to ENFSI and not organised experts – can provide forensic assistance. A critical court, prosecutorial office and defence, must keep forensic experts alert to the quality of their functioning.

²¹ Johannes F. Nijboer, The significance of comparative legal studies in this chapter.
Chapter VI

Data-Base, Exchange of Data and Forensic Expertise
1 Introduction

Collecting is as old as looking for coins along the road to Rome. People have systematically accumulated objects of similar form and purpose since time immemorial. For example, in biology in the past large collections of mounted animals were used for identification (determination) of the species and for the purpose of teaching. Many of these collections have been preserved and are now on display—usually in part—in museums.

Another example of collecting, but then in the forensic setting, is the systematic collection of fingerprints. Use of the fingerprint is very old. As early as 1800 BC writers ‘signed’ documents with their fingerprint. It is highly unlikely, however, that it was then known that this ‘signature’ afforded an infallible means of personal identification. As far as we know the fingerprint was used to reveal an individual’s true identity for the first time in 1858. Interest in modern fingerprint identification dates from the time Sir William Herschel was working in India as a government official. He was in charge of paying pensions and encountered problems when making these payments because many people falsely claimed to be entitled. He subsequently introduced the fingerprint to help determine whether the individual laying claim to the pension was in fact the rightful claimant. In the years that followed more and more research was carried out to determine the possibilities of using fingerprints to identify people. Thousands of fingerprints were systematically collected in order to establish whether the papillary ridge arrangement on every finger and thumb of every human being is unique.

About 1900, dactyloscopy was officially introduced as an aid to crime investigation and around the world fingerprints found at crime scenes or obtained from suspects were added to the collections. As time went on, these collections became larger and larger. Because the papillary ridge arrangement on fingers and thumbs contains patterns found in the fingerprints of many individuals it is possible to classify the collection into various groups for ease in filing. If a police detective wanted to know whether a certain fingerprint belonged to a suspect, this print had to be compared by hand with other prints in a particular group. In the Netherlands comparisons were carried out by hand until 1990. Since that year, HAVANK, the Dutch version of the Automated Fingerprint Identification System, has

2 Het Automatisch Vinger Afdrukkensysteem Nederlandse Kollectie (the Dutch automated fingerprint collection). HAVANK is Dutch for computer software derived from AFIS (Automated Fingerprint Identification System). Havank was also the pseudonym of a Dutch author of detective novels.
enabled much quicker comparison and identification of prints. The HAVANK system makes it possible to compare 6000 fingerprints per second.

Thanks to the development of the computer it has become possible to file, maintain and compare huge collections of data (databanks). A databank is a large collection of data stored in a computer and organised for rapid research and retrieval by another computer located at a distance via a telephone line or a special datanet. Sometimes a databank is available to the public but in other cases access is restricted to a specific group of individuals. The stored data can be very diverse. For instance, the database containing case law of the European Court of Human Rights can be accessed via the Internet.

The use of databases has become very important in the forensic sciences as well. The first paper in this chapter, written by Christophe Champod and Olivier Ribaux, outlines the importance of forensic identification databases in crime investigation and criminal proceedings. The authors describe identification databases, which make it possible to associate evidence with an individual; DNA and fingerprint databases are the best known examples. Shoeprint and ballistics databases afford the possibility of associating the evidence, but do not link the traces directly to an individual. Forensic databases play an important role in the judicial system at large.

Storage of identifying elements in databases makes it necessary to protect the privacy of the individuals concerned. Diana Alonso Blas, who writes about privacy and the use of databases in the forensic disciplines, stresses the importance of finding a balance between the need to collect data for the purpose of crime investigation and the need to protect privacy. Not everything that is technically possible is desirable. It will be up to the legislator to find the proper balance.

The development of the computer is certainly not the only remarkable technological advance of the last century. Means of transportation, too, have continually improved, making it possible to travel huge distances rapidly. This increasing internationalisation of society has, however, also resulted in more transnational crime. Chantal Joubert and Hans Bevers describe how international co-operation between police forces from various countries has taken shape since the Schengen Implementation Convention came into force. The international exchange of police data and forensic expertise is an important tool in the fight against international crime.

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4 See http://www.dhcour.coe.fr/hudoc/
Police co-operation within Europe is currently subject to many rules; countries are reluctant to delegate authority. In recent years, however, the need to co-operate has increased greatly, at least among forensic laboratories in Europe. Recently steps have been taken to establish a central European databank of automotive paints. Marjan de Boer explores whether this co-operation should go further and proceed towards creating a central European DNA database. She examines the desirability of such a database and looks at possible categories of offenders whose DNA profiles might be stored there.

Society’s social and technical development last century has also resulted in “generalisation” and with it, society has become blurred. By this we mean that society places people in a particular (high-risk) group based on certain characteristics. This trend is beginning to exercise increasing influence over criminal law. In “Actuarial Justice, Risk Management and the Modern State” Malcolm Feeley looks at perspectives in criminal law today. He notes that classical criminal law is rooted in a belief in the autonomy of the individual. The rise of the industrial society and the welfare state, however, has had a revolutionary impact on the law. Criminal law is moving away from morality towards policy. This policy is not designed for individuals, it is designed to minimise and manage the risk of danger in society.

Marjan de Boer
2 Forensic Identification Databases in Criminal Investigations and Trials

Christophe Champod and Oliver Ribaux

1 Introduction

Databases and other computerised tools have proliferated in recent years in police work and forensic science. However, the police and the judicial branch have experienced difficulties in integrating in a coherent way the advances of information technologies. Indeed, despite repeated success in specific developments (such in the fields of DNA or fingerprints), the criteria for the use of computer systems in the context of law enforcement are often poorly defined. This has been largely due to the legal, organisational and economic constraints limiting police and legal activity. The complex nature of criminality has also been a factor.

The current challenge is to design powerful architectures for information systems, integrating computerised tools and capable of dealing with an ever-evolving criminality while respecting the constraints created for the protection of citizens' rights. Forensic science has a key role to play in this challenge. It is well-suited to machine processing of scientific evidence, the basic indicators of sources, modus operandi, etc.

A broad variety of computerised tools developed for different forensic domains (fingerprints, footwear marks, DNA, etc.) function under quite similar principles, but curiously enough their use varies in different legal and organisational systems. Some questions that seem obvious for certain types of evidence are never addressed to others. One key item has appeared with the introduction of national DNA databases in various countries since doubts have been expressed on the probative value of forensic evidence obtained from such databases: "Does the fact that a suspect (or object) has been located through the search of a database weaken the evidence as a means to support identification?" Such a question has rarely been put in the literature concerning fingerprints, even though computerised databases have been used by numerous agencies from the 70s forward.

Other questions raised by the process call for further investigation: how to gather information to make proper inferences and apply them to casework are two of the challenges at hand. We will attempt to show that the

problems originate in the improper integration of such databases within
the broader information system of the police and the judicial authorities
rather than in the computer systems themselves. Databases must be seen
as tools used in a process which begins with the crime scene investigation
and ends with the criminal trial. This leads to new questions such as: “Do
we use the potential of forensic identification databases to our full advan-
tage?” and “What are the needs of investigators with regard to identifica-
tion databases?”

After focusing on the identification process as a general mechanism, we
will describe forensic identification databases, trying to seize their generic
character across the different sub-fields of forensic science. The overlap
between these two aims will provide a framework for the discussion of spe-
cific examples concerning the potential and roles of several well-known
forensic databases.

2 The identification process

The ultimate aim of the identification process is individualisation.² For
forensic scientists, individualising an object means that it is possible to
distinguish this object from all other possible objects. Philosophically,
identity of source cannot be known with certainty, and therefore must be
inferred. As Kwan has demonstrated, a hypothetical-deductive method
(assisted by methods of statistical inference) provides a reasonable expla-
nation of how forensic experts proceed in inferring identity of source.³ The
identification process can be understood as a process of reduction from an
initial population to a restricted class or ultimately to a single individual.
Depending on the type of evidence, the initial population comprises ob-
jects or persons. Two factors therefore enter into combination:

1. a relevant population of persons or objects defined by size (and/or other
particularities); in other words, each member of this population of
sources can be seen as a possible source.
2. a reduction factor based upon the combination of concordant charac-
teristics of determined selectivity. In fact the reduction is proportional
to the rarity or frequency of random match occurrences of the observed
characteristics in the population under consideration. As Kwan puts it:
“It is not the sheer rarity of a feature that is important as rarity of that
feature with respect to the set of suspected sources being considered. It
is important to stress that rarity is relative to the situation at hand.”⁴

³ Kwan, Q.Y., Inference of Identity of Source, PhD of Criminology, Department of Forensic
⁴ Ibid., p.73.
The size of the relevant population can be conceived as an open set framework or as a closed set framework. In the open set framework the population at large comes under consideration, for example, all living persons on earth or all produced objects on earth are considered potential sources. In the closed set framework the number of objects or persons is restricted to a specified set of suspected sources (for example by taking into account other evidence limiting the putative sources).

The identification process (either in the open set or closed set framework) remains a narrowing-down process, reducing the number of possible sources or hypotheses. Showing that all alternative hypotheses that could explain the phenomenon at hand can be excluded will validate the hypothesis that a designated suspect or object is the source. To avoid error, the hypothetical-deductive method makes it imperative that all plausible hypotheses regarding possible sources be taken into account.

The importance of a judicious selection of criteria cannot be overemphasised. The criteria lie in five areas (excluding consideration of cost): distinctiveness, high intersource to intrasource variance, known variance in time, normalisation (standardisation) and independence. These are ideal requirements not necessarily encountered in practice. When individualisation is the goal, the object must be defined by a unique set of properties (a set that can be attributed to no other source).

A useful logical tool — the Bayes' theorem — helps to assess forensic evidence by integrating identification factors of differing selectivity and other uncertain data in order to attain a probabilistic perspective on events and participants in the event. The application of this theorem to identification evidence has been suggested by Finkelstein and Fairley. Both closed set and open set situations can be handled in a Bayesian framework; the open set simply constitutes a specific situation.

The following events can be defined:

1. Some background information has been collected prior to the forensic examination. For example, data from a police investigation, eyewitness statements or data from the suspect's criminal record will typically contribute to I. This information will thus reduce the number of potential suspects or objects that could lie at the origin of marks.

E. The evidence: feature agreement (without significant differences) between a mark left on a scene and a person or object under examination has been reported.


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ID The mark has been produced by the person or object under examination.

ID The mark has not been produced by said object or person, and another unknown person or object is at the origin of the mark.

Proper definition of the two exclusive hypotheses (ID and ID) requires consideration of the context of the case (the defence's strategy for example); they are not always as straightforward or exhaustive as the above definitions might lead one to believe.

The Bayes formula (1) below shows how prior odds on ID are modified by the evidence E to obtain posterior odds on the issue being examined (ID versus ID).

\[
O(ID \mid I, E) = \frac{Pr(E \mid ID, I)}{Pr(E \mid ID, I)} 
\]

Readers unfamiliar with the Bayesian approach in forensic science may turn for information to the chapter in this volume by Marjan Sjerps entitled: Pros and Cons of Bayesian Reasoning in Forensic Science.

This logical tool allows an appreciation of how events interact mathematically. It clarifies the position of the scientist as well as that of the judge and defines their relationship provided an understandable interface is available to them. The scientist should focus on the likelihood ratio whereas the court is dealing with prior or posterior odds.

The application of the framework is not uniform for the various sub-fields of forensic science and also varies according to the circumstances under which the identification process is carried out. It largely depends on the nature of the evidence. Sometimes a large collection of data is available to assess relevant probabilities, while in other areas it may be difficult to identify the relevant discriminating features or to gather data, so that judgements are made on the basis of experience and more qualitative and heuristic reasoning processes.

The identification process is related to the use of forensic databases of a certain type called identification databases. To describe the latter, we shall attempt to define a general mechanism common to all such systems.

3 Forensic identification databases

Traditionally, the areas of forensic science are defined by the type of trace with which they deal. Databases have been developed for separate domains (biological evidence, fingerprints, marks, trace evidence, etc.), generally automating tasks that were previously carried out manually on large col-
lections of data. In current implementations, databases vary in terms of queries, tasks and results, whereas similarities – as well as specific difficulties – can be perceived for several fields in order to specify common roles of databases.

3.1 Identification databases

It has already been established that databases should be classified through the basic inferences they help to perform. Databases in forensic science are of various types and may be defined in terms of their objectives and the types of evidence treated. Our purpose here is to focus on forensic databases which provide the ability to associate recovered evidence with an individual (or a list of names of potential candidates) either directly or indirectly. Some examples of such databases are given in the following table:

<table>
<thead>
<tr>
<th>Type of evidence</th>
<th>Products available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingerprints</td>
<td>Automatic Fingerprint Identification Systems (AFIS) or Automatic Fingerprint Recognition systems (AFR) – FAED in French. Several companies are producing such systems, notably Morpho (SAGEM group, France), NEC (Japan), Printrak (USA) and TRW-Cogent (UK).</td>
</tr>
<tr>
<td>Shoeprints</td>
<td>Some police forces have designed databases which associate inked standards of suspect's shoe soles with the name of their owner.</td>
</tr>
<tr>
<td>Projectiles (land and groove impressions) and cartridge casings (breech face and firing pin impressions)</td>
<td>Two systems are leading this market: IBIS (Integrated Ballistic Identification Systems, produced by Forensic Technology Inc., Canada) and Drugfire (collaboration between the FBI and Mnemonic Systems Inc., USA).</td>
</tr>
<tr>
<td>Handwriting</td>
<td>Two databases are well known: FISH developed by the BKA (Bundeskriminalamt, Germany) and SCRIPT developed by the Netherlands Institute for Forensic Investigation (NIFO).</td>
</tr>
<tr>
<td>DNA profiles</td>
<td>Various countries have set up databases of DNA profiles. An overview of the current state of development can be found in Forensic Science International, vol. 88, no. 1, 1997.</td>
</tr>
</tbody>
</table>

The identification databases support some processes of analogy current among law enforcement practitioners.\textsuperscript{11} The identification of second offenders is the best known form of this basic scheme. The purpose is to retrieve in a new situation or a new case known offenders from their prior records. The search for links between cases is another basic activity that falls within this framework.\textsuperscript{12} The most common illustrations of forensic databases supporting these interfaces are fingerprints and DNA databases. Potentially, all the other marks transferred, or information left by the offender (from clothing or accessories) can be exploited in a similar way.

### 3.2 Database process

#### 3.2.1 Collect / Enter / Retrieve

The use of a database actually begins at the scene, where data are found and collected. At this stage, the problem is one of transforming data (for instance a given mark) into digital or symbolic form allowing comparison within the database. This operation can be long and complex, sometimes not fully executable by machine.

Collection of data at crime scenes is always incomplete and imprecise. Furthermore, collected marks are often fragmentary, even when the investigation is careful and thorough. The object that may have caused the trace can undergo transformation, and marks or prints can be blurred or distorted. Marks can also originate in events occurring prior to or following the investigated event. The match between recorded data and collected evidence (in digital form) is thus generally only partial. The examiner will always need to interpret a limited set of possible solutions at the end of the chain.

In current practice, a broad range of retrieval and matching algorithms using various techniques (statistical, based on neural networks or the product of artificial intelligence) are employed to compare data automatically. The design of algorithms must assure that the result of a search is a limited ranked list of possible matches; this avoids laborious, time-consuming and often fruitless comparisons. These algorithms are the heart of the process; generally they are not published for legitimate economic reasons. DNA and fingerprints provide extreme examples; the problem of matching two DNA markers is a very simple one from a computer perspective; the match is generally determined by an ‘exact’ agreement between the DNA compared. A retrieval algorithm can be implemented directly with simple computer development tools. Comparing fingerprints is a far more complex task, due to the quantity of information to be treated and the nature the data. In

\begin{itemize}
  \item \textsuperscript{11} Locard, E., \textit{L'enquête criminelle et les méthodes scientifiques}, Paris: Ernst Flammarion 1920.
\end{itemize}
some fields, like shoeprints, and in the case of projectiles and cartridges, partial matching processes may be effective; in other fields difficulties arise in overcoming the complexity underlying collected information: handwriting and voice recognition are two examples.

3.2.2 Interpret

Once a restricted set of possible candidates has been established, a list is transmitted to an examiner who is generally a forensic scientist specialising in the specific type of evidence under examination. His role is to compare the mark with each potential candidate on the list and to answer the following questions for each candidate:

- Is there an association between the mark and the suggested candidate?
- If so, how selective is this association?

These questions are clearly the same as in the identification process. The examiner will then proceed as if each candidate were suggested by a police inquiry in the absence of any and all forensic identification databases. Although the search in the database may seem to duplicate the identification process, practice requires that for each candidate the examiner ignores the selection process and attempts to identify in an open set framework. Hence, the way the ‘suspect’ comes to the analyst is of no importance to him. But the circumstances in which the identification process is required can vary in the course of the investigative process beginning with the initial criminal investigation and ending with the criminal trial. The needs can be highly different, as will be established below.

4 Integration of the results

The results of a query must be transmitted to an external partner (police officer, judges, forensic scientist, etc.) through an adequate interface. We are suggesting that this last step be carried out as a function of the context in which the database has been used. Forensic science data are used and interpreted within a broad range of inferences made in the course of crime investigations and criminal trials. A ‘three chapter paradigm’ has been suggested by Kind; it is helpful in understanding the reasoning processes involved. For the most part, the investigator proceeds in an inductive way (the problem is to find the offender using the different pieces of information) until he is convinced of having found the right suspect, whereas a more deductive attitude prevails in the preparation of the trial and the trial itself. If we subscribe to this point of view, the way forensic data must be integrated differs, depending on whether they apply to crime investigation, criminal

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trial or more complex inference patterns such as crime pattern analysis. The needs are different and therefore, the interface between the different partners should be different, in particular when using databases. We will therefore consider two main contexts for the use of identification databases: the context of the criminal trial (or the standpoint of the fact finder) and the crime investigation context (or the standpoint of the investigator).

4.1 The database process and the criminal trial

It is not our intention to provide a critical assessment of the various oral or written statements made by forensic scientists to courts. Such critical assessments can be found elsewhere. It is obvious from our description of the identification process that we favour the expression of the strength of identification evidence in a likelihood ratio (LR; in a numerical or verbal form). We will first review common statements made by forensic scientists, placing them in the Bayesian framework in order to emphasise its generality. Then we will review the literature treating the issue of the value of the evidence at trial obtained from a forensic identification database.

4.1.1 Individualisation

A definition of individualisation is given by Tuthill: “The individualisation of an impression is established by finding agreement of corresponding individual characteristics of such number and significance as to preclude the possibility (or probability) of their having occurred by mere coincidence, and establishing that there are no differences that cannot be accounted for.”

Thus the size of the population under examination is systematically set for reasons that remain obscure to its maximum (open set framework). This practice is even required in some fields: fingerprints, shoeprints, tool-
marks, firearms and DNA (according to recent FBI policy). The establishment of positive identification is an opinion: a statement of probability expressing that the chance of observing another object or person on earth presenting the same characteristics is zero. From a strictly Bayesian point of view, the examiner is never in a position to identify. But, it can happen that the LR in favour of the identification appears so high that the individualisation is declared whatever the prior odds might be. In instances such as these, no contrary evidence will ever shake the expert's certainty. It is first and foremost a statement on the posterior odds, in addition the decision to round off the numerator of posterior odds to 1 is obviously highly subjective, it is tantamount to a judgement on moral certainty. The danger of error is considered so small that the philosophical limits that human beings usually observe with respect to knowledge and truth simply evaporate.

4.1.2 Qualified opinions
Where the evidence is only corroborative, it is necessary to conclude in a way that reflects this statistical uncertainty. In some forensic fields (fingerprints, toolmarks, shoeprints), practitioners have voluntarily excluded probability statements — other than exclusion and positive identification — from their conclusions. In these fields, all pieces of evidence falling between these extremes is classified as 'inconclusive'. But in the fields that recognise qualified opinions (or corroborative opinions), examiners have expressed their conclusions in pragmatic terms. The following qualifications are among the most frequent: "very (highly) probable, probable, possible". Their respective meaning lies in their power of reduction from an initial population in an open set framework. These conclusions are simply statements on the posterior probabilities!

The above description depicts the ideal open set framework constantly reaffirmed in the literature. No doubts are ever expressed that the real case investigation, with its close relationships between partners (forensic scientists, prosecutors, investigators, and others), induces an identification process working in a closed set framework.

4.1.3 Random match probabilities or frequencies
When statistical data are available, forensic scientists often disclose them to characterise the selectivity of the features studied. For example, if a biological stain recovered on a crime scene is analysed and matches the

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DNA profile of a given suspect, the scientist will often report the probability of the random match of such DNA profile (or frequency $f$) in the relevant population. This estimate $f$ provides the denominator of the likelihood ratio. The numerator is either ignored or systematically and implicitly set at 1.

4.1.4 Consequences of a database search
The crux of the matter is as follows: will the strength of the evidence be different for the court if:

1. the association with the person is the consequence of a search through a database dedicated to the type of forensic evidence under examination (here called the database setting), or if
2. the association is based on a name provided by a conventional police inquiry and then selected for reasons unconnected with the forensic evidence (here called the inquiry setting)?

The literature on the subject focuses mainly on the recent DNA databases. In our discussion, we will bear in mind that the arguments pertaining to DNA evidence are theoretically applicable to any identification evidence.

Let us imagine that the forensic science laboratory maintains a database of DNA profiles of known offenders and that our suspect's name comes up because the profile of a crime stain matches his profile and that of no other candidate in the database. How would such a situation affect the evaluation of the evidence?

We take as our point of departure the release of the first report of the National Research Council on DNA technology22 (hereinafter NRCI). This report recommended that the markers used to evaluate a match probability must be different from those used in the DNA database to identify the suspect (NRCI, p. 124 and 129). However, this recommendation has proved difficult to implement in forensic practice (insufficient DNA traces in the evidence, desire to use as many loci as possible to exclude other suspects in the database). The second NRC report on DNA evidence23 (hereinafter NRCII) takes the view that generating a suspect by a 'trawl' through a database of the DNA profiles of many individuals will reduce the evidential strength of the DNA evidence. According to recommendation 5.1, when the suspect is found in a search of DNA databases the random match probability should be multiplied by $N$, the number of persons in the database.

(NRCII, pp. 133-135 and 161). This recommendation has been discussed at length in the literature. The main point is that the framework adopted by the NRCII is inadequate, and leads to illogical conclusions (for example, when the database is extended to the whole suspect population). We note that this opinion is not without exception: Morton defends the statistical reasoning of NRCII but favours the alternative suggestion (also made in NRCI) of using additional markers whenever feasible. But when a Bayesian perspective is adopted, it is easy to demonstrate that the likelihood ratio for such evidence is (slightly) higher than the expected likelihood ratio calculated where the suspect was not selected through the DNA database, but in the inquiry setting.

The likelihood ratio can be expressed as follows:

\[ LR = \frac{Pr(E | ID, I)}{Pr(E | ID, I)} \]  

(2)

According to Balding and Donnelly, in the database setting under consideration, the evidence consists of:

- \( E_C \): the DNA profile of the trace (crime stain);
- \( E_S \): the DNA profile of the suspect (including the observation that there is a match);
- \( O \): no other individual in the database matches the crime stain.

The \( LR \) can be developed as follows:

\[ LR = \frac{Pr(E | ID, I)}{Pr(E | ID, I)} = \frac{Pr(E_C, E_S, O | ID, I)}{Pr(E_C, E_S, O | ID, I)} \frac{Pr(O | ID, I)}{Pr(O | ID, I)} \]  

(3)

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29 Balding, D.J. and P. Donnelly, Errors and Misunderstandings.
LR1 will be slightly greater than the likelihood ratio calculated for the inquiry setting (generally expressed by the reciprocal of the relative frequency in some population). In fact, the supplementary known information that other profiles in the database do not match the crime stain profile may lead to a (slight) revision downwards of the estimates of the frequency of the profile, compared to the estimate for the inquiry setting.

LR2 shows the database search effect. If we define $\bar{A}$ as the event that the individuals in the database other than the suspect are not the source of the crime stain, Balding and Donnelly have shown that $LR2$ can be simplified (under two legitimate assumptions) as follows:

$$LR2 = \frac{1}{\Pr(\bar{A} \mid ID, I)}$$  \hspace{1cm} (4)

The denominator denotes the conditional probability that the source of the crime stain is not included in the DNA database, given that the suspect is not the source. This probability also depends on available background information. In any case, $LR2$ will be greater than 1, hence the likelihood ratio in the database setting will be greater than the $LR1$ obtained for the inquiry setting.

In conclusion, there is almost no difference between the two settings in terms of the strength of the DNA evidence. This may appear counterintuitive. Common sense would lead us to believe that it is not surprising to obtain a match between the suspect's profile and the crime stain where many people are examined through an extensive database search. The argument is correct if we state that it applies to prior (and therefore to posterior) odds but not to the likelihood ratio of the evidence. As Robertson and Vignaux have argued, human intuition gives the correct answer to the wrong question.\(^3\) If we follow NRCII, we answer the question: "What is the probability of obtaining a match by carrying out this search procedure?", whereas forensic scientists must answer the following question: "How much does the evidence increase the probability that it was the suspect who left the stain?".

The difference between the database and the inquiry settings lies in a potential difference in prior odds. For example, in the absence of a DNA database, the number of exclusions of potential sources through inquiry may be large and the simply being able to access a DNA database may lead police to rely entirely on such a search. In this scenario, the prior odds may

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be different for each setting: strong in favour of the defendant in the database setting, and strong against the defendant in the inquiry setting. This concern is of primary importance for the court but is irrelevant to the forensic scientist whose attention remains focused on the likelihood ratio. Here it is of primary importance to clearly state the size of the database when it is used as a method for selecting the suspect since it could prove to be a decisive factor in determining prior odds.

4.2 Database process and crime investigation
The use of databases in criminal investigation has still wider implications. The problem of the investigator is to find the right offender(s) for the case under investigation through the collection and treatment of varying pieces of information. Despite the difficulties in describing the reasoning processes involved in the course of the investigation, there is evidence that the typical policeman works on 'promising' sets of individuals to which he feels the offender may belong (a frame defined by Kind). He scrutinises this frame in order to reduce it by a process of elimination. Of course, the frame is mainly made of people innocent of the crime and who have nothing to do with it. To lie within the frame of the investigator can cause some inconvenience to the individuals concerned, and can even endanger their private lives (interrogation, surveillance, telephone tapping, among others). Nevertheless, the practice is generally at least implicitly, accepted by society at large. It is not perceived as shocking, since it is assumed that the investigator has a high degree of professionalism in dealing with people and suspects, except of course by some people who have long belonged to the group of likely suspects in the eyes of the police.

The investigator constructs his frame in a great variety of ways, ranging from intuition and experience to structured methods; here we will make no attempt to give an exhaustive account of them. However, it can be said that the use of database recording previous experiences, names of convicted perpetrators, or other types of information is quite common, as in the following scenario adapted from an actual case.

4.2.1 Scenario 1
During the night, a burglary was perpetrated in a village. A witness identified a yellow car, of a particular model, in the surroundings of the victim's house. The investigator searched the appropriate database and found one hundred owners of this model in this region. As the case was an important one, the investigation started with this frame of individuals. Despite certain uncertainties as to the information at hand (was the car really yellow, had the model been correctly identified by the witness, etc.), it occurred to no one to question the validity of such an investigative process. Although

at least 99% of the people in the frame are innocent, the approach would generally not be considered as shocking. Transposing the process using a forensic database leads us to consider new situations rarely encountered in practice as the following scenario will illustrate.

4.2.2 Scenario 2
A crime has been committed in a house (perpetration). A print of very poor quality has been recovered and secured. Normally no database search would be made since the print contains insufficient detail for obtaining a valid identification. But let us suppose that the print is entered into the system that turns up a list of candidates. The examiner assessed the potential associations and found a set of prints showing matching features with no dissimilarities. The investigator in the field will probably not be informed of the name of the compatible individuals because the print appears insufficient for positive identification (or on the other hand precisely because two or three matches were found (in a collection numbering to the thousands))!

The mechanisms used in both examples are very similar, but the way the forensic data are exploited is quite different. The first example only involves common-sense reasoning and most people are comfortable with this; forensic data, however, are seen as scientific and technical. It is considered unacceptable by many practitioners to supply any answer other than definite identification or one allowing a very high degree of certainty. This attitude is clearly incompatible with the real methods of crime investigation. We are not suggesting that the question has been inefficiently handled in any given case, as for the most part it all depends on the personal relationship between the investigator and the forensic scientist. The system itself poorly formalises this type of interface, and when it does so, it systematically leads to net loss of information.

The argument demonstrates that the forensic identification database is under-exploited in generating hypotheses in the course of criminal investigation. This is a general trend throughout forensic science. The extent of this phenomenon varies with the relevant agencies (and especially according to the relationships between the investigators and the forensic scientists) and with the type of forensic evidence involved.
Examples

Three examples of the ideal investigative use of identification databases follow. These examples will not be associated with real practice which varies considerably across countries and organisations. Some procedures may be followed routinely, others may be excluded according to whether policy is explicitly or obscurely explained.

Generally each identification database will yield a list of potential candidates; these results may be used in different ways, as examples 1 to 3 will illustrate:
1. Submitting the list to a forensic scientist specialised in the field for conclusive identification or a qualified opinion on each candidate. Such an assessment will generally be a subjective one, based on the examiner's experience and knowledge. It is generally not directly quantifiable and is independent of the database.
2. Using the database itself to estimate the likelihood ratio associated with each candidate. In this case, the value of the LR will depend on the size of the database.
3. Submitting the list to an examiner who will then assess each candidate. When an association is found, the examiner will try to use independent statistical research (external to the database) to estimate the likelihood ratio. Here the value of the LR will not depend on the size of the database.

5.1 Example 1: Investigative use of a projectile database
In the course of an investigation of a case, a bullet is recovered on the scene. After a search in a database such as IBIS (bulletproof° module), a list of possible projectiles (connected with other known cases, names or seizures) is generated along with match values. The match value describes the respective closeness (in algorithmic terms) between the unknown bullet (land and groove impressions) and the known projectiles. The algorithm used by the system is generally not known, and match values are not directly related to statistical values describing the probability of a random match occurrence. The efficiency of the system is well-established as it will designate the correct candidate (when present in the database) in a short list with good probability. Each potential association \((i=1,...,N)\) will be evaluated by an experienced examiner, the total number of controls \((N)\) is generally fixed by policy, but may vary according to the case or the examiner. For the examiner, each candidate is perceived in a manner reminiscent of the process of inquiry. The specialist adopts the open set framework. If a known projectile is found to match the unknown bullet, the examiner will conclude (depending on the striation agreement between the questioned and the known projectile) identification or reach a qualified opinion ('possibly', 'probably', 'very probably' fired from the same weapon). A conclusion can be disclosed to the investigators even if a
qualified opinion 'only' is reached. We note that the examiner considers the evidence in an open set framework, whereas the investigator usually operates in a closed set framework. Again, to bridge the gap requires the use of likelihood ratios, which can be broadly assessed by the specialist in accordance with his knowledge and experience.

In the area of future developments, we propose using the efficiency of the match algorithm to assess the $LR$ associated with a match value. To obtain such figures, one would need to calculate the ratio between the probability densities for each match value ($MV$) when considered under proposition $ID$ or under proposition $\overline{ID}$

$$LR = \frac{p(MV | ID)}{p(MV | \overline{ID})}$$

Because of the well-known efficiency of such systems, the $LR$'s can be expected to be quite high. In terms of interface, then, it would be possible to disclose the likelihood ratios to the investigator. We note that the latter interface does not necessarily require firearms specialists, as the potential associations will not necessarily be assessed through a process involving expertise. The consequences of this approach are a higher throughput of information with an obviously lower level of certainty compared to the expert approach in the use of such databases. For investigative purposes, the level of uncertainty that can be viewed as acceptable in generating hypotheses may be quite low and highly case-dependent. The objective is clearly to generate hypotheses for further verification.

Obviously, the question of redundancy (going through the identification process twice: once through the computerised database, then by the examiner) is eliminated in favour of a computer system evolving towards an expert system. Its reliability must be tested and controlled. One possible direction is to adapt the Turing test to such a system compared to forensic scientists specialised in the field.32

5.2 Example 2: Investigative use of a shoe impressions database

In the course of a burglary investigation, shoeprints from one pair of shoes (left by the offender) are recovered from the scene. Manufactured features are the only ones that can be discerned; no acquired characteristic is visible on the prints (see illustration below).

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Upon returning to the forensic service, a database of inked impressions from arrested burglars is searched. Among 2465 impressions, one match (design and size) is found with a sport shoe impression (Sparx®) belonging to a known previous offender (see illustration below).

The association will be submitted to the investigator for further verification. An estimate of the likelihood ratio is as follows:

\[ LR = \frac{Pr(E \mid ID, I)}{Pr(E \mid ID, I)} \]  \hspace{1cm} (6)

The numerator is close to 1 (assuming good compatibility) while the denominator reflects the rarity of the shared characteristics. The latter probability can be supplied by the database at hand (if its population is representative of the suspect population). In the case in question, the propor-
tion of impressions showing such features is 2/2465. An upper limit of the confidence interval of the estimate may be appropriate if it is a policy to err in favour of the suspect. In any event, the $LR$ will exceed 300 which represents strong supportive evidence in favour of the identification.

Our example centers on a simple query arising in the conventional identification process. But the investigation context may involve more complex inferential schemes, for the most part unspecified. It is not possible to reduce this complexity to a single type of database query. For example, in the above scenario it might be worth checking the number of shoes belonging to the named person. The database of recovered prints can be searched for matches in an effort to associate the suspect's additional shoes with other cases and so on. Given that the schemes for interrogating forensic databases are not yet fully developed, the efficient use of such databases will depend, to a critical extend, on the integration of the tool in the police service. The forensic database should be situated locally, promoting informal exchanges between forensic scientists and investigators. In our opinion, database centralisation (at the national level, for example) results in a loss of efficiency in criminal investigations since it creates physical barriers between the investigators and the scientists (factors of time, distance or organisational procedures in reaching the database).

5.3 Example 3: Investigative use of fingerprint databases
In the course of a murder investigation, a fingerprint in blood has been found on the victim's belongings. The mark does not belong to the victim. Although the number of minutiae is limited, a search in an AFIS system is performed. After several attempts varying the manual encoding of the minutiae visible on the print, the examiner retrieves a corresponding fingerprint from a known recidivist. To assess the evidence, we will try to estimate the random match probability of such a configuration of minutiae (see the schematic representation on the next page).

The configuration is composed of a bifurcation, two lakes, (2 and 5), one island (3) and a ridge ending (4). We observe that in numerous fingerprinting practices, such evidence will be ignored or not even disclosed due the limited number of minutiae.

The statistical results obtained by research may be useful here. A computer program has been developed\textsuperscript{34} to enable the acquisition of data on an extensive sample of nearly a thousand fingerprints selected from more than 100,000 fingerprint forms. Nine types of minutiae (ridge ending, bifurcation, island, double bifurcation, hook, lake, opposed bifurcation, etc.) were taken into account along with their direction and length when defined. A model for computing an upper limit estimate of the probability of configurations was proposed and successfully tested. For the configuration in question, the upper limit estimate of the random match probability is a figure of 1 in 650000. This information (or its associated likelihood ratio) is of the utmost importance for the inquiry and the criminal trial and should be disclosed.

It is important to mention here that the current AFIS systems (or AFIS practices) sort the fingerprints that can be searched through the database according to a minimum number of visible minutiae on the print (generally 8 minutiae). This limit is a technical one at least in part, since it allows search algorithms to return the adequate candidate (where present) in the smaller list, but it also results from the need to supply definitive answers when associations are declared. That policy inevitably leads to a net loss of information in criminal investigations.

\textsuperscript{34} Champod, C., \textit{Reconnaissance automatique et analyse statistique des minuties sur les empreintes digitales}, Institut de Police Scientifique et de Criminologie, Lausanne: Université de Lausanne 1996, thèse de doctorat.
6 Conclusion

Forensic databases have their place in investigative and probative information system of the police and the judicial system. They support the crime investigator, the forensic scientist and the courts in many of their activities. Their roles have been analysed here with special focus on the forensic identification databases used in criminal investigations and trials (such as DNA, fingerprint or shoeprint). The main process used by such databases is the identification process. When viewed in a Bayesian framework, it leads to evidence in the form of a likelihood ratio. It has been shown that the likelihood ratio does not depend upon the database process itself provided the assessment of the selectivity of the evidence can be established by independent data (as in the case of DNA or fingerprint evidence). However, if the database itself supplies the data for assessing the selectivity of the evidence (for example in shoeprint or projectile evidence), then the size and quality of the database is decisive for the assessment of the likelihood ratio.

Even if the designation of a suspect by a database search has a limited influence on its value as evidence, it must be emphasised that the availability of a database to find a suspect may have considerable influence on the inquiry process. If the recovered evidence (associated with a database) is viewed as the panacea for conducting investigations, then the practice may have a drastic influence on prior odds. Constructing an investigation solely on a database search may be as detrimental to a defendant as building a case on a single reliable witness. In any case, the size of the database used must be disclosed to the fact finder.

Finally, in some identification fields, especially where practice is unfortunately focused on a dichotomy of solutions (identification versus exclusion), the identification process operates in an open set framework that destroys a useful interface between the forensic scientist and the investigator (who carries out his duty in a closed set framework). A significant loss of identification evidence can occur in such instances, whereas identification databases provide an extremely powerful tool for designating potential candidates (and hence hypotheses) in the course of the investigation. Again, adopting a Bayesian approach to the evidence permits one to bridge the gaps in the sense that likelihood ratios are completely independent of the frame and may be disclosed to the court as well as to the investigator in the field.

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3 International Exchange of Police Data and Forensic Expertise

Chantal Joubert and Hans Bevers

1 Introduction

An aspect of forensic expertise that is not often studied, is the one overlapping both the fields of forensic expertise and that of international legal assistance in criminal matters, especially cross-border police co-operation. One might even ask, whether such an overlapping exists, and in the affirmative, how often it occurs. As far as we know, there is not much information on the intensity or frequency with which forensic expertise is being exchanged by the police from one side of the border to the other, but at least it does happen. As diversified as forensic expertise may be, it is inevitable that at some point in an investigation the police in one country might need some expert information, knowing that the best or only person who may provide this specific type of expertise lives and works in another country. In that situation, the question emerges as to the legal possibilities for the police to ask this expert's assistance.

Much has been written on international police co-operation. It is not our intention to redo the work so many have done before us. What we would like to do is give a practical overview of the possible exchanges of expert data between the police forces of two countries. Before we examine each possibility, we will give an overview of the existing legal framework in the post-Schengen Europe. As far as the national implications of international co-operation are concerned, we have limited ourselves to the Dutch situation.

With the coming into force of the Schengen Implementation Convention, police co-operation in Europe has developed immensely in recent years and an overview of the existing post-Schengen norms will give an idea of how far police exchange of expert data can go. We will mention the tradi-

1 For an overview of international police co-operation, we refer for instance to J. Benyon et al., Police Co-operation in Europe: An investigation; Center for the study of public order, Leicester 1993; M. Anderson and M. den Boer, European Police Co-operation, University of Edinburgh, Department of Politics, 1994 and C. Joubert and H. Bevers, Schengen Investigated, 1996; J. Pradel and G.J.M. Corstens, Droit pénal européen, Précis Dalloz, 1999; Kloseck, The development of international police Co-operation within the EU and between the EU and third party States: A discussion of the legal bases of such co-operation and the problems and promises resulting thereof, A.U.I.L.R., 1999, 14, p. 599.
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International police co-operation as well, but only as an illustration of how police co-operation functions in other cases. Then, as we mentioned, we will make an inventory of various factual hypotheses that may occur and as we go along, we will apply the law to these hypothetical situations. In this way, we hope to give the reader an idea of the factual and legal possibilities of actual international exchange of expert data.

2 International police co-operation: a short overview of existing international frameworks in Europe

Whether it is on a cultural, social or operational level, police data exchange at the border has almost always been present along the changing borders of Europe. Almost every international organisation has taken part in the evolution of international police co-operation. The United Nations, the Council of Europe, UNESCO, the Commonwealth, the European Community, the Benelux, the Nordic Council and many others have all contributed their share of legal instruments. It is not our object here to discuss them all in detail, rather we would want to give an overview of the developments in Western Europe, mentioning only those instruments which have contributed to develop formal legal instruments.

2.1 Traditional exchange of police data

Traditionally, one can distinguish between informal and formal police co-operation. The former is primarily dependent of existing social channels, while diplomatic channels have dominated the latter. In recent years, however, efforts have been made to give informal channels more structure, for instance by embodying simple rules for data-exchange in international documents. In that sense, arts. 39 and 46 of the Schengen Implementation Convention can be regarded as good examples of formalising informal exchanges. Similarly steps have been taken to facilitate formal channels, for example by centralising the information points. In that sense, Europol can be considered a good example of a simplified framework of formal channels.

Data exchange is the most common form of co-operation in criminal matters between countries. In border regions, it is a daily reality. Informal data exchange has long been the panacea of informal contacts between police officers along the borders. In the course of time and with the increasing mobility of citizens, a need was felt for more formal lines of co-operation. These formal lines have failed, however, to replace the informal networks completely. These will probably always exist, at least for the simple infor-

2 These articles will be discussed in more details when we discuss 'the Schengen tools.'
The existing frameworks of formal co-operation outside Europe consist mostly of Interpol. In this framework, each member country has a central Interpol bureau where the police of another country may submit queries. This type of exchange is best tailored for the mutual judicial assistance between the different ministries of justice and prosecutors. Europol fits into this line of formal data-exchange. However, it is unique, as, instead of having one Interpol bureau in each country, each national unit in a country of the European Union has sent liaison officers to one central bureau, located in The Netherlands. In this central bureau, they can directly contact one another.

2.2 Schengen
On March 26, 1995 a new body of rules specially designed for the actual day to day police co-operation came into force: The Schengen Implementation Convention. Not only does this convention provide for an array of rules concerning operational co-operation, it also contains specific regulations for the police data-exchange.

The Schengen Implementation Convention, which binds all EU States except the UK, Ireland, Denmark, Finland and Sweden, contains a total of 142 articles. Schengen’s main concern is to provide rules designed to compensate for the ‘lack of security’ created by the abolition of border checks between the contracting parties. This is why it contains such rules as those on the intensification of border checks at the external borders of the Schengen area (artt. 3-8), partial harmonisation of the legislation of visas, residence permits and organised travel (artt. 9-27) and harmonisa-

3 For a clear overview of these informal police channels, see J. Verbeek et al., Politie op Internet, Kluwer 1999, p. 25 ff.
7 Note that negotiations are well underway for the British candidature to Schengen.
tion of asylum procedures (artt. 28-38). Furthermore, it expends on measures in the field of police and security (artt. 39-91).

These measures concern a number of issues: police co-operation (artt. 39-47), modernisation of some central aspects of international co-operation including the possibility of directly sending witness citations and other types of citations to their recipients in other Schengen countries (artt. 48-69), psychotropic substances (artt. 70-76) and firearms and ammunition (artt. 77-91). In addition, the Convention provides for the introduction of an international database and the Schengen Information System (or SIS) is designed to protect public order and security (artt. 92-119). In the following paragraph, we will concentrate here on those provisions relevant for data exchange between police forces.

3 The legal tools of the international exchange of police data

3.1 The Schengen tools

The Schengen Implementation Convention (SIC) foresees two situations where police data may be exchanged across the border.

Art. 39 SIC regulates assistance requests being done across the border (police A ask police B for information about a person, object or case Y). The principle is that the request and its processing must be done in accordance to national law and competence. The aim of the request may either be to prevent or to investigate a crime. However, when the requested information has been reserved to judicial authorities or when the use of coercive measures are needed to comply with the request, the request must follow the regular channels of mutual legal assistance. Furthermore, written information may only be used as evidence after prior authorisation of the judicial authorities (39 (2) SIC). In principle, the request must be done to and from designated central authorities, except in border regions where more direct lines have been convened to by agreement of the responsible ministers.

Art. 46 SIC regulates spontaneous assistance between the police on either side of an internal Schengen border (police A warns police B that Y will be crossing the border). This spontaneous information exchange must be done with the aim of preventing future offences. As above, the information must be given to the designated central authority for that country, except when provided for otherwise in border area agreements.

As mentioned above, the Convention provides for the possibility of regulating police co-operation in border areas in a more direct way, by agreement between the responsible ministers (art. 39 (4) SIC). Examples of such border agreements are the Maastricht – Liège – Luxembourg agreement

Note that in the meanwhile, artt. 9-38 have lost their practical relevance, especially thanks to the so-called Dublin Convention and first pillar measures.
(1997) and the South Limburg – Aachen agreement (1997). Both instruments work along the following general lines: Information coming from the general police registers may be exchanged directly between police officers, as long as the information is necessary for the good administration of the police task in the involved countries. Information on race, religion, sexual orientation, intimate behaviour, political opinions etc., may only be exchanged when it is not possible to do otherwise. Information kept in the so-called CID registers may only be exchanged with the authorisation of the responsible public prosecutor (Officier van Justitie).

As a last relevant Schengen provision, art. 52 must be mentioned. It allows that one Schengen State may send judicial documents directly by mail to residents of another Schengen State. Although this does indeed include witness citations, par. 3 of this provision does not allow an expert or witness who ignores such a document to be sanctioned.

3.1.1 The Dutch implementation of the Schengen tools
Most of the Schengen tools are implemented in art. 552i of the Dutch Code of criminal procedure (Wetboek van Strafvordering- Sv). This disposition sets out the workings of the actual police mutual assistance for the Dutch legal system. It signals for instance the general rule according to which all requests for mutual assistance must be forwarded to the locally competent public prosecutor (552i (1) Sv). However, when it is possible to respond to the request without resorting to coercive measures, the forwarding of the request may be left out. For the Dutch legal order, coercive measures include not only ‘force’ but also methods as telephone tapping, surveillance, monitoring a controlled delivery or an infiltration, when foreign police officers want to pursue an investigation on Dutch territory etc. In the remaining cases, when the police may give the requested information by virtue of its own authority, it is necessary to keep close record of all the given information in a special register (par. 3).

3.2 The Europol tools
Europol is a police co-operation framework where a central body, Europol, houses and manages computerised information data banks for the member States. Each member State designates or creates a national unit responsi-

9 CID registers contain personal data that must be considered criminal intelligence. We use the term CID registers for both CID registers and grey field registers, both registers being different in their degree of accessibility. The CID registers contain information about persons who are registered as potential suspects for severe, frequent or organised crime, while grey field registers contain the same information about people who are not yet registered as CID subjects. In the new text of the Act on the police registers (APR), the grey field registers will be renamed special police registers, and subdivided in temporary registers and severe crime registers (Wet van 27 mei 1999 tot wijziging van de Wet politieregisters (bijzondere politieregisters); Staatsblad 1999, Nr. 244).

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ble for managing Europol requests (art. 4 Europol Convention – EC) and sends one or more liaison officers responsible for the information exchange between Europol and his member State (art. 5 (1) EC). Third countries may also send liaison officers but this requires a treaty between Europol and the third country. It is important to make note that it is not possible for Europol or the different national units to exchange information directly.11

Europol houses three computerised data banks (art. 6 EC): An information system (art. 7 EC), a working data bank for analysis and a corresponding information index (art. 10 EC). The country providing Europol with information is responsible for the content of the information. Information may be exchanged to and from Europol in order to fulfil the Europol tasks: the prevention and repression of severe criminality.12 Information is subject to the eventual restrictions given by the providing country. In principle, information may be exchanged unless the exchange of the information may endanger the conclusion of a criminal investigation or the life and limb of an individual. Moreover, information may be held back if it might endanger the internal security of a particular State (art. 4 (5) EC). Information may also be exchanged to third countries when this is necessary for the fulfilment of the Europol tasks, but only if the level of privacy protection is adequate and according to the rules in force for third countries.

The Europol data bank for analysis is interesting for this chapter as it may contain forensic data regarding the identification of potential suspects. Indeed, the Europol rules implementing this data bank,13 adopted in virtue of art. 10 (5) par. 2 EC, enumerates the types of information that may be kept for identification purposes. The article contains an indicative list of possible information that may be kept: voice profiles, DNA analysis, fingerprints etc.

4 Hypothesis and examples

In order to add a practical touch to our research, we intend to provide an overview of situations involving both international police co-operation and forensic expertise. Although we only have some real life examples of such situations, we are aware that dozens of them may be imagined and are hy-

11 For an overview of the Europol Convention, see: J.A.B. Janus, ‘De Europol Overeenkomst’, in Ars Aequi, June 1998, pp. 597-601, as well as the relevant references in note 5.
12 Art. 2 EC states that Europol shall ‘act to prevent and combat unlawful drug trafficking, trafficking in nuclear and radioactive substances, illegal immigrant trafficking, trade in human beings and motor vehicle crimes.’ In an annex to this list, such crimes were added as illegal trade in human organs and tissues, kidnapping, racism, organized robbery, fraud, racketeering, computer crime, illegal trafficking in arms, endangered species, and money laundering related thereto.
In order to enable the study of as much hypotheses as possible, we distinguished (a number of) relevant parameters, which could – in combination with each other – create situations involving both forensic expertise and international police co-operation. In this paragraph, we will make an inventory of those situations.

Our first parameter is the expert. The expert can either be a police officer or a civilian. The question as to whether an expert is indeed a police officer or an civilian will only make a difference in the sense that in the latter case, the expert contribution or report will possibly not be in the possession of the police, who will not be in the position to dispose of it freely. However, whether the expertise sought has been gathered or processed inside the police or out, the police may obtain it at a later date.

Another relevant question is whether the police is able to get the expertise if it is not in its possession. The expert is either known or unknown by the police and the data needed for the expertise is either collected or still needs to be. If the expert is known, he will just be asked to submit the information and if he is not known, the police will have to look one expert up. If the data needed for the expertise have already been collected, the expert will only have to process it. If the data still needs to be collected, there are two possibilities: the data is either available and needs to be collected or collecting the data necessitates resorting to coercive measures.

A third international question which may arise is whether the expert could give field assistance. Two situations may arise here: The field assistance should be given on an operational level or for evidence purposes. Finally, should the expert assistance be needed for evidence purposes, there are two possibilities: Either the contribution or the expert in person is needed in court.

As we combine the categories mentioned, we get a number of different, abstract situations. Factors that may influence the outcome can be found in the question whether coercive measures have to be used to collect the data for the expertise, whether the contribution is on its way or already in the possession of the police or whether it is destined to be used in court proceedings. As we examine these factors, the situations will be clustered on the hand of possible legal consequences. For the purpose of the present analysis, we have managed to cluster the possibilities in three categories of factual situations.

Note that we have not made an inventory of expertise possibilities in this context. Since our research only concerned procedural aspects and possibilities of involving experts in one country in criminal investigations in another country, the expertise matter is not relevant for our purpose, and will only play a role in some of the practical experiences to be mentioned.
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In the following three sub-paragraphs, we will try and illustrate these schemes with three factual examples.

4.1 The police of country X ask the Dutch police for information on file
Let us imagine that the police of Nordrhein-Westfalen (Germany) have been observing the activities of a certain John D. who lives in Münster and has ties with individuals in Amsterdam. They suspect him of fencing goods, especially cameras and cam-corders, stolen from tourists in Amsterdam. The German police would like to know whether John D. is known to the Dutch police. They are particularly interested in fingerprints or photographs the Dutch police may have in their possession. As long as the information requested is needed purely in the investigation phase, the information may be exchanged. However, if the information is meant to be used for court proceedings, the exchange needs judiciary approval. If the information is in the possession of an expert known of the police, the information may be exchanged under the same conditions.

It is possible that the information is not readily available on file and must be collected or processed. In that case the exchange may take place under the same condition of finality. If the data is stocked in a CID-register, authorization of the responsible prosecutor will be necessary. If the data needed is accessible via one of the Europol databanks, the request will be forwarded to the national unit, who will in turn address the central Europol bureau in The Hague (in the case of the Netherlands, this is the Criminele recherche informatiedienst (CRI) in The Hague).

Furthermore, collecting the data may necessitate resorting to coercive measures, like taking a photograph or collecting a fingerprint of the suspect, in which case judiciary intervention will be necessary.

We can also imagine another situation: In order to improve their understanding of an offence in which voodoo or black magic seems to have played a role, the police in Germany asks the Amsterdam police, who had to deal with such cases before, for information about these phenomena. As long as this information will only be used for operational purposes (understanding what has happened in order to solve the crime), instead of using it as evidence or otherwise in a judicial procedure, the Amsterdam police may provide the foreign police with all information available.

The same solution applies to the situation where the police has to seek the information, but the information remains readily available. Here is another example to illustrate this: In order to establish how long ago a person whose body was found has died, it may be helpful to detect the kinds of insects that that may be found in the corpse. If the police of country X wants to contact an expert in this field and knows that the police in the

15 See footnote 9.
Netherlands has or knows such an expert, the Dutch police may help their foreign colleagues to get in contact with the expert. If they have relevant information available themselves, they may also forward this to the police in X, under the restriction that it will be used for operational purposes only.

In the Netherlands, there are some exceptions to this general flexibility. If the required information is kept in the CID registers, it cannot be retrieved or exchanged without the authorisation of the responsible CID-prosecutor. If the required information concerns DNA profiles that should be compared, this can only be done with the authorisation of the public prosecutor. Although the law on DNA analysis is about to be amended, the police will not have access to the DNA databank under the new law either, since it restricts the access to the prosecutor.\(^6\) Note that, besides this restriction to international exchange of DNA information by the police, there is also an impediment to invoking the help of foreign specialists in forensic DNA analysis: according to art. 2 of the DNA analysis Decree (*Besluit DNA-onderzoeken*), such research may only be ordered from the Netherlands Forensic Institute and the laboratory of Leyden University.

4.2 The German police needs expert field assistance from police in the Netherlands

This would happen for instance when the police in country X would need an expert in computer cracking, working within police in country Y. Let us say for instance that the German police came across a storage area of stolen goods, mainly cameras and cam-recorders. On the site, they found several computers that seem to have been used for some sort of administration system. The data in the computer could be important in finding out more about the fencing network. The data is indeed encoded and the computer data is evidently secured by a code. The German police knows of a Dutch police officer, expert in the field of computer decoding.

In that case, the German police asks the Dutch expert to come over to Germany. The expert would be working within the jurisdiction given to him by the police requesting his services. Although there is no legal means to compel the expert to come to Germany for field assistance, there is also no legal barrier that would prohibit such assistance. In that sense, the fact that some border regions even organise common patrols is an example to

\(^6\) *Wijziging van de regeling van het DNA-onderzoek in strafzaken*, parliamentary document 26 271 nr. 103. Note that the newly proposed art. 9 will make it possible that these databanks, which are now purely judicial, will be reformed as police registers. Besides, the Dutch minister of justice has proposed that the exchange of DNA profiles be enabled between EU member states, and meanwhile an EU Council Resolution on the exchange of the results of DNA analysis was published, which invites all member states to establish such databanks in order to enable a more efficient co-operation (9 June 1997, O.J. 24 June 1997, C 193/2).
support this theory. As long as the expert is giving assistance under the hospice of the police of the requesting country, in this case Germany, the assistance would take place without problems.

Another example, this one from the newspaper, tells the story of an unidentified body found in a Frisian city, who was shot in the head from a very short distance with a big gun, so that his head had exploded. The police asked American specialists in head reconstruction for assistance.¹⁷

However, if this assistance would be required in order to serve as evidence in court, it would probably be wise to use the mutual assistance channels, as we will see in the following sub-paragraph.

4.3 The Dutch police ask the police of country Y for information meant to be used as evidence

In their investigations on the fencing network presumably set up by John D., the Dutch police need to link the stolen goods found in the Amsterdam storage area with those found in Münster. They also would like to find out whether all these stolen goods can be linked with John D. All the clues tending to establish this link are liable to be used as evidence in the case against John D. The Dutch police has found several fingerprints and some footprints in the storage room. They ask the German police whether they have found some fingerprints the transcript of which could be sent to the Amsterdam police to be analysed by their experts. They are also curious as to whether the footprints found in Münster match those found in Amsterdam.

All of these elements are liable to be used as evidence. This means that a request for mutual legal assistance in criminal matters will be made to the competent judicial authorities, in this case the German judicial authorities. In cases where the expert should appear in person, the Schengen Implementation Convention foresees the possibility to send citations to someone directly. Refusal or omission to comply with this order, however, is not subject to any sanction.¹⁸ In this particular example, this would mean that the Dutch police could send a court order to the fingerprint expert in Germany.

In the sadly famous Tjoelker case, a young man was kicked to death by a group of drunken men. After three men were convicted, investigations against a fourth suspect were opened since footprints of a running shoe were found on the neck of the victim. With the help of a British shoe sole specialist, it was confirmed that only the fourth suspect had on shoes of the same make as those having possibly left their trace on the victim’s neck. In spite of this material evidence, the suspect was not prosecuted.

¹⁷ De Telegraaf (Dutch Daily), 9 June, 1999.
¹⁸ An exception to this concerns art. 34 of the Benelux Extradition Convention, which provides that summoned witnesses are obliged to appear at court proceedings taking place in another Benelux state.
since all witnesses had declared that he was the only one who had not actually kicked the victim. Had the fourth suspect been prosecuted, the British expert would have been asked to testify, or at least his expert report would have been admitted as evidence, in which case a formal request would have been necessary.

5 Conclusion: What is possible and for which purposes?

On the hand of the applicable law and the factual situations sketched above and in the sole intention of giving an overview of the legal ramifications of the problem, it is possible to come up with the following table. The table summarises what we have said above.

A. Oral & written information

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the expert information readily available to the police?</td>
<td>YES →</td>
<td>Information can be exchanged freely according to art. 39 SIC, as long as the information is not meant to be used in judicial proceedings.</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>Go to question 2.</td>
</tr>
<tr>
<td>2. Can the police get the information now?</td>
<td>YES →</td>
<td>an expert who has the information available is known to the police. → Information may be exchanged according to art. 39 SIC, as long as the information is not meant to be used in judiciary proceedings.</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>more information is needed for the expertise. → Go to question 3.</td>
</tr>
<tr>
<td>3. Can the police get the information at a later date?</td>
<td>YES →</td>
<td>the information only has to be collected and processed. → It may be exchanged according to art. 39 SIC, as long as it is not meant to be used in judiciary proceedings.</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>the information lies in CID registers. → Authorisation of the responsible CID-manager is needed (artt. 13-14 APR).</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>the information is necessary for comparison with DNA profiles stored in the DNA databank. → DNA analyses and comparisons may only be ordered by the public prosecutor (art. 151a Sv) or the investigative judge (art. 195a Sv).</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>the information necessitates resorting to coercive measures. → Judiciary assistance is needed (art. 39 SIC).</td>
</tr>
<tr>
<td></td>
<td>NO →</td>
<td>the information lies in one of the Europol databanks. → A request may be filed to one's own national unit (artt. 4, 5 &amp; 9 Europol Convention).</td>
</tr>
</tbody>
</table>
### Chapter VI: Data-Base, Exchange of Data and Forensic Expertise

#### B. Field assistance

1. Is the assistance needed for evidence purposes?
   - **YES** → Go to question 2.
   - **NO** → the information is needed for operational purposes. → The expert may be invited to assist the police on a voluntary basis (art. 52 (3) SIC).

2. Is the assistance needed for the judicial evaluation of evidence?
   - **YES** → Go to C.
   - **NO** → the assistance is needed for disclosing evidence and the expert will act under the authority and supervision of the locally competent police. → The expert may be invited to assist the police on a voluntary basis (art. 52 (3) SIC).

#### C. Evidence in court

1. Is the expert contribution needed as evidence?
   - **YES** → It must be requested by means of request for mutual assistance (art. 39 SIC).
   - **NO** → Go to question 2.

2. Is the expert needed to testify in court in person?
   - **YES** → The expert may be sent a subpoena directly (art. 52 SIC). See question 3.
   - **NO** → Go to question 1.

3. Does the expert actually appear in court?
   - **YES** → He will be asked to testify under oath as any other witness or expert.
   - **NO** → Unlike an expert subpoenaed by the authorities of his own country, foreign authorities are in general not allowed to force or punish an expert unwilling to appear in court (art. 52 SIC). As an exception to this general rule, such transnational sanction for unwilling witnesses is possible under art. 34 of the Benelux Extradition Convention.

In conclusion, the way international exchange of forensic expertise by the police will take place will depend on the subject matter of the expertise, the way it has been obtained and for which purpose. It is a question of degree.

Some information may be exchanged internationally without prior authorisation. This is the case for instance for suspect or witness identification, characteristics, fingerprints and photographs. Anything that is not restricted in any way, that does not necessitate resorting to coercive measures and that is required for operational use only: to find someone or something, to prevent a crime etc.

Information that is more sensitive and that is kept in CID-registers will require prior authorisation by the responsible magistrate. This is the case for
instance of the identity of acquaintances of a suspect, his political beliefs or his religion.

The international exchange of information to be used as evidence requires judiciary authorisation. This is the case of a fingerprint linking a suspect to a crime committed in the requesting country. The same goes for the application of coercive measures. This is the case for instance when a voiceprint of a suspect is needed for an expertise (unless a sample can be obtained on a voluntary basis), when this print should be made from a telephone tap or when pictures must be taken in secret.

Note that there is a fine line separating the aims of investigation and those of evidence. Where is the line between information for operational purposes and information to be used as evidence? It has been reported to us that sometimes information that has been given for investigation purposes is given again formally (through the mutual judicial assistance channel) in order to be used as evidence. This can be explained by the fact that the former is very flexible and the latter quite time consuming. There is a parallel to be made between the tendency to postpone the moment of the active police phase and the tendency to postpone the moment of transnational evidence gathering. Informal and pro-active investigating phases correspond in many national legal systems with the moment no particular legal guarantees exist (in many cases there is no particular suspect, or in any case not enough elements to characterise one person as such). In the active phase of the police investigation, the moment one is actually looking to 'wrap up' the case, there are a number of legal restraints: in the national system, it usually means that the suspect has certain rights. In the transnational system, the procedures for the request for mutual judicial assistance are time consuming. Moreover, the police must hand over the case to the prosecutor. As in national investigations, police officers involved in a trans-national investigation may tend to postpone the moment of investigating for the purpose of gathering evidence. As we mentioned, there are some reasons for that: length of the procedure, the desire to see the case through, the complexity of the procedure. In such a case, there is a risk of artificially postponing this moment, in which case the right of the suspect to a fair trial may be jeopardised. Since there are not many provisions, national or international, protecting the rights of the trans-national suspect, there is a need to look into this matter more thoroughly.19

Another question is whether the fair trial rights guaranteed by art. 6 ECHR are enough of a guarantee for trans-national suspects. What is to say about the possibility, or impossibility, of having a counter-expertise done? Should the trans-national justice system include the necessity to take two samples for analysis, one of which could be handed over to the suspect in order for

him to arrange for a counter expertise? Should the police act as though they were always gathering information for the purpose of gathering evidence? Should any interviews or interrogation or expert field assistance be video-taped and sealed for later viewing in court? Should copies of such tapes be made available to the defence before trial? These are all questions that should be answered as international co-operation in criminal matters intensifies. In this way, the experience of international criminal courts, like the International tribunal for the former Yugoslavia may be of great interest in the search towards ways of guarantying a fair trial to trans-national suspects.

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4 Privacy and the Use of Databases in Forensic Disciplines: a Balance of Interests

Diana Alonso Blas

The evolution of technology in the last decades makes it possible to store enormous amounts of data in databases.

It is therefore theoretically possible to collect and keep different sorts of data about the entire population of a country. For instance, one can imagine developing a database containing DNA information, blood samples, tissue or fingerprints of every citizen to facilitate forensic research.

In fact there is no need to imagine this at all for these national databases already exist! An example that has been the subject of much comment is Iceland, where the government recently proposed creating a centralised electronic database containing health records and other related information, including genetic data, in principle relating to all Icelanders, for the purpose of monitoring the use of medical services and pharmaceutical products.

The intended purpose of this database was to increase knowledge in order to improve health and health services; a legitimate aim, one might think at first glance. However, it is not so simple to draw this conclusion, since other interests of those whose data are processed could be at stake.

In March 1999 U.S. Attorney General Janet Reno asked a federal commission to study the possibility of requiring that a DNA sample be collected from every person arrested in the United States (even for minor traffic violations) and permanently stored in a national database. Such a database would be extremely large since almost 15 million people are arrested in the US yearly.

It is true that this national database would facilitate the investigation of crime and offences. However, American civil libertarians protested against the increased collection of DNA data, arguing that it constitutes an illegal search with little purpose in most cases, especially for minor crimes.

1 The author wishes to thank Ulco van de Pol, vice-president of the Registratiekamer (Dutch Data Protection Authority) for his valuable remarks on a previous version of this text.
2 As stated in article 1 of the Draft Bill on a Health Sector Database.
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In Europe there is quite a long tradition of data protection or privacy protection. One of the first examples is the Council of Europe Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data of 1981. This Convention, which was the first and only legally binding international instrument of world-wide significance, draws inspiration directly from the European Convention of Human Rights and Fundamental Freedoms, which was opened for signature in 1950, half a century ago.

In recent years, the European Union has also assumed a very important role in the data protection field. The European Data Protection Directive of 1995 opens a new era of harmonised data protection in Europe by offering a set of principles and provisions for implementation in all countries of the Union. Most of these countries (with the exception of Italy and Greece) had already enacted privacy legislation before the adoption of the Directive but this legislation presented some quite substantial differences, which jeopardised to some extent the free flow of personal data within the European Union.

The European Court of Justice in Luxembourg has also recognised the importance of the right to respect privacy in judgements like the X case, in which the Court held that the right to respect privacy is one of the fundamental rights protected by the Community legal order.

Article 8 of the European Convention on Human Rights and Fundamental Freedoms states that the right to respect for the private life of an individual can only be restricted by a public authority in accordance with domestic law and in so far as it is necessary in a democratic society for the defence of a number of legitimate aims.

In other words, the benefits gained by creating a central database containing data on all citizens of a country, which would be very helpful to forensic investigation, has to be examined in light of the principles of the European (Council of Europe and European Union) data protection instruments.

In this contribution we will use the European Data Protection Directive as a basis for our analysis. This Directive, which entered into force on 25 October 1998, imposes clear obligations on the Member States of the European Union. From that date onwards, individuals are entitled to in-
voke the provisions of the Directive before national courts, even if the Directive has not yet been implemented into national law.\(^8\)

Other instruments from the Council of Europe will however also be taken into consideration, in particular, the Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data of 1981. Countries that have signed this Convention have undertaken to apply it to automatic personal data files and automatic processing of personal data in the public and private sector.\(^9\)

Special attention will also be devoted to some recommendations of the Council of Europe that specifically address the issue of medical data banks. These recommendations are not legally binding but contain standards of reference for all the States of the Council of Europe, whether they are party to the Convention or not.

They consequently have a rather universal character and constitute a request to consider in good faith the possibility of elaborating and implementing domestic law in accordance with internationally agreed interpretation of the principles laid down in the Convention. Experience shows that national legislators take into account the recommendations of the Council of Europe when drafting new data protection legislation.

### 1 The concept of personal data

Most of the data necessary for forensic research can be qualified as personal data. The most common definition of personal data is the one contained in Article 2, letter (a) of the European Data Protection Directive: *all information relating to an identified or identifiable natural person.*

Two elements of this definition deserve special attention:

**A. All information relating to**

The expression ‘all information relating to’ covers all data which can furnish information about a defined person.\(^10\)

Sometimes the nature of the data as such is the main element giving information about the person; for instance, data about the behaviour of a person, his/her opinions, etc. In other cases, not only the nature of the data should be taken into consideration but also the context in which they are collected or used.

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\(^9\) See Article 3 of this Convention.

\(^10\) For more information, see the first chapter of B. Crouwerts-Verbrugge, B.M.A. Van Eck and E. Schreuders, *Persoonsgegevens beschermd, Uitspraken van de Registratiekamer* [Personal Data Protected, Decisions of the Dutch Data Protection Authority], 1997.
In any case, in order to be considered as personal data, data must be relevant to the way a person is viewed or treated in social intercourse. In other words, the data should have significant influence on the way the data subject participates in society or community life.

Where forensic research is involved, it is clear that the investigation will have an extraordinary influence on a person’s life and on the way they are treated or viewed by those around them; imagine for instance the consequences that assessment of the identity of a person who has committed a crime will have for society’s reactions.

There is no doubt about the applicability of the first part of the definition of personal data to the data used in forensic research.

B. Identified or identifiable person

It is not necessary to know the name of a person to speak of personal data; it is enough if the data make it possible to identify this person. As the Directive puts it, someone is identifiable who can be directly or indirectly identified.

Some of the data most often used for forensic research purposes are DNA-data, fingerprints, shoeprints, but also paint from a car or traces of explosives. Obviously, not all these data are equally sensitive in data protection terms but they all have something in common: they are collected and stored in order to identify the person(s) who have committed a crime or offence or been victims of such a crime.

The aim of their collection is to identify a person who is potentially identifiable through the investigation of these data. The work of forensic researchers is carried out in much the same spirit as policework: they contribute to the solution of a crime or offence. They are obviously not interested in data that can not lead them to the person they are looking for; in other words, they try to obtain as much ‘personal data’ as possible!

Common and well-known examples of data used in forensic research which can be clearly qualified as personal data are the following:

• the sperm samples found on Monica Lewinsky’s famous blue cocktail dress which matched the DNA features of President Clinton;

• the shoeprints found near the place where O.J. Simpson’s wife was killed. Examination proved that these shoeprints could only belong to very specific and exclusive sport shoes. O.J. Simpson had by chance been photographed some weeks before the death of his wife wearing shoes of this kind, although he later denied ever having owned these shoes...
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- the shoeprints found on Meindert Tjoelker's neck, which matched the sport shoes of the fourth person prosecuted in this famous Dutch case.\textsuperscript{11}

In the example of the above-mentioned health database in Iceland, the envisaged database was supposed to contain anonymous data. However, in a country with a relatively small population, genetic information is likely to indicate biological lineage and to reveal identities of persons concerned.\textsuperscript{12} The security measures initially proposed by Iceland to replace identifiers by a code were not sufficient to guarantee the anonymity of the Icelandic population.

These examples are proof of the fact that data which at first glance do not ‘look’ like personal data can very often lead to an individual. For this reason, the definition of ‘identifiable’ in the European Directive is, unlike that in the Council of Europe Convention,\textsuperscript{13} very extensive.

Recital 26 of the preamble to the Directive states that to determine whether a person is identifiable, account should be taken of all the means reasonably likely to be used either by the controller or by any other person to identify the said person. It is obvious that a team doing forensic research will use all available means to identify a person who has committed a crime or offence or a victim whose identity is unknown (for instance, when a corpse is discovered).

In an article of June 1997,\textsuperscript{14} Prof. Dumortier, of the University of Leuven, applied the criteria set forth in Recital 26 of the Directive to the case of a register of cancer patients in Belgium. The Belgian Privacy Commission had around that time handed down an opinion regarding the Belgian National Cancer Register stating that the data contained in this register could not be considered as personal data.

The data contained in this register had indeed been rendered anonymous, so that an average individual checking this list could not determine the name of the patients concerned.

However, as Dumortier correctly pointed out, the definition of the Directive is so broad that data can be considered personal data as long as anybody (the controller or any other person, according to Recital 26 can identify the said person. In this case, the data collected and provided to the

\textsuperscript{11} For an extensive discussion of this case, see Marjan Sjerps in this volume.
\textsuperscript{12} See the statement regarding the Icelandic database made by the Data Protection Commissioners of the EU and the EES-countries, gathered in Santiago de Compostela (Spain) on 16–18 September 1998 for the 20th International Data Protection Conference.
\textsuperscript{13} See the explanatory memorandum on the convention, point 28, where the following is specified: ‘identifiable persons’ means a person who can be easily identified: it does not cover identification of persons by means of very sophisticated methods.
\textsuperscript{14} J. Dumortier, Geanonimiseerde data en de privacywet [Data rendered anonymous and privacy law], \textit{Vi-juridisch, Vi Matrix}, June 1997.

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register by the doctor treating the patient can still be matched with the patient thereby identifying the person with the help of the doctor. Since 'any person' who can identify the person exists, data contained in the register should be treated as personal data in light of the Directive.

Having said this, we think that it can be concluded that the data used for forensic research should generally be considered as personal data, at least potentially.

2 Special categories of data: sensitive data

Traditionally, the data protection doctrine has distinguished special categories of data that are called sensitive data. This distinction was made for the first time in Article 6 of the Convention of the Council of Europe of 1981 and was adopted by almost all European countries in their national legislation.

The European Directive deals with sensitive data in Article 8. This Article prohibits in general the processing of certain categories of data such as personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership and the processing of data concerning health or sex life.

The reason why these data should have special protection resides in their nature and in the important consequences that their processing can have for the social life of the data subject. The Directive refers in its preamble to sensitive data as data which are capable by their nature of infringing fundamental freedoms or privacy.

As has been said earlier, one of the inherent features of personal data is the fact that they can significantly affect the data subject's participation in society or community life.

It is clear that the processing of data concerning a person's sexual inclination (for instance, the fact that somebody is homosexual), health (for example, the fact of being HIV positive) or political opinions can seriously influence the way a person is viewed or treated by others. The same can be said with reference to data concerning previous criminal convictions. These data especially need to be protected.

Some of the data that are regularly used for forensic research belong to the category of sensitive data since they somehow concern the health of natural persons; for instance, blood or tissue samples or DNA data. In these cases, as we will explain later, the specific rules concerning these data are applicable.

15 See Recital number 33 of the preamble to the European Data Protection Directive.
3 Legitimate grounds for processing personal and sensitive data

Data protection legislation expects personal data to be treated with due care. For instance, one can not just process personal data randomly or for any reason whatsoever.

Both the Council of Europe Convention and the European Directive underline the fact that all processing operations should be lawful and fair to the data subject. The principle of fair and lawful processing constitutes one of the core principles of privacy protection.

The concept of processing is worthy of some explanation. Processing refers not only to the moment a computer is processing personal data, as the term might suggest; the notion reaches much farther.

Article 2, letter b, of the Directive defines processing as any operation or set of operations which is performed upon personal data, whether or not by automatic means, such as collection, recording, organisation, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, blocking, erasure or destruction.

For forensic researchers this means that the principles of due care and fair and lawful processing should be respected not only at the moment data are collected but also at later stages, when data are stored or disclosed.

To ensure that the processing of personal data occurs in a legitimate way, processing must be done on the basis of one of the grounds defined in Article 7 of the European Directive. In the context of forensic research, the following grounds could play a role:

- Unambiguous consent: if a suspect or a victim of a crime or offence collaborates with the investigators and agrees to the investigation, it is clear that his/her personal data can be legitimately collected and processed.
- Consent means that the data subject must be absolutely free to consent and have enough information before taking a decision; only then can we speak of free and informed consent.
- A person who is considered a suspect of a crime or offence is not totally free to decide whether or not to co-operate with the forensic researchers. Caution is therefore necessary when using the term consent in this context.
- Compliance with a legal obligation to which the controller is subject: for instance, in the case of DNA data, there is in the Netherlands a legal obligation to keep these data in the national data bank of genetic pro-

16 See Article 5 of the Council of Europe Convention and Article 6 of the Directive. Recital number 28 of the preamble to the Directive also refers to this issue.
files in Rijswijk when dealing with suspects of offences punishable by a penalty of imprisonment of eight years or more.\textsuperscript{17}

- Necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller.

As has already been said in the previous section, some of the data regularly used for forensic research belong to the category of sensitive data since they somehow concern the health of natural persons. In these cases, processing is only legally permitted when one of the following exceptional grounds plays a role:

- Explicit consent of the data subject: if a suspect or a victim of a crime or offence gives explicit consent to the researchers, personal data can be processed, even if they belong to the category of sensitive data. Here again, the limited freedom of a suspect when giving consent should be taken into consideration.

- Necessary for the establishment, exercise or defence of legal claims: even without the consent of the data subject, who is in many cases unknown to the researchers at the moment that the data are processed, sensitive data can be processed in a crime investigation when they can serve to establish, exercise or defend a legal claim.

It is important to mention that doctors and other health professionals dealing with health data are in principle bound by the obligation of professional secrecy. However, doctors working in the police and justice field somehow have a different status: they are only bound by professional secrecy when this does not hinder the exercise of their functions.

Article 8, paragraph 4 of the European Directive enables the Member States to lay down other exemptions for reasons of substantial public interest and subject to the provision of suitable safeguards. It is therefore necessary to assess whether the benefits of forensic research are important enough to constitute substantial public interest. This assessment is up to the national legislators.

The importance of the principle of consent of the data subject has been especially emphasised by the European Data Protection Commissioners in their statement concerning the envisaged database in Iceland: \textit{the principle of free and informed consent of the person concerned to the storage and further processing of his or her data must be fully respected. The data subject must also be given the right to withdraw from the base once his or her data have been entered.}

\textsuperscript{17} See the law of 8 November 1993, which incorporated new provisions in the criminal code dealing with DNA research in criminal cases (Official Journal 1993, 596), the royal decree of 4 July 1994 on DNA research (Official Journal 1994, 522) and the regulation of the Minister of Justice on DNA research (Official Journal 1994, 174).
Exemptions from these principles would only be acceptable for exceptional reasons and with adequate safeguards for the correct use of the data.

4 Specific rules of the Council of Europe regarding medical data banks

As we mentioned earlier, some of the data commonly collected for forensic research belong to the category of sensitive data because they refer to the health of individuals. In this case the rules applicable to medical data should be taken into consideration.

The Council of Europe dealt as early as 1981 with the issue of medical data banks in the Recommendation of 23 January,\(^{18}\) in which it expressed its concern about the risk of increasing use of computers for, among other purposes, medical research.

Progress in medical science and developments in information technology made a revision of this recommendation necessary. In 1997 a new Recommendation on the protection of medical data was adopted by the Council of Ministers on the 13th of February.\(^{19}\)

This 1997 Recommendation was motivated by the fact that automatic processing of medical data is increasingly used by information systems, not only for medical care, medical research, hospital management and public health but also outside the health care sector.

Medical data are defined in the context of this Recommendation as all personal data concerning the health of an individual. It also refers to data that have a clear and close link with health as well as to genetic data.

The main principles of this Recommendation will be outlined in the following paragraphs.

Medical data can only be collected and processed if in accordance with appropriate safeguards provided by domestic law. Controllers of files who are not health care professionals should only collect and process medical data subject either to rules of confidentiality comparable to those incumbent upon a health care professional or subject to equally effective safeguards provided by domestic law.

The cases in which this recommendation allows the collection and processing of medical data are quite limited. In the context of forensic research, the following grounds are possible:


19 Recommendation No R (97) 5 of the Committee of Ministers to Member States on the protection of personal data, adopted by the Committee of Ministers on 13 February 1997 at the 584th meeting of the Ministers' Deputies.
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- If provided by law: for the prevention of a real danger or the suppression of a specific criminal offence or some other public interest.
- If permitted by law: to safeguard the vital interests of the data subject or a third person, or to establish, exercise or defend a legal claim.
- If the data subject (or his/her representative or a body or authority provided by law) has given consent.

The processing of genetic data is subject to specific safeguards: processing of these data for the purpose of a judicial or a criminal investigation should be subject to a specific law offering appropriate safeguards.

The results of any genetic analysis should be formulated within the limits of the objectives of the medical consultation, diagnosis or treatment for which consent was obtained.

When, in the legitimate interest of public health or medical science, the person in charge of the medical treatment or the controller of the file, in order to enable him/her to defend or exercise a legal claim, it proves necessary to store medical data that no longer serve their original purpose, technical arrangements should be made to ensure their correct storage and security, taking into account the privacy of the patient.

5 Applicability of the data protection law: the third pillar question

Forensic investigations are usually carried out by an authorised forensic laboratory. In the Netherlands the work of this laboratory falls within the scope of application of the existing privacy legislation (currently the Wet Persoonsregistraties or WPR and very soon the Wet Bescherming Persoonsgegevens or wBP) that is applicable for anyone keeping personal data in a file, whether it is the government, a firm or an individual.

However, once the data have been transferred from the forensic laboratory to police or justice agencies, those who can use these data for criminal investigation or proceedings, the situation changes.

The European Data Protection Directive defines its scope of application in Article 3, excluding the processing of personal data concerning public security, defence, State security and the activities of the State related criminal law.20

The reason why these activities are excluded lies in the organisation of the European Communities or, more accurately, in the Treaty of Maastricht on the European Union. The Member States have transferred a large number of competencies to the European Union, retaining certain activities which they consider inherent to their national identity or sover-

20 See also Recital 13 of the preamble to the Directive.

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eignty, such as defence, police and penal matters (the third pillar activities).

For this reason, the Data Protection Directive can not regulate areas that do not fall within the scope of application of European law in general. This does not mean, however, that no data protection rules apply to the third pillar activities.

To start with, the Member States are obviously free to extend the protection of the Directive to the data processing activities in this field. For instance, the Dutch legislator has opted for a general data protection law that covers all sorts of processing operations with the only exception of the police. Furthermore, other very important international instruments such as the Council of Europe Convention or the European Convention on Human Rights do not have limitations like the ones of the Directive on their scope of application. Their principles are therefore fully applicable to data processing in the police and justice sector.

In the Netherlands, the legislator has chosen for a separate and specific statute on police records. In the next section we will devote special attention to the existence and contents of this law.

6 Specific regulation of police files in the Netherlands

The existence of this separate statute, as far as we know the only one in Europe, is justified mainly by the considerable sensitivity of the data processed by the police and by the specific circumstances under which data are collected in the police field.

For instance, the police often have data not voluntarily given by the data subject or data collected from the data subject without him even being aware that these data exist.

The police, then, possess personal data which justify laying down the strictest, and hence more specific, requirements for their collection, storage and use.

In addition, the police organisation itself has a legitimate need to exchange information internally on a large scale. This need for free flow of information is sometimes not easy to reconcile with the principles of the general privacy law and the sensitive nature of the information the police possess.

Specific regulation seemed therefore necessary to the Dutch legislator. Also, the fact that the police is a closed organisation makes it possible to draw up specific regulations applicable to it.

21 The following paragraphs dealing with the Police Records Act are based on a paper by Ulco van de Pol, *A police code of practice within the framework of data protection law in the Netherlands*, presented at the Data Commissioners Conference in Copenhagen, September 1995.
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The Dutch Police Records Act regulates among other things the collection and contents of the data files, the recording of sensitive data, the responsibility of the controller, the system for transmission of data and the rights of the data subjects.

This Act contains stricter rules regarding sensitive data, allowing them to be processed only when this is unavoidable for the purpose of the record and to supplement other personal data.

The system for transmission of data is also very strict: while there is a free flow of information within the police organisation where this is necessary to carry out policing duties, a closed system exists when supplying data to outsiders. The Police Records Act contains an exhaustive list of cases in which personal data may be transmitted to other authorities, such as judicial or governmental authorities, as well as organisations for the assistance of victims and insurance companies in the interest of handling claims of traffic accidents.

However, Article 30 of this Act authorises police officers to supply information to third parties when this is necessary for the performance of their tasks; for instance, they may disclose information to a witness if necessary or even to the television broadcasting company in order to broadcast a call for information from the general public when additional knowledge about an unsolved crime is urgently needed.

When information from a police file is given to a person or body outside the police organisation, they must in principle keep this information confidential.\(^\text{22}\)

7 Conclusion

The processing of personal and sensitive data for the purpose of forensic research can only take place within the boundaries established by the international and national data protection rules.

As has been explained, forensic researchers deal in most cases with personal data and sometimes sensitive data. These data should always be treated with due care and processed in lawful and fair manner at all stages: collection, storage and disclosure to third parties. One should not forget that processing is a broad concept involving many different operations.

The context in which the data are obtained should be taken into consideration as well: suspects of a crime or offence are in a situation in which consenting to the investigation of their personal data can not be easily considered as a free decision.

\(^{22}\) See Article 30 of the Dutch Police Records Act.
Not everything that is technically possible is desirable; one should take into account the different interests at stake: not only the need to do justice and solve crimes but also the interests of victims and suspects. The results of this kind of investigation undoubtedly have an enormous influence on their further participation in society. Personal data protection is consequently of paramount importance in this field.

In other words: a balance needs to be found between the legitimate interest of collecting and processing personal and sensitive data for forensic research and the privacy of the persons whose data are processed.

Mainly it is up to the legislator to find this balance and formulate the main rules of the game in specific legislation. The principles of the Council of Europe Conventions offer an adequate data protection framework for these activities. Additionally, Member States are obviously free and even encouraged by the European Union to extend the scope of application of the Directive to the third pillar.

And why not provide specific rules like those in the Dutch Police Records Act for a domain which deserves special protection?

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5 Actuarial Justice Risk Management and the Modern State

Malcolm M. Feeley

1 Introduction

Jurgen Habermas has observed that law is not a distinct discourse, but that a hybrid located somewhere between morality and policy, and modern law has moved decidedly closer to policy than morality. He of course is not alone in making such an observation. Near the outset of the twentieth century both Rudolf von Ihering in Germany and Roscoe Pound in the United States showed that the rise of industrial society and the welfare state were having a revolutionary impact on the law.¹ Modern law, they argued, was regulation and the modern lawyer was neither a moral philosopher nor a theologian, but a social engineer. Law was, they suggested, an instrument for 'taming chance.'²

Of all the areas of law on this continuum, the criminal law has perhaps been anchored closest to morality. Yet, recent developments suggest that it too is moving towards policy. Increasingly it too is understood as an instrument for managing risk. This paper sketches out this development, provides some sustained examples, and explores its implications.

I begin my examination with an example, an extended discussion of the theory of selective incapacitation because it is the most dramatic illustration of this development. Elsewhere my colleague and I have labeled this new form 'actuarial justice' because it focuses concern on an aggregate population yet is anchored in a system that remains individual-focused. Although selective incapacitation is the starkest illustration of this trend,


² This term is not theirs, but Ian Hacking's. He used it to characterize the rise of statistical thinking which permits policy analysis whose focus is not on the individual, but the population as a whole, traditionally the stuff of policy analysis and not the law. See his The Taming of Chance (Cambridge: Cambridge University Press, 1990. Actuarial justice is a distinctive type of legal policy that has become clearer in light of Foucault's contribution to the understanding of the structure of power in modern society. See F. Ewald, L'Etat Providence, Paris: Bernard Brasset 1986; J. Simon, The Emergence of a Risk Society: Insurance, Law, and the State, Socialist Review, 1987, 95, pp. 61–89; and the several contributions in the collection, G. Burchell, C. Gordon and P. Miller (eds), The Foucault Effect: Studies in Governmentality, Chicago: U. of Chicago Press 1991.
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this new form is found in all areas of the criminal process. Furthermore, this development is not an anomaly; it is part of a trend that merges concern with crime and regulation, and even more generally blunts the distinction between law and policy.

2 Selective incapacitation

Consider: a person is convicted of a criminal offense. She receives a sentence of ten years in prison. Upon complaining that others similarly situated have received prison terms of only five years, she is informed that her 'dangerousness profile' is higher than the others and therefore she merits a longer sentence. Because of this and in order to reduce risk to society she must serve a longer term than others.

Rather than being driven by a concern for individual responsibility and retribution (or rehabilitation), such a scheme is explicitly utilitarian. It is concerned with predicting and managing the future behavior of aggregates, not individuals. Such sentencing violates central tenets of classical criminal law. Yet if the objective of the criminal process is to reduce social risk or aggregate dangerousness, it is rational. It is not concerned with the offender's current crime; it is a catalyst for analysis and not an object of central concern because the sentence is to be determined by an estimate of future behavior. It seeks an optimal sentence, one that minimizes the aggregate of future harmful behavior. Selective incapacitation, as this approach to sentencing is called, promises to reduce the effects of crime in society not by altering either the offender (through rehabilitation or specific deterrence) or her social context (changes in the environment that may inhibit crime), but by rearranging the distribution of offenders in society. Selective incapacitation holds that if prison can do nothing else, it can detain dangerous people for a time and thus delay the resumption of their criminal activity. If there are enough such delays for long enough periods, this policy can produce significant aggregate effects. If enough dangerous people can be identified and detained long enough, crime will decline. The aggregate effects of such a policy depend on the effectiveness of risk profiles generated by collating factors that correlate with dangerousness. This approach explicitly embraces a sentencing scheme in which


criminal sanctions are determined not by the nature of the criminal offense or the character of the offender, but by risk profiles that are abstractions, statistical artifacts, rather than representations of 'types' of individuals. The objective is to identify high-risk types—career criminals—and then subject them to long-term control, while investing in shorter-term or lesser controls over those with lower risk profiles. It represents, to use Ian Hacking’s famous phrase, 'the taming of chance'.

Selective incapacitation focuses not on individuals, but on the population itself as a target of power. It is concerned with the distribution of behavior in the population as a whole. This does not mean that individuals disappear, only that they are not treated as coherent or autonomous subjects. Rather they are recreated as statistical artifacts—'average offenders', 'high risk offenders', 'career criminals', and the like—which are the intersections of various categorical indicators. Individuals are behavioral units whose behavior in the aggregate reveals the distribution of danger in society. Actuarial crime policy is not designed for individuals, but is designed to respond to the problem of dangerousness. Actuarial justice takes crime for granted, and seeks policies that will minimize and manage aggregate risk—the sum of dangerousness in society—through policies of danger management. If classic criminal law and criminology (in all its various forms) seek to identify the individual offender and then respond to her in any of a number of (often highly contested) ways, actuarial justice is preoccupied with the criminal justice 'system' whose function it is to manage danger efficiently.

If the theory of selective incapacitation is the most dramatic example of actuarial justice, it is not the only one. In the pages that follow I want to show that, far from being an isolated and idiosyncratic idea, selective incapacitation reflects a major new way of thinking about crime, the criminal law, and the criminal process. Although it remains to be seen just how expansive this development will become, it is a perspective that is already deeply embedded in contemporary thinking about the criminal process, and social control, and social theory more generally.

The balance of this paper examines several other examples of this emerging new policy, and then explores their implications. Although I focus on American and British trends because I know them best, I will briefly point out examples of actuarial thinking on the Continent as well. My discussion, however, will be neither exhaustive nor even systematic. Rather it offers illustrations of the wide variety of ways that actuarial thinking is employed in the criminal process and criminal law. And more generally, it shows how this development is part of a trend throughout the twentieth

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5 Hacking, I., op. cit.
century that has moved law farther along Habermas’s continuum, away from morality and towards policy.

3 **Selected Institutional manifestations of actuarial justice**

3.1 *Preventive detention*

Thirty five years ago, the distinguished American law professor Caleb Foote wrote of the "coming constitutional crisis in bail" in the United States. He was concerned that despite a broad constitutional right to bail to obtain release prior to trial, the courts had not breathed meaning into this right. Animated by his article and continuing abuses of the money bail system, liberals mounted an effort to develop a meaningful bail system. However, rather than articulate a theory of right to bail, they embraced an administrative response. Claiming they could predict who was and who was not a good risk for appearance at trial and hence pretrial release, they developed risk-based predictive system of release. Those with close ties to the community were good risks and could be released on their own recognizance, while whose without community ties could not.

Although this effort was successful and led to more liberal pretrial release practices, it did not lead to a constitutional *right* to bail. The reform took an ‘administrative’ and risk-based approach rather than a rights-based approach. Pretrial release agencies used the accused’s ties to the community (employment, marital status, and the like) to predict likelihood of appearance at trial. However, as the public mood shifted and law and order concerns gained ascendancy, these agencies kept their orientation but changed their focus. Renamed pretrial service (rather than pretrial release) agencies, they offered to predict risk of dangerousness for purposes of pretrial detention. That is, they maintained their administrative orientation and their risk-based focus, and merely shifted the object of their predictions, from likelihood of appearance at trial to likelihood of engaging in a dangerous act if released prior to trial. And as concern with drugs increased, these agencies continued to adapt. They used the results of drug tests to refine their correlates of dangerousness, and hence their predictive capacities. In this way, an institution that began as a response to the lack of a constitutional right of bail was transformed into an agency to assess and manage risk of dangerousness, even going so far as to collect urine from new arrestees as part of this process. This may appear to be a dramatic about-face, a radical transformation of function. But if understood within the framework of risk analysis and efficient social policy, it is a natural if not inevitable extension. Such is the power of a paradigm.

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3.2 Probation and parole
In the United States parole and probation were established in the early 1900s as a means of reintegrating criminal offenders into their communities. The orientation of parole and probation officers was that of social workers, and their duties were much the same. But in the 1970s, in response to the belief that 'nothing works,' probation and parole agencies began to shed this orientation and adopt a risk-management approach. Now they spend much of their time collecting a continuous flow of data which is used to sort out high-risk from lower-risk offenders and to subject them to various levels of custody and surveillance. 8

Now most federal parole and probation officers spend most of their time collecting and entering data into the offense-based information forms which locate offenders on the 258-cell sentencing grid under the act establishing the federal sentencing guidelines. 9 Others administer drug tests, and fold the findings into a running calculus of dangerousness. This shift in orientation of parole and probation has led to new functions for drugs and drug testing. Traditionally criminal law treated drug use as harmful conduct which could be prohibited and punished. And in the rehabilitative model, drug use was seen as pathological, a sign of the need for individual treatment. With the advent of inexpensive and reliable drug testing, actuarial justice regards drug use in quite a different manner. Drug tests provide valuable data for predicting dangerousness. Thus drug use — and drug tests — are useful tools in risk assessment.

3.3 Other types of actuarial developments: defensible space
So far I have focused on new functions for traditional criminal justice institutions. But actuarial crime concerns have also affected a host of other institutions that at first glance are not directly related to criminal justice concerns. Such developments include the new forms of private space that have emerged in recent years. By privatizing space we heretofore have thought of as 'public,' unobtrusive risk-based danger management can be pursued with ease. Consider these new forms of 'private' spaces: shopping malls, airports, condominium complexes, gated communities, and mega-amusement parks. In contrast to limits on managers of public space, owners of private spaces have considerable freedom to specify their criteria for entrance, admission and membership. Perhaps most important, unobtrusive social controls can more easily be embedded in private than public spaces than in public ones.

Consider one familiar example: in order to facilitate life in very cold (or very hot) climates, businesses in many city centers have connected virtu-

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ally all the buildings with each other by means of glass enclosed second-
story concourses. Almost all such 'skyways,' as they are called in Minnea-
polis (one of the first American cities to create a downtown-wide indoor
walkway system — run through private businesses which can establish their
own criteria for entrance) 'no shirt, no shoes, no service,' 'no clusters of
teenagers,' 'check your bags at the door,' detention of suspected shoplift-
ers on 'suspicion' rather than probable cause, and the like. Indeed, the
very entrances to such up-market stores are likely to deter many casual
strollers.¹⁰

One might be tempted to say, "So what?" But these walkways are typi-
cally paid for by public funds though tax abatements, tax credits, grants,
and the like. And more generally, city officials initiate and oversee the de-
velopment of the walkways. And more generally, consider that in many
communities the private shopping mall has for all practical purposes re-
placed the public square, Disney-like worlds the public park, and gated
private condominium complexes the neighborhood. The cumulative ef-
fects of unobtrusive forms of risk management in these settings can be
substantial. They are 'defensible spaces' in ways the public street, the pub-
ic square, the public park, and the neighborhood are not.¹¹ Those with a
purpose, those with resources, those with means can feel free to use them.
Those without a clear purpose or means do not, and inexpensive and un-
obtrusive surveillance can distinguish who should and should not use
them.¹² Usually sidewalks of bustling cities are among the most democratic
settings in modern societies; the young bump up against the old, the pen-
sioner waits for the green light next to the up-and-coming young execu-
tive. Yet, by creating a dual set of walkways — one at street level fully pub-
lic, and the other semi-private — Minneapolis has segregated its residents
even as they move about the busy city center. Although the walkways are
justified by climate and convenience, the division among users of the two
sets of sidewalks is no doubt also based upon a set of unarticulated risk
factors. The young, the boisterous, the disheveled, the people of color —

¹⁰ For another example and discussion, see C. Shearing and P. Stenning, 'From the
Panopticon to Disney World: the Development of Discipline,' in A. Doob and E.L.
Greenspan (eds), Perspectives in Criminal Law, Toronto: Canada Law Book 1988,
pp. 335-349.

¹¹ For an explicit and self-conscious analysis of the relationship between urban design and
crime risk concerns, see O. Newman, Defensible Space; Crime Prevention Through Urban

¹² The concern with preventing and controlling crime through the management of space is
hardly a new concept. Walter Burgess and his colleagues who founded the Chicago
School of Sociology at the turn of the century, examined the ecology of deviance. How-
ever, there is an important distinction between their concerns and today's. Burgess and
his colleagues were interested in designing communities that would reduce individual
criminal activity and integrate deviants into conventional community life. Contrast this
with the Minneapolis skyway, which seeks to manage a problem, not change individual
lives by segregating would-be offenders from upright members of the community rather
than integrating them into the community.
the dangerous classes – move about on the sidewalks outside, while the ‘substantial’ people with a purpose use the skyway one story up.

4 Criminal law and procedure

Classical criminal law is rooted in a belief in the autonomy of the individual. This belief nurtures two distinctive features of the criminal law, concern with intent and a concern with determining harm. This approach requires demonstration of intention, foresight, knowledge and belief concerning actions and their consequences. And the insistence on demonstrating harm is required to justify punishment. Indeed, it is the requirement of *mens rea* (bad or evil intent) and intentional injury that may most clearly distinguish crimes from torts, and punishments from damages, and prevents punishment for thoughts alone with action. This requirement of intent makes ‘corporate’ crimes problematic. But despite the triumph of classical criminal law thinking that in the United States is represented by acceptance of the Model Penal Code, modern legislatures have not been deterred from criminalizing conduct without requiring proof of either intent or injury. By jettisoning classical concerns of the criminal law, these developments have paved the way for a risk management and actuarial policy analysis in the criminal process.

Below I examine developments of risk management in four areas of the criminal process: new and expanded forms of criminal liability, the creation of corporate criminal liability, the growth of forfeiture of assets laws, and developments in criminal procedure. My discussion is brief, and meant only to illustrate the wide variety of ways that risk management concerns have permeated traditional criminal law and procedural doctrines.

4.1 Strict liability and related types of offenses

The twentieth century has witnessed a proliferation of offenses which impose strict liability, expand presumptions, and embrace prohibitions against endangerment. Although criminal in form, such laws do away with or significantly modify traditional requirements to demonstrate intention (*mens rea* or its continental equivalents) and harm. Rather than punishing someone for injurious conduct, they seek to regulate and manage dangerous behavior. Common examples include criminalization of driving while intoxicated (defined objectively by blood alcohol level), speeding (defined objectively by set limits), failure to wear helmets or seat belts, presumptions of intent to sell drugs (based upon amounts in possession), and the


14 There are of course borderline areas which have generated considerable debate among retributivists, e.g. punishment for criminal attempts, criminal conspiracy, and ‘victimless’ crimes.
like. Some see in such laws an evolutionary yet radical development. First the requirement of intent was eroded by the requirement of negligence, then criminal negligence was stretched and supplemented with the notions of unacceptably risky behavior independent of any intent, negligence, or injury.  

4.2 Corporate criminal liability
In the mid-eighteenth century Blackstone could accurately observe, "A corporation cannot commit treason, or felony, or other crime, in its corporate capacity [because it does not have a mind and hence intent] though its members may in their distinct capacities". Modern legislatures have not heeded his pronouncements, and have proceeded to make corporations liable for all sorts of criminal acts." Indeed, corporate criminal liability is something of a growth industry, although admittedly it remains controversial for the reasons Blackstone states.

4.3 Forfeiture of assets (RICO and RICO-like statutes)
Traditionally the criminal law has allowed law enforcement officials powers to seize instrumentalities of the crime. The gun used in the robbery or the cash stolen in a burglary could be seized at the arrest. The reasons for this are obvious: so that the material can be used as evidence, so that weapons cannot be used in any additional offense, and so that offenders do not benefit from the fruits of their crimes. But recent developments now permit law enforcement officials to confiscate and seize assets that extend well beyond the traditional notions of instrumentalities and fruits of crime. The advantages of these powers for law enforcement are tremendous. Seizure can be triggered by arrest, not conviction, and indeed a subsequent decision not to prosecute, to dismiss or to acquit does not guarantee return of the assets. Once used sparingly in the occasional case as a decision incident to arrest and prosecution, recent innovations, including the fact that in some places the police can keep a portion of the profits, assure that forfeiture law are invoked frequently and aggressively. Although this new policy can be seen as the rejuvenation of a traditional but under-used power, it is best be understood as a feature of actuarial justice,

15 More examples: making it a crime for a person who tests HIV-positive to have sex with someone without first disclosing this condition; failing to register as a sex offender after a residential move. Consider additional possibilities: we have criminalized heroin. Why not cigarettes? Sugar? Salt? Ingesting each involves increasing (unacceptable?) risks to health and social costs.
part of an expanded strategy that does not depend on the strictures of criminal law and procedure to manage danger.

4.4 Developments in criminal procedure and displacement of probable cause

Classic criminal procedure seeks to limit police power through the requirement of establishing probable cause. However, in the United States in recent years, this standard has been steadily eroded. It was in the 1960s that the U.S. Supreme Court first upheld ‘stop and frisk’ exception in the absence of probable cause. At that time the Court restricted this exception to a narrow set of circumstances, including ‘reasonable suspicion’ on the part of an ‘experienced police officer’ confronting what appears to be to be a ‘developing crime’, but since then the exceptions have been so expanded as to constitute a new general rule.

Some of this expansion is due to the use of statistically generated ‘risk profiles’. Over the years American law has legitimated a host of such profiles which are used as the basis for stopping and searching suspected drug curriers, airplane hijackers, terrorists, illegal aliens, and the like. A related development is the increased collaboration of police with probation and parole officers; lacking evidence to obtain a search warrant, police turn to parole and probation officers who are not constrained by this provision to conduct warrantless searches. With as many as forty percent or more of the young black men on probation or parole in some communities, this constitutes a near-open invitation for constant surveillance of those with high-risk profiles.

None of these four types of practices reviewed above embraces actuarial thinking as fully as does the practice of selective incapacitation. But each contains substantial elements of risk-management thinking or is compatible with it. Although most still focus on individuals, and some of them (e.g., crimes of endangerment) impose sanctions that can be tied to some objectively proclaimed threshold of danger, on the whole in these areas of law, individuals are often seen as ‘types’ and the imposition of sanctions is part of a larger concern with regulating a dangerous activity within a population. Furthermore some of them rely upon explicit actuarial techniques such as risk profiles for their implementation. Police use random checks or selected stops determined by profiles to enforce speeding, drunk-driving and other types of endangerment laws, instead of waiting for individualized evidence of wrongdoing. Assets forfeitures and stop and frisk encounters (especially at airports and borders) rely on profiles of suspicion. Indeed, most types of proactive, regulatory enforcement are based on upon aggregate risk assessments and other forms of population management. Although not all of these expanding areas of law embrace the a


19 One expression indicative of the widespread use of racial profiles acutely understood by African Americans, is the folk crime, ‘driving while black.’

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pure actuarial model, they certainly represent a move away from classical, individual-oriented law and a move towards population management concerns.

4.5 Causes of these developments
Although the criminal law has long made room for the use of the types of practices discussed above, they have typically been regarded as exceptional, and have been rare, limited in scope, and treated with wariness. The change is that modern criminal justice has enthusiastically embraced these 'exceptions', and now turns to them with increasing frequency and enthusiasm.

Two factors account for this development. First, conditions of modern life not only lead to fear of risk of danger more than people once did, but give us more confidence in our capacity to manage risk. We want to criminalize and to punish not only those who poison their spouses, but those who drive drunk. But in the former case we punish for actual harm done; while in the latter we punish for creating a propensity, for increasing the risk of harm whether or not injury has occurred. Second, with the rise of the modern regulatory state, law enforcement has enhanced its capacities for proactive behavior and surveillance, making it possible to criminalize not only behavior which produces a victim who can complain, but also behavior which entails risk of danger but neither victim nor injury. Many of the proactive strategies of modern law enforcement — surveillance, inspections, random stops, reliance on profiles, and the like — are designed to monitor levels of risk rather than to detect intentional injury. Indeed, in a recent book Richard Ericson argues that risk management, rather than detection of crime, has become the primary function of modern police.

Modern risk management strategies are pursued for still other reasons. Law enforcement officials find their jobs much easier if they do not need to prove intent and injury. For this reason, they have pressed for the redefinition of crimes or the creation of new crimes that do not depend upon intent or injury. Indeed, proof nowadays often hinges upon easily obtained 'objective' evidence — bodily fluids or other types of incontrovertible physical evidence. Witness the dramatic expansion of criminal endangerment statutes over the past fifty years. These changes have not only made law

20 For instance, the 1734 Swedish Code made it a criminal offense to leave a loaded weapon where children might easily get their hand on it. And in the mid-eighteenth century, the English Parliament enacted the 'Black Codes,' making it a crime punishable by death to appear at night with a blackened face. The aim of the law was to curb poaching; it was much easier to detect someone who had a black face than it was to detect someone who had killed game illegally.


23 Most (if not all) criminal law texts published before mid-century did not even mentioned them. Now statutes on endangerment are discussed at length in all texts.
enforcement easier; they have also transformed parts of the criminal law into a regulatory activity, one which seeks to manage risk rather than secure compliance.

From the standpoint of classical criminal law, such developments are objectionable for several reasons. First, they sanction people for actions that may not be intentional, and for behavior that increases only the likelihood of injury in the aggregate but has not or would not cause any tangible injury in the particular instance. Second, by blunting intentionality and focusing on risk, they blur the distinction between regulation and crime. Further, punishment is divorced from injury and thus violates a core concern of just deserts theory. The criminal law's traditional focus on the individual is shifted to a concern with the aggregate, and criminal law enforcement dissolves into a more general activity aimed at social regulation and the management of risk.24

In England and the United States these developments, along with statutes criminalizing corporate illegality, have been readily adopted and widely accepted. Scores of laws of these sorts have been adopted over the past half-century, and their adoption has been challenged only by a tiny portion of the bench and bar and academy. Although these laws also raise thorny practical issues for punishment, such concerns have not slowed down their development.

On the European Continent the number of such laws has probably grown as rapidly, but this development appears to have been accompanied by more controversy among legal scholars. Anchored as they are in systematic and deductive legal dogmatics, continental scholars have always been more quick than their American colleagues to challenge regulatory-style criminal laws. They see them as undermining the foundations of the criminal process,25 while Anglo-American scholars who eschew theory, are more likely to treat them as 'anomalies'. Still, developments in both systems closely resemble each other. Indeed, the criminalization of risk appears to be present in all modern societies.

24 For a discussion of the conceptual development of new forms of hybrid criminal-civil sanctions, see K. Mann, op. cit.
25 One of the earliest and most vociferous continental critics of criminalization of endangerment and risk, was Karl Binding, who fiercely resisted the idea that risk-taking should lead to criminal liability, since risk-taking was, he argued, a by-product of any useful activity. See K. Bilding, Die Normen und ihre Uberbreitungen. Eine Untersuchung uber die rechtmassige Handlung und die Arten des Delikts, Vieter Band, Leipzig: Die Fahrlassigkeit 1919. See also, L. von Bar, Die Lere vom Causalzusammenhange im Rechte, besonders im Strafrechte, Leipzig: 1871. For an overview of early response to the idea of criminalizing risk in continental criminal law dogmatics, see K. Nuotio, Normative and Epistemological Aspects Concerning Legal Liability for Risk-Taking, Refaerd, 1995, 71(62). See also various writings of Winfried Hassemer.
5 Risk management and modern law

It is tempting to account for the rise of actuarial justice in the criminal process as a consequence of the contemporary crisis of law and order, and mounting pressures to abandon principle for expediency. But this would be wrong. Modern law is regulatory. As Von Ihring and Pound observed near the outset of the twentieth century, law aggregates interests and the lawyer is a social engineer. If this is correct, then the core function of the modern regulatory state is manage risk and tame chance. And if this function appears particularly salient in the criminal process, it may not be because the criminal law has succumbed to this temptation, but just the opposite. Of all areas of the law, the criminal law has the most concentrated focus on the individual, and the greatest concern with intentionality and injury. Indeed, in other areas, where the law does not have such intense concerns, actuarial justice is much more fully developed. Modern evidence law, modern tort law, and anti-discrimination law, to take just three examples with which I have some familiarity, all enthusiastically embrace aggregate risk-management efforts that displace concern with the individual and intention. I sketch out these developments below.

5.1 Evidence law

Modern evidence law, especially in the United States, has been heavily influenced by statistical risk thinking. Indeed the history of evidence law might be summarized as the movement from the insistence on divine judgement, to the absolute certainty of human judgement in the particular case, to probabilistic assessment. Consider the use of DNA and other forms of evidence that depend on an assessment of statistical probabilities.

5.2 Torts

Modern accident law in the United States and in common law countries generally is no longer primarily oriented towards determining negligence, assessing damages, and imposing responsibility. Although these concerns continue to be important, a variety of no-fault and strict liability regimes have significantly modified them. As Harvard Law Professor Henry Steiner has observed,

"Judges applying the new tort law] visualize the parties before them less as individual persons or discrete organizations and more as representatives of groups with identifiable common characteristics. They understand accidents and the social losses that accidents entail less as unique and events and more as statistically predictable events. Modern social vision tends then toward the systemic-group-statistical in contrast with

the vision more characteristic of the fault system, the dyadic-individual-unique."

Steiner's point is that the newer doctrines of strict liability, no-fault and the like – fueled by the ubiquity and inevitability of accidents and the rise of insurance – has rinsed the moral element from traditional tort law. Furthermore, what has not been erased by new doctrine is eliminated by insurance companies, whose activities center on efficient risk allocations, cost spreading, and compensation. Ironically, it may be the self-interest of large numbers of well-organized trial attorneys who continue to remind us of the moral basis of tort law.

5.3 Anti-discrimination law

Similarly, modern employment discrimination law and related policies have at times embraced risk analysis, although this way of thinking remains highly contested. Traditional anti-discrimination law required proof of intent. The victim has to show that she was singled out and willfully or intentionally excluded from consideration or for a position owing to sex, or race, or religion. In contrast, some case law interpreting Title VII of the Civil Rights Act allows courts to base findings of discrimination upon statistical analysis: if on average women are paid less than men proportionate to their numbers in a relevant pool, and the disparity is substantial enough that it is unlikely to occur by chance, intentional discrimination can be inferred and it is not necessary to show intent. However, some courts permit such inferences to be drawn without requiring that the disparities be probed in order to see if they can be accounted for by legitimate considerations (such as job-related skills, etc.). To the extent that the courts do not require more than statistically significant disparities to infer discrimination, another principle may be at work. The courts may be engaged in risk management in selection or distribution of benefits rather than (or in addition to) remedying classic, individual-focused and intentional discrimination. If so, they may be embracing a covert version of affirmative action and preferential treatment that has been openly embraced by many legislatures and administrative bodies. Although administratively-devised affirmative action and preferential treatment policies may be justified as remedial devices, they usually do not depend upon findings or inferences of individual discrimination, and are designed to distribute aggregate risks according to a prescribed formula.

29 F. Ewald, op. cit.
32 If there is a tendency to associate traditional individual-based law with liberals, and actuarial law with conservatives (perhaps because high standards of criminal proof are to
6 Conclusions

Earlier I argued that the actuarial features I have described are not anomalies in an otherwise robust criminal process. Rather they represent a distinct new perspective whose presence is felt in all areas of the criminal law and of current thinking about crime. Whether they develop into a fully coherent theory of the criminal process, one that replaces the extant retribution-based criminal law, remains to be seen. But it is clear that risk management is a distinct and pronounced trend within the criminal process. Indeed, it is not only a trend within the criminal process, but one that may be a distinctive if not defining characteristic of modern law and modern society generally. Earlier I suggested that regulation is the characteristic form of social control in the modern state. To the extent that it is, risk management may be the distinctive feature of the regulatory activities of the modern state. Certainly Ulrich Beck and others have suggested that it is.33

Michel Foucault is of course the great contemporary theorist of the risk society. Indeed, he purports to have pinpointed the birth of the risk society in the German Railroad Act of 1878, which eliminated the element of fault within the system of liability in accident law, and in so doing introduced into law the ideas of causal probability and risk and the use of the sanction to shape the likelihood of inevitable risks. Once adopted in accident law, this mode of thinking came to transform the criminal law as well.

This insight is well taken. Certainly the risk society is characterized by a movement away from a focus on the individual actor, intentionality, and moral responsibility, and towards a concern with aggregates disassociated from intentionality and moral responsibility. But the origins of this development probably lie less with the changes in and the immediate consequences of liability rules in accident law than in the birth of the administrative state. They flow from the very nature of the modern welfare state. If modern accident law supplements traditional fault-based liability in order to manage unintended harms, and the criminal law is modified to protect against dangers neither intentional nor even resulting in injuries, even more general concerns guide the modern welfare state in its effort to manage and insure against risks or all sorts.

Michel Foucault’s great contribution to this analysis is to show how this has led to decentralization of power, the rise of the disciplinary society, and a new form of ‘governamentalitry’. And Ulrich Beck’s contribution is to

some extent supplanted), the example of anti-discrimination law should give reason for pause. Although in the United States progressives or liberals probably oppose actuarial thinking in the criminal process, many would embrace it in anti-discrimination law. Actuarial, risk-based analysis cannot be neatly pegged along a conventional liberal-conservative continuum. The larger political and ideological implications of the actuarial approach are not yet well developed or clearly understood.

33 Beck, op. cit., and Ewald, op. cit.
have shown how 'risk management' constitutes a unifying idea underlying all sorts of social policies in modern society.

However sociolegal theorists have been acutely aware of the risk management features of the modern welfare state for at least one hundred years. Beginning in the late nineteenth century, they identified the trend as it first emerged and anticipated its significance. In Germany, Rudolf von Ihring developed a utilitarian conception of the function of laws which in effect reconceptualized all laws as regulatory provisions designed to serve social utilitarian ends. And in the United States Roscoe Pound elaborated on von Ihring's ideas, conceiving of law as an instrument of 'social engineering' to manage 'social interests'. Any fully-developed sociological analysis of actuarial criminal justice must be anchored in these larger theoretical concerns.

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6 Towards One European DNA Database?

Marjan de Boer

1 Introduction

Many offenders leave their 'visiting card' at the crime scene, particularly at the scene of 'physical' crimes such as burglary and rape. Members of the technical division of the police commonly find physical evidence at the scene of a residential burglary. A shoeprint in the yard, fingerprints on the windows and window ledges, a carelessly discarded cigarette butt, are routinely preserved and processed evidence. The unique and immutable character of the fingerprint and body samples make them of paramount importance in conclusively establishing the identity of an individual. Biological traces left at the scene of a crime contain DNA. Each individual has a unique DNA profile.¹ The fingerprint and the DNA profile afford an unparalleled degree of certainty in personal identification and have been of enormous value in the clearance of crimes. Since the DNA profiling technique was developed and published in 1985 by the British geneticist Alec Jeffreys², utilisation of this relatively young method of forensic investigation has grown tremendously.

Forensic data – fingerprints, paint and DNA profiles – are being stored more and more frequently in computerised databases: huge collections of readily accessible data. Two types of databases are used in the forensic laboratories: databases containing personal identification data (DNA profiles and fingerprints) and databases containing nonpersonal data (paints). This distinction is important because personal privacy of an individual is at issue in the storage of personal data. According to article 8 of the European Convention on Human Rights, invasion of personal privacy by the public authorities is permitted only if there is a legal basis in law and if necessary in a democratic society. This article further specifies the interests justifying such an invasion of privacy. The storage of the results of DNA profiling require more attention from the lawmaker than storage of data on paint samples.

The information stored in databases is of enormous potential value to criminal investigation and proceedings at the international as well as the

1 Identical multiple birth have identical DNA.
national level. However, the obstacles that must be overcome in the utilisation of forensic data from another country should not be underestimated. Lack of harmonisation within DNA profiling has hindered useful exchange of DNA profiles (between countries). Each forensic laboratory has its own way of producing a DNA profile. Comparison of two DNA profiles is only possible if both have been determined using a set of the same markers.

The present contribution addresses utilisation of a DNA database. Before turning to the potential value of a DNA database to criminal investigation, we will explain what DNA is and the procedure for producing a DNA profile. An overview is then presented of the countries in Europe that have a DNA database and of the steps taken so far to enable international exchange of DNA profiles. Finally, the desirability and feasibility of a central DNA database for the Member States of the Council of Europe will be examined.

2 What is DNA?

The basic unit of DNA is the nucleotide, a nitrogen base. DNA is composed of only four of such nucleotides: adenine (A), guanine (G), thymine (T) and cytosine (C). The nucleotides are linked to form two long opposite nucleotide chains, forming a double helix. A characteristic of the double helix is the fact that an A nucleotide is always opposite to a T nucleotide and a C nucleotide always to a G nucleotide. A combination A-T or C-G is called a base pair.

Cells from blood, hair roots, sperm, saliva contain DNA. The cell nuclei contain several DNA strands. These DNA strands are called chromosomes, that come in pairs. An individual inherits one chromosome from the mother and the other from the father. Humans have 23 pairs of chromosomes that together make up the genome. Because a child’s DNA is from both parents, parents are sometimes asked to provide DNA in cases of missing children. If a body is found, the identity can probably be determined definitively by comparing the DNA pattern of the unidentified child with those of its parents, brothers or sisters.

Genes occupy a fixed position (locus) on a chromosome. These genes are segments of DNA that encode a specific hereditary character, for example a blood group. In the course of human evolution, mutations in the
3 DNA profiling

DNA profiling begins with a small sample of genetic material found at the crime scene or taken from a suspect and ends with a band pattern that can be transformed into alpha numeric codes by a computer. The DNA profile is unique for each individual, and can be very easily compared with other profiles.

In many cases, the amount of DNA isolated from a biological sample is insufficient to produce a DNA profile directly. The DNA sample is then amplified until the quantity needed is available. The Polymerase Chain Reaction (PCR) technique is used for this purpose. The PCR technique makes it possible to produce a DNA profile from even the most minute biological samples of saliva on a cigarette butt or degraded human tissue, for example. For this reason, DNA analyses based on the PCR technique have become standard in almost every forensic laboratory. The DNA test that is based on repetitive DNA, like STRs, consists of the following three steps. First, the DNA is extracted from the cell nucleus and the amount of extracted DNA is measured. Next, the selected parts of the DNA are made to replicate themselves several million of times. The length of these amplified


DNA segments is determined. Finally, the differences in length are expressed graphically in a DNA profile.\textsuperscript{7}

4 The DNA database

As we mentioned earlier, a DNA database is a collection of DNA profiles stored in a computer. Basically, three different types of profiles can be distinguished, and it is advisable to structure the database accordingly:

1 Profiles obtained from biological material left by an offender at the scene of the crime (‘scene profiles’).
2 Profiles produced from biological material of a convicted offender (‘person profiles’).
3 Profiles of missing persons (or their relatives).\textsuperscript{8}

Whenever a new profile from any of the three categories is run through a database, all profiles in the collection should be included in the search. This will afford an opportunity to compare profiles and perhaps find a ‘match’. It is possible to compare scene profiles with person profiles to determine whether the traces found at the crime scene were left by the suspect. Scene profiles can also be compared with other scene profiles to learn whether other crimes have been committed by the same, unknown offender. Finally, scene profiles can be compared with person profiles and other scene profiles to see whether a known offender has committed other offences. The following three examples will demonstrate the enormous utility of a DNA database to crime investigation.

4.1 Example 1: comparing the profile of the trace to profiles of known offenders

Suppose a woman has been attacked and raped by a stranger. The assailant left her at the side of the road, believing she was dead. Luckily, the woman was found and taken to the hospital in time. The traces of the crime – semen stains – were secured and a DNA profile was produced by the Netherlands Forensic Institute. This profile was run through the DNA database. It was not the first time this rapist stuck; his DNA profile was in the database as the result of a previous conviction. This made it possible to establish his identity. In this case, comparison of the profile of the trace with offender profiles already in the DNA database made it possible to link the trace to a known offender.

\textsuperscript{7} Vakbijlage DNA-onderzoek [DNA Profiling Professional], 1 November 1996 Rijswijk: Gerechtelijk Laboratorium [Dutch Forensic Science Laboratory].

\textsuperscript{8} The Interpol European Working Party on DNA Profiling, p. 15. This part of the DNA database is not available at every forensic laboratory because it is only recommended.
4.2 Example 2: comparing the profile of the trace with other trace profiles
The Netherland Forensic Institute, the police, and the Openbaar Ministerie (Public Prosecution Service) in the Netherlands recently completed the 'DNA bij inbraken' DNA in burglaries project. The aim of this project was to determine whether DNA analysis can be used to help solve burglaries. The project examined whether burglars left biological traces at the scene of the burglary and whether a DNA profile could be produced from these traces. The resulting profiles were entered into a database and an attempt was made to link data. The project was a huge success. It was possible to match traces from several burglaries, showing that these had been committed by the same person. The clearance rate for residential burglaries has increased substantially thanks to DNA analysis.

4.3 Example 3: comparing the trace profile with the profiles of known offenders and other traces
A body is brought to the Netherland Forensic Institute. The pathologist discovers some hair clenched in one of the victim's hands. A DNA profile can be determined from the hair roots. Suppose the police have a suspect of this alleged murder. Under Dutch law, this suspect can be forced to allow samples to be taken of blood (or, in the near future, saliva) for the purpose of DNA analysis. When the DNA profile of the suspect was run through the database, it matched the profile of the hair in the victim's hand. The profile of the suspect also matched profiles of traces found at three other crime scenes. With the help of the database, it was possible to link this offender to four crimes.

The three examples show how useful the DNA database can be in criminal investigation. The match in the database shows a relationship between the trace found at the scene of the crime and the suspect. DNA analysis plays an important role not only during the crime investigation phase but in the presentation of evidence as well. The results of DNA analysis present strong evidence to the court in view of the reliability of analysis and the high degree of certainty with which it is possible to conclude that a profile of a trace belongs exclusively to the suspect. However, the conclusiveness of the evidence will depend on the circumstances of the case in question. There must be a clear relationship between the trace recovered and the offence. For example, if sperm is found in a rape case, DNA analysis can show that the suspect has had sexual contact with the victim. This does not provide conclusive proof of rape, however, because in many cases the suspect does not deny having had sexual contact with the alleged victim.

9 Eindrapport DNA bij inbraken [DNA in burglaries, final report], 6 May 1999.
10 See article 195d of the Dutch Code of Criminal Procedure.
11 Beside the results of a DNA comparison other evidence is necessary for a conviction.
12 Mul, S.W., De huidige en toekomstige regeling van het DNA onderzoek in strafzaken [Current and future regulation of DNA profiling in criminal cases], DD 29 (1999), 3 p. 179.
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Other evidence is needed to prove coercion in order to convict the defendant. In most sexual offences a clear relationship can be proved between the trace obtained and the offence, but in how many cases does the suspect deny physical contact?

5 Initiatives in harmonisation of DNA profiling technology in Europe

The days that criminals limited their activities to their own countries lie far behind us. As European borders become more open, crime is growing increasingly international and cross-border crime can be expected to further expand in the years to come. As we mentioned in the introduction, many perpetrators leave their 'visiting card', consisting of biological material, at the scene of the crime. Therefore, the DNA profiling technique is a powerful tool in solving crimes. However, in order to compare a DNA profile of a Dutch criminal (stored in the national DNA database at the Netherland Forensic Institute) with a profile created with traces of body material found at a crime scene in Germany, a certain degree of standardisation of the DNA profiling technology is required. In the past several years, the Council of the European Union, an Interpol Working Party and a Working Group of the European Network of Forensic Science Institutes (ENFSI) have worked towards establishing needed harmonisation of the DNA profiling technology.

In 1997 the Council of the European Union adopted a resolution concerning the exchange of DNA profiles. This resolution notes that sharing DNA profiles can contribute significantly to the investigation of crime and urges Member States to exchange DNA profiles. Exchange is possible only if the Member States have DNA databases. The Member States are invited to consider establishing national DNA databases. At present, Germany, England, Finland, the Netherlands and Austria have DNA databases in operation. In Belgium, France and Norway the preparation of a national database is well underway.

It is important to establish national DNA databases, but with a view to exchanging DNA profiles between Member States it is essential to build the national databases in accordance with the same standards and in a compatible way. To accomplish this goal, the resolution asks Member States to take into account the findings of a study carried out by the Interpol DNA Working Party when setting up a computer system for DNA profiles.

13 For this reason police officers must be well trained to find and preserve biological traces.
14 Council Resolution of June 9, 1997, on the exchange of DNA analysis results (97/C 193/02).
In 1996, this Interpol European Working Party on DNA Profiling was established to create a forum where European experts in the field of DNA profiling could meet to set guidelines and make recommendations to promote the wider use of a standard DNA profiling technique as an aid to criminal investigation in Europe.\(^{15}\) To apply DNA profiling technology to criminal investigation, Member States need to establish their own national DNA databases. These databases should respect the European standard set of loci (ESS) recommended by the Interpol European Working Party on DNA Profiling in accordance with the suggestion of the ENFSI DNA Working Group. The loci used to produce a DNA profile exert a crucial influence on the profile obtained. Exchange of profiles between countries requires at the minimum the use of the same core loci (ESS) throughout Europe.\(^{16}\)

6 Towards one central European DNA database?

A central European database of automotive paint has existed for several years now. One of the main reasons for creating this central database was the difficulty encountered in collecting information about the composition of automotive paints because cars, even cars of the same type and model, are produced at various locations throughout Europe. The composition of the paint differs along with the manufacturing site. Car and paint producers are not very willing to help all forensic institutes keep their collections up to date by providing them with the latest paint compositions. Taking all this into account, it is obvious that it takes a lot of effort to build and maintain an automotive paint collection. Consequently, it is not possible for one country to build a complete collection. Co-operation is the only solution.\(^{17}\) For this reason, an ENFSI Paint Working Group started in 1995 to build a European automotive paint collection and database.\(^{18}\) The existing paint collection at the Bundeskriminalamt in Germany served as the basis for this European database. With the help of all European Paint Group members, this collection will be kept up to date.\(^{19}\)

Co-operation is necessary in order to compile a useful collection of automotive paints for a database. The question is whether this same close degree of co-operation is necessary with respect to DNA analysis. In other

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16 The currently recommended STR-loci are: D21S11, VWA, HUMTHO1, FGA, D8S1179, D3S1358, D18S51 and amelogenin, the XY homologous gene 'sex test'.
18 This group now has a membership of 33 laboratories in 22 European countries and 3 non-European countries (Canada, the United States and Japan).
19 Declaration concerning co-operation in the development and use of a European Automotive Paint Collection.
words, is a central European DNA database a good idea? To answer this question it is important first to determine what we wish to achieve by establishing a European database?

For the DNA database the situation is different in comparison with paint. In principal at this moment, every country is able to set up and to maintain such a database, although at this moment not every country has a DNA database. Moreover, the types of samples (related to different types of offences) in the different countries differ a lot. The purpose of a European DNA database would be to enable the exchange of profiles between participating countries in order to facilitate detection of offenders that are active in different countries.

Suppose the Member States of the European Union decide to create a central DNA database by bringing the separate databases together in one database. All Member States have access to this database. They can compare a profile of trace material directly with the profiles of traces and individuals stored in the database. The advantage of this far-reaching form of co-operation is that an offender who commits offences in more than one Member State in which biological material has been preserved can be easily identified via the central database (providing his profile is in the database, for example in connection with an earlier conviction). However, the national databases contain a large number of profiles that are not relevant to other countries. A single European database containing hundreds of thousands, and eventually millions of profiles of suspects and traces would be costly. This extensive co-operation goes beyond what is necessary for the purpose of exchanging profiles of offenders who are active in more than one country.

A central European DNA database is not the only option available for the exchange of profiles of offenders wanted by several countries. International assistance in criminal matters affords another possibility. If a rape occurs in Germany and the German police have indications that the offender is Dutch, then the German police can request their Dutch colleagues to compare the profile of the trace material with the profiles stored in the database maintained by the Netherlands Forensic Institute. A disadvantage of this way of working is that it takes time. The prosecutor, for example, must give permission to carry out comparison of DNA profiles. If the witness indicates that the offender is probably from another country, but is unable to identify the country, a number of countries must be requested to compare the trace profile with the profiles in their national databases. At present there are only five countries with national databases, but this number is sure to grow in the future. A rather time-coming procedure!

A third way for countries to exchange DNA profiles is a combination of these two possibilities: each country creates a national DNA databank and
the profiles of suspects active in more than one country are filed in a central database accessible to all participating countries via Interpol or Europol. The advantage of this approach is that only the really ‘serious cases’ and profiles of international offenders are kept in this database. The database is ‘cleaner’. Because all the profiles are in a central database a Member State, upon suspicion that an offender from another country is involved, can run the trace profile through the central database so that it is possible to see immediately whether this suspicion is correct.

National legal rules can be an obstacle for the exchange of DNA profiles by a central European database. When national rules differ and don’t harmonise, exchange of data might only be possible by the channels of international legal aid.

7 Conclusion

If countries create DNA profiles according to the standard markers proposed by the ENFSI Working Group, an important step will have been taken toward harmonisation of DNA technology. Profiles will then be exchangeable.

The question remains as to how this international exchange among the Member States of the European Union can best be organised. We have examined three possibilities. The first, a central DNA database for all Member States, is unlikely. Creation of a database containing hundreds of thousands of profiles in order to detect a relatively small group of international offenders would be going too far.

Nevertheless, a central file of DNA profiles has definite advantages. A database containing profiles of offenders wanted internationally would make it possible, even without knowing the country of origin of the offender, to quickly determine whether the offender is sought in connection with offences in other countries. Working on a small scale would probably be more convenient, less costly and above all more effective than a single database for all countries. Each country would use its national DNA database to aid criminal investigation within its own borders. The DNA profiles of selected categories of offenders could be stored in a central databank administered by Interpol or Europol and directly accessible to all Member States.

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Chapter VII

Evidence and Statistics
1 Introduction

In criminal cases evidence is important for proving the guilt or innocence of the accused. In this chapter the value of evidence comes up for discussion, together with statistical methods that can be helpful in judging the value of the evidence.

In most criminal cases we have to deal with a set of unique events which happened in the past and cannot be reproduced fully. Unless there is an increase in the numbers of surveillance cameras there will seldom be a video or still photographic record of the criminal events. This also means that generally there will be no direct evidence that proves the guilt (or innocence) of a suspect and clarifies the way in which the criminal act happened. As a consequence, we end up with the problem of assessing the value of the evidence and the ancillary evidence. In criminal cases these are primarily questions of probability and believability; judgments which result in the accused being found guilty beyond reasonable doubt, or the case remaining unproven, where the accused will be acquitted.

Investigations in criminal cases are sometimes very complex and many people are involved. At the crime scene, police officers and scene of crime officers (and in murder cases also the coroner) are active. The evidence is then often transferred to a forensic science institute where several people will handle and investigate it. Via the police or prosecution the evidence will end up in court. This is reason enough to have a healthy scepticism towards evidence. Evidence which is investigated in a forensic science institute is usually the most difficult type of evidence for the judge or jury to understand. The outcome of the scientific investigations (data, pictures etc.) is interpreted by the forensic expert in the criminal context and often also in relation to criminal law, and laid down as such in his expert report. In this way subjective elements are introduced connected to the often objective scientific investigation methods and presented to the court as expert evidence.

In the contribution by John Spencer, “Evidence and forensic science”, the author discusses the security of forensic evidence compared to other evidence. The author first proposes a breakdown of the evidence into three categories: testimony, recordings, and things or real evidence. The risks with the different types of evidence are discussed and special attention is given to forensic evidence and the role of the forensic expert. The procedure for appointing an expert is also discussed, together with the way the expert's report is handled in court. He concludes with the proposal that two sets of rules have to be developed to make sure that the experts are

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1 In his contribution John Spencer looks at the Dutch law of evidence mainly as a foreigner would do by interpreting the 'law in the books'.

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competent and free from improper pressure, and that the prosecution, judge or jury and the defence have the opportunity to subject the expert's opinion to proper scrutiny.

The investigation of evidence by forensic scientists is often done by comparing it with existing collections of evidence from earlier cases or collections made from selected available materials. This affords the opportunity to use statistics in the assessment of the scientific investigations. However, we have to keep in mind that in court it is credibility which counts. A method used more and more frequently in forensic science is Bayesian reasoning. Marjan Sjerps explains in her contribution the basic elements of the Bayesian framework and how this can be used in the interpretation of evidence as a statistical expedient with the investigation of a hypothesis about the events at the crime scene. The arguments pro and contra the use of the Bayesian framework are discussed and the author hopes to convert the reader into a 'sceptical Bayesian enthusiast'.

The third contribution in this chapter by David Schum goes into more detail about believability judgments. The use of Kolmogorov and Baconian probabilities as well as Bayesian statistics are discussed with respect to singular evidence. The problem remains that in criminal cases events are involved that cannot be replicated or observed repeatedly. How can we then use statistical evidence where this is never encountered in litigation? Schum demonstrates that probabilities can be used to assess (ancillary) evidence in terms of believability judgments that in fact have a basis in concepts that come from Kolmogorev and Bayes' rules. In criminal cases more hypothetical scenarios are possible and the use of equations (based on probability rules) guarantees only that these scenarios are coherently built up. They help us to determine which scenario is more or less probable but never which one is true. The virtue of probabilistic reasoning is simply that it helps one to understand more about the rich complexity of inferences based on evidence.

Wim J.J.M. Sprangers
2 Evidence and Forensic Science

John R. Spencer

How safe is forensic evidence, as compared with evidence of other types? At first sight, this question looks as unanswerable as the famous stupid question “How long is a piece of string?” The answer to the string question is “It depends on the piece of string”, and to the question about evidence the only real answer is “It depends on how good the piece of evidence is”. However, it is true that all kinds of evidence — even forensic evidence — are bedevilled by their own particular set of risks, and it is an interesting exercise to compare them and contrast them.

1 The different categories of evidence

Broadly speaking, the legal systems in the developed world allow the same kinds of thing to be used to establish guilt or innocence in criminal proceedings. Very different, however, are methods the different systems use to classify them. French evidence law, the first and basic rule of which is that everything is admissible as evidence and the court is free to give any fact or circumstance the weight it feels that it deserves, has practically nothing to say about the different forms of evidence. Dutch law goes to the opposite extreme. Article 338 of the Dutch code of criminal procedure requires all convictions to be based on “lawful means of proof” — which it lists exhaustively as (i) the personal observation of the judge, (ii) the declaration of the accused, (iii) the declaration of a witness, (iv) the declaration of an expert, and (v) official documents. Subsequent articles then go on to provide that some of these forms of evidence are enough to found a conviction where they stand alone, whereas others require some form of corroboration. Needless to say, this provision has led to a lot of discussion in Dutch legal writing about the different types of evidence, and their inherent weaknesses and strengths.

Anglo-American law, of course, has a highly developed set of rules about criminal evidence. These are based mainly on case-law, and the task of stating the law of evidence in terms of general principles has fallen to legal writers rather than to parliamentary draftsmen.

To this generalisation there are obviously exceptions: for example, the general rule in the common law countries limiting the use that may be made of the fact that the accused has a criminal record.

CPP art. 427: Hors les cas où la loi en dispose autrement, les infractions peuvent être établies par tout mode de preuve et le juge décide d’après son intime conviction.

The Anglo-American writers have invented their own scheme for classifying evidence. This classification scheme is a double one. First, it draws a distinction according to what the evidence proves. This is the distinction between direct and circumstantial evidence. Direct evidence is evidence which (if true) establishes a disputed fact on its own, and without the need to connect it with other items of evidence, or to draw deductions from it: like the alleged victim's testimony that the defendant hit him, the defendant's confession that he did so, or the film from the security camera that caught him in the act. Circumstantial evidence, on the other hand, "may be defined as any fact (sometimes called an 'evidentiary fact', 'facium probans' or 'fact relevant to the issue') from which the judge or jury may infer the existence of a fact in issue (sometimes called a 'principal fact' or 'facium probandum')." The classic example is the statement of a witness that he saw the defendant leaving the house in which the victim was stabbed to death, carrying in his hand a bloodstained knife. Secondly, Anglo-American writers draw a further set of distinctions according to what the evidence itself consists of. Thus leading English writers, for example, draw a four-fold distinction between testimony, hearsay, documents and "things or real evidence".

When discussing the reliability of different types of evidence, what seems to be needed is a classification scheme of the second type. However, glad as I would be to adopt a classification scheme which is familiar to me as an English lawyer, I do not think the Anglo-American scheme would be helpful for this paper. The first two categories, 'testimony' and 'hearsay', are confusing to the continental reader. By 'testimony' the common lawyer means oral evidence, given at trial, by either the defendant or the witnesses. This looks odd to continental lawyers, because they traditionally see the defendant's statements as something inherently different from the evidence of witnesses. By 'hearsay', the common lawyer means a combination of two separate things: the formal statements that witnesses have given to the authorities during the investigative stage, and what continental (and Scottish) lawyers call de auditu testimony – i.e., what witnesses say they heard from other people. Once again, this blurs two categories which the continental lawyer sees as inherently distinct. The category 'documents' is not a helpful one, even to common lawyers, because in criminal cases it seems to be superfluous. In criminal cases a document is usually important because it records what someone said, when (for common lawyers) it also falls into the category of 'hearsay'. Or else it is important because of something else about it, for example that it has the defendant's finger-prints on it or a forged or altered signature – in which case it also falls into the category of 'things or real evidence'. Turning to this fourth

5 Ibid. pp. 45-55.
6 Ibid. p. 48.
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category of 'thing or real evidence', this seems unsatisfactory because it is too wide. Traditionally it consists of clues, like the wound on the victim's body or the matching bloodstained knife found in the defendant's pocket. Such things are pieces of circumstantial evidence. In recent years, however, the 'thing or real evidence' category has been expanded to take in things like photographs, films, videos and audio-recordings of the offence actually being committed. Although these are 'things or real evidence' in a certain sense, they are different from wounds or bloodstained knives because they provide direct rather than circumstantial evidence of the disputed fact: a videotape of the defendant actually sticking a knife into the victim needs to be connected with no other additional fact in order to suggest that it was he who stabbed him. To me, these technological recordings are similar to eye-witnesses recounting what they have seen and remembered, except that the memories and voices are mechanical instead of human ones. For the purpose of comparing the risks of fallibility that different kinds of evidence present, I think they deserve a section to themselves.

In what follows, I propose to divide criminal evidence into three categories. The first is factual assertions made by human beings. This category includes statements by witnesses and statements by defendants, and covers statements made pre-trial as well as statements made at the trial itself. For simplicity I propose to call this category testimony, although it is rather different from what common lawyers usually mean by that term. The second category consists of automatic records, like photographs and video-recordings. By these I mean recordings of the incident in question actually happening, and not (for example) video-recordings of witnesses describing them,7 which in my scheme are a form of testimony. In this paper I shall call them recordings. The third category consists of 'things or real evidence'. This consists of various kinds of circumstantial evidence which common lawyers have traditionally put under this heading, but excludes direct evidence in the form of recordings.

Where within this three-fold scheme is the place of forensic evidence? To some extent, it could be seen as a special sub-type of the third category, things or real evidence. Much forensic evidence involves things or objects (whether animate or inanimate) which are more or less meaningless to the layman, but which 'tell a tale' on the application to them of scientific skills that are beyond the knowledge or abilities of the court itself. But this is not always so, because forensic evidence also covers the application of scientific skills and knowledge to other matters. A forensic psychologist, for example, might explain or evaluate the words of other people, or the acts

7 For example, video-recorded interviews with child witnesses, as are now frequently used in criminal proceedings in England; see the Criminal Justice Act 1988 s.32A. Davies, Wilson, Mitchell and Milsom, Videotaping Children's Evidence: an Evaluation (Home Office 1995).
that they have done. In broad terms, forensic evidence is the application of some specialised skill or knowledge to some object, phenomenon or matter that is relevant to the case. As such, it *sui generis* and falls outside the other categories of ‘normal’ evidence.

2 **What are the inherent risks in the ‘ordinary’ forms of evidence?**

As far as testimony is concerned the risks in principle are three: lies, honest errors, and inaccurate transmission.

Where the testimony is the defendant’s, lies are on the whole a bigger risk than honest error. In the nature of things the defendant usually knows the truth about the key issue, which is whether he committed the offence in question or not — and as to that, any inaccuracy in his evidence is likely to be deliberate rather than accidental. But of course honest errors by defendants are also possible. They can make accidental errors about incidental matters, like where they were or what they were doing at the time that the offence took place. And defendants whose mental processes are disordered — either permanently, or temporarily through pressure and disorientation, do occasionally admit to crimes in the honest but mistaken belief that they committed them. A small number of defendants are mythomaniacs, who spend their lives getting into trouble by weaving fantasies, some of which succeed in convincing both themselves and the police. A classic example is the tragic case of Judith Ward, whose continual fantasies about her involvement with Ireland and the IRA led her to make false confessions to a multiple murder, for which she wrongly served 18 years in prison before the error was discovered.9 Where people make false confessions, they typically do so to the police and then attempt to retract them at the trial. However, it is not unknown for innocent defendants to persist in false confessions to the trial stage and beyond.9

Witnesses, no less than defendants, can tell lies, but with them there is a greater risk of honest error. Particularly dangerous are the risks of false eye-witness identification — a problem that was officially recognised in the United Kingdom in the 1970s,10 and of which it may be that some of the continental systems are still insufficiently aware.11

9 A classic case is that of Barry Foster, a man of low intelligence who not only falsely confessed, but actually pleaded guilty at trial to a four serious sexual offences against little girls, three of which were later conclusively shown to have been the work of someone else: Foster, 1984, 79 Cr App R 61.
The third type of risk inherent in testimony — transmission error — arises where the evidence of the defendant or a witness is delivered to the court in the form of a statement that he or she previously made to someone else, like a police-officer or some other kind of investigator. The person who took the statement may have misheard what his informer said, or misunderstood it. Worse, he may have deliberately falsified it. The classic example of this in recent British legal history is the case of the 'Birmingham Six', whose convictions were eventually quashed when it became clear (inter alia) that the police had fabricated at least part of their confessions.

The legal systems of all parts of Western Europe have traditionally tried to minimise the risks of lies and honest errors by requiring testimonial evidence to be given on oath and by subjecting those who furnish it to questioning. The common law traditionally went further, and simply declared certain types of presumptively unreliable testimony inadmissible. Until 1898, indeed, it even forbade the defendant to give evidence at trial (!), and even today his pre-trial statements are in theory admissible only to the extent that they amount to confessions (i.e. incriminate him). In more modern times, the trend in the common law countries has been to move from rules excluding categories of presumptively unreliable evidence to rules that limit the use that can be made of it. This in England and Wales, eye-witness identification evidence is now subjected (in effect) to a corroboration requirement. Corroboration requirements are unusual in the continental legal systems, but not unknown there. Dutch law, in particular, forbids the court from convicting on the uncorroborated word of a single witness, or of the defendant himself.

The continental legal systems have usually tried to cope with the risk of transmission errors by the rules designed to require the investigative authorities to record them with a certain level of formality. The common law has traditionally applied a more drastic remedy in the form of the celebrated hearsay rule, which in principle renders inadmissible all testimony except that given orally to the court of trial. Despite this rule, the defendant's out-of-court 'confessions' have always been admissible in evidence in the common law countries. In the past, this has given the common law

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12 McIlkenny and Others, 1991, 93 Cr App R 287.
13 In het Continental legal systems, unlike in England, Scotland and Ireland, the defendant does not give evidence on oath — an arrangement which is sometimes said to give him, as one of his rights, 'the right to lie'.
14 In the continental legal systems this is usually done by the president of the court, in the common law systems it takes the form of cross-examination by the opposing side.
15 Turnbull, 1977, QB 224.
17 German law, however, goes further by imposing a requirement that the court hear oral evidence from the witness, where he is available: Strafprozeßordnung §250.
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its fair share of transmission errors; since the mid-1980s, however, the law
of all parts of the UK has required most interviews with the defendant in
the police-station to be tape-recorded.18

With recordings (in the sense in which the term is used in this paper) there
is little or no risk of honest error. A video-camera (for example) can of
course malfunction – but if it does, it is does not absent-mindedly record
X knifing Y when in reality it was Y who knifed X. A recording device may
sometimes record something that is inherently ambiguous – for example, a
voice or a face that might be X’s or could possibly be Y’s – but if it does, it
is possible to replay the recording repeatedly in order to examine it more
closely, and without deforming the information in the process: something
which with a human memory is impossible. In the case of recordings, the
risk (such as it is) is mainly one of deliberate falsification. How great this
risk is depends upon the medium. Still photographs are comparatively easy
to falsify, videotapes much less so. With the risk of falsification in mind,
English law imposes, as a precondition for admitting a tape-recording as
evidence in a criminal case, evidence as to its provenance: 19 In addition,
computer-generated evidence may only be adduced where evidence has
been given that the computer was working normally.20 The use of record-
ings as evidence in criminal cases gives rise of course to difficult issues of
civil liberties, but these fall outside the scope of the present study.

In a strictly literal sense, things or real evidence are more reliable than testi-
mony, because they can neither lie nor be mistaken. In practice, however,
clues always depend on witness testimony, and are therefore subject to the
risks inherent in that form of evidence. Sometimes the court has nothing
more than the word of a witness that the real evidence exists or existed.
And even where the thing or object (or a photograph of it) can actually be
produced in court, the court will usually have nothing more than the word
of a human being to prove the circumstances that make it incriminating. In
a murder-trial, a bloody knife found in the defendant’s possession a few
minutes after the stabbing is a powerful piece of evidence – but the fact
that it was found there will have to be established by testimony. Regretta-
ibly, there is always the possibility that this testimony is intentionally false,
as where (for example) the police plant clues upon an innocent suspect.21
In theory this sort of testimony could also be inaccurate as the result of an
honest mistake or misunderstanding, although in the nature of things this

18 Police and Criminal Evidence Act 1984 s.60 and Code of Practice E. (Astonishingly –
and indefensibly – the obligation to tape-record interviews does not apply to interviews
with suspected terrorists!)
19 Robson, 1972, 1 WLR 651; Blackstone’s Criminal Practice, paragraph F8.43.
20 Police and Criminal Evidence Act 1984 s.69. (This provision has now been repealed by
the Youth Justice and Criminal Evidence Act 1999).
21 As in the celebrated case of Detective Sergeant Challenor, who planted bricks in the
pockets of demonstrators in order to charge them with possessing offensive weapons: see
the official Report into the Challenor case, Cmnd 2735 (1965).
is much less likely. And it is also possible, of course, for the testimony about the finding of the object to be true but the deduction the court is asked to draw from it a false one.22

3 The risks inherent in forensic evidence

Forensic evidence is the evaluation of something else, and this something else must usually be proved by other evidence. Thus — irrespective of the quality of the science — forensic evidence commonly carries with it the risks of error that are inherent in some other kind of evidence. Where a forensic scientist gives evidence about a clue, for instance, there is always the risk that that the material he examined has been intentionally tampered with or falsified. For example, the stick of gelignite which an expert correctly shows to have the defendant's finger-prints on it may have acquired them because the police tricked him into touching it when questioning him. It is also possible for the material that the expert worked on to be misattributed through honest error. In an English case, a hospital muddled up two vaginal swabs, one from a little girl of six and the other from a sexually active adult; the discovery of semen in the swab thought to have come from the little girl led to a false assumption that she had been sexually abused.23 In the celebrated French case of Marie Besnard, the mortal remains of some of her allegedly poisoned relatives seem to have got accidentally mixed up with those of others.24

Turning to the risks that are peculiarly those of forensic science, the first risk is that the scientific theory on which the expert opinion is based is wrong. The history of science, and of lawyers' attempts to harness it, provide some startling examples. At the Bury St. Edmunds witch trial in 1665, an expert on 'demonology' explained to the court the various ways in which witches were able to afflict their victims by secretly "conveying pins into them, with needles and nails".25 Perhaps demonology can be written off as the archetypal 'soft science'. But even within the 'hard' sciences, serious and persistent errors are not uncommon. In the last century, many eminent doctors believed that male masturbation was responsible for "every conceivable ill from pimples to insanity, including stooped shoulders, loss of weight, fatigue, insomnia general weakness, neurasthenia, loss of manly

22 As where a gold coin reported stolen is found in Y's possession — which, unknown to everyone, had been taken and 'planted' by a thieving magpie: Bentham, Rationale of Judicial Evidence, Book V, ch. III, section V.
23 G v North Tees Health Authority [1989] Family Court Reporter 53. Fortunately no one was prosecuted, but the girl was detained in hospital for a week and subjected to intrusive medical examinations and questioning. (The legal proceedings described in the report were the girl's civil claim for negligence against the hospital.)
24 'In the coffin of Léon Besnard's younger sister were found two lower jaws, three shoulder-blades and two sacrums, together with three extra vertebrae...' J.M. Austin, Les grandes affaires criminelles de Poitiers, 1995, p. 238.
25 The trial of Rose Cullender, 1665, 6 State Trials 687.
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vigour, weak eyes, digestive upsets, stomach ulcers, impotence, feeblemindedness, genital cancer...". In the last century, experts also had some equally unsound ideas about the workings of the insides of women. The 1849 edition of Taylor's Medical Jurisprudence – a solid work of science\(^{27}\) – the author informs readers that studies show women invariably conceive "at or about the time of menstruation".\(^{28}\) It was in an attempt to guard against the problem of erroneous method that the courts in the United States invented the 'Frye test', forbidding the use of expert evidence based on any new scientific method except where it has "gained general acceptance in the particular field to which it belongs".\(^{29}\) In 1989 a similar concern led the Dutch Supreme Court to rule that, where it is plausibly suggested that the official court expert's methods are controversial, the court must at least give reasons for refusing to seek a second opinion.\(^{30}\)

The second risk is that the scientists deliberately 'cook' their results. Whilst no case comes to my mind where forensic scientists were shown actually to have invented their results, in one notorious English case forensic scientists working for the prosecution certainly suppressed information about a number of tests they conducted, the results of which had undermined the prosecution case. This was, once again, the case of Judith Ward\(^{31}\) – and in the course of quashing the conviction, the English Court of Appeal laid down new rules imposing far-reaching duties on the prosecution to share all relevant information with the defence.\(^{32}\)

The third risk is that the scientists, though honest, have done their work incompetently.

Scientific incompetence, like incompetence in lawyers, can take various different forms.

The scientist may have used methods that are unreliable, although he does not realise this. At the first trial of Marie Besnard, for example, the official expert claimed to be certain that he had detected arsenic in body samples because he had seen, with his naked eye, a phenomenon called "Marsh rings" in a test-tube of fluids derived from her late husband's body; the

\(^{28}\) p. 569.
\(^{29}\) *Frye v United States*, 1923, 293 F 1013. In the case in question the rule was used to exclude evidence polygraph tests (alias 'lie-detectors').
\(^{30}\) HR 28 February 1989, NJ 1989, 748. The case concerned an expert's opinion that certain children had been sexually abused, based partly on their reaction to anatomically correct dolls.
\(^{31}\) See note 8 above.
\(^{32}\) The subsequent upheaval led to the rules being amended and restated in the Criminal Procedure and Investigations Act 1996.
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expert's incompetence was dramatically demonstrated when the defence lawyer asked him in court if he could see such rings in any of the new test-tubes that he produced from his brief-case — and the expert claimed to find some in tubes that contained not arsenic, but antimony.33

Sometimes the incompetence consists of the way in which the scientist interprets the results of his tests, rather than in the way he does them. In the Birmingham Six case, a forensic scientist did two successive tests for nitroglycerine on the hands of the suspects. The first, a crude test, was positive for hands A and B, but negative for hands CDEF etc. The second, which was allegedly 1,000 times more sensitive, showed negative for A and B, but positive for C. Logically they cancelled one another out: the only reasonable deduction was that either one test had misfired, or they both had. Yet he told the court that the first test made him 99 per cent certain the suspects had been handling nitroglycerine, and the second test 100 per cent certain.34

Similarly, the scientist may be incompetent because he fails to take account of some important extra factor in the case that could make his apparently damning conclusion innocent. In a notorious Scottish case, a forensic scientist reported that the accused’s body fluids contained a substance found in the body fluids of only 6.6 of the population, and that this substance was present in samples taken from the vagina of the woman the defendant was accused of raping. He failed to mention, however, that the victim was also part of this 6.6 per cent, which meant his tests proved nothing.35

The error in this case was a serious and specific example of a general type of error, which is where the scientist overstates his conclusions by saying that his findings are conclusive proof of some disputed matter when in fact they are only consistent with it. From time to time this has led to serious difficulties in the legal system. In the celebrated 'Cleveland affair' a large number or children were diagnosed as having been sexually abused and removed from their families, largely on the basis of a finding called 'reflex anal dilation'.36 It seems the paediatricians in the Cleveland area believed this finding to be conclusive proof of sexual interference, when it can in fact be caused by other factors.

33 See Austin, footnote 24 above, pp. 236–237.
34 McIlkenny and Others, 1991, 93 Cr App R 287, at p. 296. Unfortunately for the defendants, this logical error was not detected at the trial, and only grasped by the Court of Appeal at the third attempt.
Lastly, forensic evidence involves a danger which has nothing to do with the honesty or competence of the scientist, but arises from the competence of the tribunal. Where evidence of a highly technical type is involved the court may not be up to understanding it. In recent years, there has been official concern in England about the impact of DNA evidence upon juries. This has given rise to a developing body of case-law about how such evidence ought to be adduced at trial, and what the judge must and must not say to the jury about it in the course of his direction.

An additional problem when experts give evidence to a criminal court in England arises from the way that it is presented to the tribunal of fact. Whether this is composed of jurors or lay magistrates, they see no written report in advance, and are expected to absorb the information the expert is called upon to provide through his oral presentation in the witness-box. This is very different from what happens in France or Holland when a case is tried before a court composed of professional judges, when the expert's report will be in the dossier and the judges will have the chance to read it and to ponder upon it in advance of trial. Where (exceptionally) in France a case is tried before a jury, however, the expert has to communicate with the jurors in much the same way as he does in England - with the consequence that similar difficulties arise.

4 How can these risks be minimised?

In the common law world, the instinctive reaction to a type of evidence that is thought to be inherently unreliable is to invent a rule excluding it. The common law systems have done this, to some extent, with expert evidence. In the USA there is (or was) the Frye test, which rejects scientific evidence unless it is of a type which is generally accepted as valid by professional opinion. Over the years this provoked a lot of controversy, mainly on the ground that it deprived the courts of the latest advances of scientific knowledge - and in 1993 the United States Supreme Court finally rejected it in Daubert v Merrell Dow Pharmaceutical Inc. The English...
courts have also rejected the Frye approach, but in criminal cases they have adopted the cruder expedient of excluding certain types of expert evidence altogether – in particular, evidence from psychologists bearing on how far a given witness is capable of belief.

In my view, devising rules of evidence designed to restrict the types of expert help the courts can use is an unsatisfactory technique for dealing with the sort of problems of forensic evidence outlined in this paper. Exclusionary rules have the disadvantage that they sometimes shut the door on forms of expert help that could be genuinely useful, and in doing so they fail to deal with the problem of experts in court-approved areas of knowledge who are biased or incompetent – which is partly why there has been a reaction against the Frye test in the United States. In my view, the right solution is to try to develop rules of procedure regulating the way in which experts are selected, and their opinions are tested and examined. Two sets of rules are surely needed: (i) rules designed to make sure that the experts whose opinions are presented to the court are both technically competent and insulated from pressures to tailor their results to the expectations of one or other side, and (ii) rules that give both sides – and in particular the defence – an adequate opportunity to subject the expert’s opinion to proper scrutiny.

In my view, the continental systems are already far ahead of the common law as regards rules designed to secure neutrality in experts. In the common law experts are traditionally chosen and called adversarially by the parties, which inevitably generates a risk or bias, whereas in the continental systems they are routinely appointed by the court. Despite the revelation that biased expert evidence was a major factor in some of our worst miscarriages of justice, the idea of introducing court-appointed experts in English criminal proceedings still generates great opposition in the United Kingdom and has so far made no progress. However, major reforms are now on foot in English civil procedure, one important part of which is a move towards a single, neutral expert. If this change proves to be a success, it may eventually lead to changes in criminal procedure too.

The fact that an expert is court-appointed is not, of course, a guarantee of quality – and within some of the continental systems the fact that there is insufficient quality-control over court-appointed experts gives rise to

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43 Robb, 1993, 93 Cr App R 161. The case involved expert evidence about voice identification. The Court of Appeal did not explicitly refer to the Frye case, but rejected the defence argument that the expert’s evidence should be rejected because his techniques were viewed as valid by no more than ‘a minority of the profession’.

44 Robinson, 1994, 98 Cr App R 370.

45 Report of the Royal Commission on Criminal Justice (Cm 2263 1993), ch.9 §74.

46 Under the Civil Procedure Rules 1998, in most civil proceedings where expert evidence is required this will henceforth be provided by a single expert appointed jointly by the parties – or, in default of agreement, by the court. See Frenkel, Expert evidence under the new Civil Procedure Rules, New Law Journal, 1999, 197, p. 254.
criticism. With this in mind, there seems much to be said for the French system, which for the last 40 years has required experts to be chosen from official lists, the admission to which is carefully controlled. In other parts of continental Europe, there are signs that the courts are beginning to wake up to this problem. In a recent Dutch case, an orthopaedic shoemaker had been allowed to give expert evidence that a footprint at the scene of a murder was the defendant’s. The Supreme Court held that the court should have questioned him to see whether his expertise extended beyond the fitting or surgical boots and shoes to include footprint recognition.

Those who defend the common law system of adversarially appointed expert witnesses usually claim that it puts the criminal defendant in a better position to challenge an adverse expert opinion than does the system of court-appointed experts. Whether this is really true is in my view questionable – and even more questionable is whether, if it is, this results in a better quality of scientific knowledge being put at the disposal of the court. However, it is clear that no system of court-appointed experts can guard against the risks of error inherent in forensic evidence unless it provides adequate machinery to enable the defendant to insist on the court obtaining a second opinion.

References

Austin, J-M., Les grandes affaires criminelles de Poitiers; Geste éditions 1995.

48 For an account of the details in English, see J.R. Spencer, Court experts and expert witnesses – Have we a lesson to learn from the French?, Current Legal Problems, 1992, 45, p. 213.
50 I have given my views on this at length elsewhere. See the article cited in footnote 48 above, and also ‘The role of experts in the common law and the civil law: a comparison’ in S.J. Ceci and H. Hembrooke (ed), Expert Witnesses in Child Abuse Cases, American Psychological Association, Washington: 1998).
51 As to which the current position varies considerably as between one continental system and another. Article 244(4) of the German Code of Criminal Procedure, for example, imposes certain serious formal restrictions – whereas the Codes of Italy and Portugal go so far as to allow the defence to appoint their own ‘technical consultant’ to work alongside the official expert.

Hanson, R.S., James Alphonzo Frye is sixty-five years old; should he retire?, *Western State University Law Review*, 1989, 16, p. 357.


Murphy, P. et al. (ed), Blackstone's Criminal Practice, London: 1999.


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3 Pros and Cons of Bayesian Reasoning in Forensic Science

Marjan Sjerps

1 Summary

Bayesian reasoning is a stimulating impulse for forensic science. According to this line of reasoning, the central concept 'strength of evidence' is defined as a likelihood ratio, and the role of the forensic expert is to assess this ratio. This has important theoretical consequences: it provides a logical framework for defining fundamental principles of forensic science and for developing theory; it clarifies the role of the forensic expert; it inspires new lines of research; and it provides a common 'language' for experts working in the same or even in different fields, which facilitates the harmonisation of evidence interpretation.

An important practical consequence of Bayesian reasoning is that it provides a guideline to derive the strength of the forensic evidence in a structured and logical way. This guideline is useful even in the absence of data. Furthermore, the logical way of reasoning helps to avoid classical errors of thinking such as the prosecutor's fallacy. Other practical consequences are that the expert tends to focus more on alternative hypotheses, and may therefore feel more need to discuss with the legal decision-maker which hypotheses are relevant in a particular case. Finally, the expert's report will change: instead of reporting on the probability of a single hypothesis the expert reports on how much the evidence changes the probability of the hypotheses relative to each other.

There are a few obstacles for the practical implementation of Bayesian reasoning in forensic casework. One obstacle is that people do not intuitively reason in a Bayesian way. Hence, experts reporting to lay persons cannot simply state a likelihood ratio. Furthermore, current theory usually ignores the fact that in practice the expert estimates the likelihood ratio on the basis of limited information. Hence, more research is needed on how much the estimate may deviate from the true but unknown value. This is also important when assessing the strength of the combination of several pieces of evidence. Finally, Bayesian analysis of legal cases soon becomes complex. Simplifying assumptions, graphical tools and training may nevertheless allow an expert to apply Bayesian reasoning in order to increase insights.
Chapter VII: Evidence and Statistics

2 Introduction

Bayesian theory originated in statistics and probability theory, and is named after the Reverend Thomas Bayes (1702-1761). Its application in legal science has led to vigorous discussions among jurists. This has split the legal scholars into 'Bayesian enthusiasts' and 'Bayesian sceptics'. In forensic science, Bayesian reasoning has been rediscovered a number of times but has raised most interest by its application in DNA analysis. In the past ten years, it has become increasingly clear that the Bayesian framework is also useful for almost any other type of forensic scientific evidence. Important textbooks on this subject are Robertson and Vignaux and Aitken. As in the legal sciences, the application of Bayesian reasoning in forensic science has led to a debate about its usefulness, but this debate appears to me to be limited to a relatively small number of people and troubled by misunderstandings.

In this paper, I will list the pros and cons of Bayesian reasoning in forensic science which I personally find most important (sections 4.1 and 4.2). Furthermore, I will explain some frequently heard misunderstandings (section 4.3). The last section (5) addresses the consequences of applying Bayesian reasoning in forensic science for experts and legal-decision makers. I hope that this overview will help the reader to obtain a clear picture of the main advantages and disadvantages of the Bayesian framework in forensic science. My aim is to transform the reader into a 'sceptical Bayesian enthusiast'.

Section 3 contains a very brief introduction of the Bayesian framework, applied to forensic science. It is based on the textbooks mentioned above and on the work of Ian Evett, who has published numerous papers on applications of Bayesian reasoning in forensic science. Readers who are already familiar with the Bayesian framework can skip section 3.

In forensic science, Bayesian reasoning is used to evaluate the strength of the forensic evidence. Strictly speaking, the term 'Bayesian' is in this setting slightly misleading, and it would be better to talk about 'likelihood methods' or 'likelihood ratio approach'. Robertson and Vignaux prefer

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1 See e.g. R. Allen and M. Redmaine (eds), Bayesianism and Juridical Proof, The international journal of evidence and proof, 1997, 1, pp. 253-360.

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the word 'logical'. However, since the term 'Bayesian' seems to be used most often, I will use this term.

*Throughout this paper one can replace words like he, his etc. by their feminine counterparts.*

3 **The Bayesian framework**

3.1 Elementary probability theory

3.1.1 What is probability?
Probability is a central concept in statistics and probability theory (areas of mathematical research). A lay person may therefore be surprised that it has several definitions, and that there is no universal agreement as to which definition is preferred. Nevertheless, the rules that probabilities obey are the same for most definitions. These rules are developed in probability theory. I will mention here three kinds of definition, the frequentist, the logical degree of belief, and the personal degree of belief.° The following concepts are used:

- **statistical experiment**: an experiment with uncertain outcome (e.g. throwing a dice);
- **sample space**: the set of all possible outcomes (e.g. the sample space for throwing a dice is \{1,2,3,4,5,6\});
- **event**: a set of one or more outcomes (e.g. the event 'less than 4' for throwing a dice is the set \{1,2,3\}).

The **frequentist** approach assumes an infinite number of independent repetitions of the same statistical experiment, and defines the probability of event \(A\) as the limiting fraction of times that event \(A\) occurs. For example, if a dice is thrown an infinite number of times, the limiting fraction of times that 4 shows up is 1/6, hence the probability of event '4' is 1/6. Some have argued that it often is impossible to assume an infinite number of independent repetitions. For example, if Victor was murdered, it makes no sense to define the probability that Dennis is the murderer as the limiting fraction of times that Dennis murdered Victor.° Advocates of this line of reasoning therefore define the probability of event \(A\) as the degree of belief in \(A\), measured on a scale from 0 to 1. This is sometimes called the **fiducial** approach. Two sub-approaches can be distinguished within the fiducial approach: the assumption that the degree of belief is uniquely specified is

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called the logical approach, and the assumption that each individual specifies his/her own belief is called the personal or subjective approach.

For applications in forensic science, most experiments are of the kind where it is difficult to imagine an infinite number of repetitions or uniquely specified degrees of belief. For example, it is hard to imagine Victor being murdered an infinite number of times, or a uniquely specified degree of belief that it was Dennis who murdered Victor. Hence, the personal fiduciary approach seems to be suitable in a forensic setting. An important proponent of this approach is Ian Evett.¹

3.1.2 Conditional probabilities and Bayes' theorem

Suppose we randomly cast a die and ask for the probability of the event 'evens'. Without further information, we would estimate this probability as 1/2, abbreviated as Pr(evens) = 1/2. However, if we are provided with the information that either 1, 2, or 3 came up, then our estimate is 1/3. Thus, information can change the probability of an event.

To denote information, the symbol | is used which can be translated as 'given that': Pr(evens | 1, 2 or 3) = 1/3. Such probability is called conditional probability. For the degree of belief definition of probability, all probabilities are conditional since the degree of belief must be based on some kind of information. A conditional probability is defined by:

\[
Pr(A | B) = \frac{Pr(A \text{ and } B)}{Pr(B)}
\]

This reads as: the probability of event A given that event B occurred equals the probability that A and B both occur divided by the probability that B occurs. For example:

the probability of 'evens', given '4, 5, or 6' = the probability of 'evens and 4, 5, or 6' divided by the probability of '4, 5, or 6' = the probability of '4 or 6' divided by the probability of '4, 5, or 6' = 1/3 divided by 1/2 = 2/3.

Let Pr(not-A) denote the probability that A does not occur. Pr(A | B) and Pr(B | A) are related to each other by:

\[
Pr(A | B) = \frac{Pr(B | A) \cdot Pr(A)}{Pr(B | A) \cdot Pr(A) + Pr(B | \text{not } A) \cdot Pr(\text{not } A)}
\]

Formula (2) is a simple form of Bayes' theorem, named after the Rev. Thomas Bayes. In the dice example, with A defined as 'evens' and B as '4, 5, or 6', we derived above that the left hand side of (2) equals 2/3. When we calculate the right hand side we obtain for the numerator 2/3\cdot1/2 and for the denominator (2/3\cdot1/2) + (1/3\cdot1/2), and their ratio indeed equals 2/3.

In some countries, such as the UK, it is common to express probabilities in terms of odds, for example in horseracing. The odds on A are defined as the probability of A as opposed to the probability of not-A:

\[\text{odds on } A = \frac{\Pr(A)}{\Pr(\text{not } - A)}.\]  

(3)

For example, when casting a die the probability of '4' is 1/6, so the odds on '4' can be expressed as 1 to 5 or 1/5. The odds on A can be calculated before or after we obtain information that another event B has occurred. These odds are referred to as prior and posterior odds respectively. In the dice example, defining A again as 'evens' and B as '4,5, or 6', then the prior odds on A are 1 and the posterior odds on A given B are 2.

Yet another important concept is the likelihood ratio, often abbreviated as LR. The LR for B given A versus not-A is the probability of B given A divided by the probability of B given not-A. Written as a formula:

\[\text{LR of } B \text{ given } A \text{ versus not } - A = \frac{\Pr(B | A)}{\Pr(B | \text{not } - A)}.\]  

(4)

Hence with A and B as defined earlier the LR for B is 2/3 divided by 1/3 yielding 2.

When equation (2) is expressed in terms of odds, one obtains a very useful formula:

\[\frac{\Pr(A | B)}{\Pr(\text{not } - A | B)} = \frac{\Pr(A)}{\Pr(\text{not } - A)} \cdot \frac{\Pr(B | A)}{\Pr(B | \text{not } - A)}.\]  

(5)

In words:

\[\text{posterior odds} = \text{prior odds} \cdot \text{LR}\]  

(6)

This is known as the odds-form of the simple version of Bayes' theorem.

Applied to the dice example, one obtains: 2 (posterior odds on A given B) = 1 (prior odds on A) \cdot 2 (LR for B given A versus not-A).

3.2 The Bayesian approach to interpreting evidence

3.2.1 The Bayesian framework

Consider a very simple situation: a crime has been committed by a single offender, and a suspect is apprehended. There are two hypotheses of interest: C: the suspect committed the crime, and not-C: the suspect did not
commit the crime. A decision-maker is provided with some information about the crime, denoted by I, such as the circumstances of the crime (where, when, how etc.), and relevant data, e.g. frequency data of DNA profiles. Furthermore, the decision-maker is informed about the evidence against the suspect, denoted by E. He has the task to assess the probability that the suspect committed the crime, in other words, to estimate the odds on C, given E and I. The Bayesian approach to interpreting evidence pertains to explaining how the evidence E affects the decision-maker’s estimate of the odds on C, given the information I.

Before the evidence is presented, it is assumed that the decision-maker has some estimate of the odds that the suspect committed the crime, based on the information I. These odds are referred to as the prior odds. How a decision-maker should arrive at an estimate of the prior odds is a subject of controversy (see 4.2.3). If the decision-maker thinks that it is equally likely that the suspect did or did not commit the crime, the prior odds are one. It is sometimes thought that this is a neutral position with respect to the suspect, but this is definitely not the case (see 4.3.7). If the decision-maker thinks it is more likely that the suspect did not commit the crime, the estimate of the prior odds will be less than one, with zero as lower limit in case the decision-maker is convinced that the suspect could not have committed he crime. If the decision-maker thinks it is more likely that the suspect committed the crime than not, the estimate of the prior odds will be larger than one, with infinity as an upper limit in case the decision-maker is convinced that the suspect has committed he crime.

When the evidence is presented, the decision-maker updates the prior odds that the suspect committed the crime by multiplying them with a factor according to the strength of the evidence (in light of the information I). The updated odds are called the posterior odds. Hence,

\[
\text{posterior odds on } C, \text{ given } E = \text{ prior odds on } C \cdot \text{ multiplication factor measuring strength of } E.
\]  

(7)

The difficulty with this simple model of course lies in the assessment of the size of the multiplication factor. How should the strength of the evidence be measured? This is the point where Bayes’ theorem becomes useful. If we apply equation (5) to C and E we see that

\[
\frac{Pr(C|E)}{Pr(\text{not } C|E)} = \frac{Pr(C)}{Pr(\text{not } C)} \cdot \frac{Pr(E|C)}{Pr(E|\text{not } C)}.
\]  

(8)

where all probabilities are also conditional on the information I. We recognise these terms as:

\[
\text{posterior odds on } C, \text{ given } E = \text{ prior odds on } C \cdot \text{ the LR of } E, \text{ given } C \text{ versus not-C},
\]  

(9)

where all terms are evaluated given the information I.
Comparison of (7) and (9) shows that the multiplication factor measuring the strength of the evidence is defined by, given the information I, the LR of E given C versus not-C. Hence, according to the Bayesian framework, when evidence is presented to a decision-maker he should incorporate this by calculating the LR and multiply with his prior odds. This yields the posterior odds, which represent the updated belief in C. The relevant questions that must be answered to obtain the LR are: (1) what is the probability that evidence E will occur if the suspect committed the crime, and (2) what is the probability that evidence E will occur if the suspect did not commit the crime? These are the central questions for the Bayesian interpretation of evidence.

To see that the LR can indeed be interpreted as a measure of the strength of the evidence, consider a situation in which the evidence is more likely to occur if the suspect committed the crime than if he did not. In this situation, we have evidence against the suspect and indeed the LR is larger than one. Furthermore, if the evidence is highly likely to occur if the suspect committed the crime but highly unlikely if he did not, we have strong evidence against the suspect, and indeed the LR is large. Likewise, (strong) evidence in favour of a suspect has a LR (much) less than one, and ‘neutral’ evidence has a LR equal to one.

We will now use equation (9) to explore the effect of the prior odds and the LR on the posterior odds. If the decision-maker thinks that the suspect cannot have committed the crime prior to any evidence presented (prior odds =0), then whatever the evidence may be this will not change his opinion (posterior odds =0). If on the other hand the decision-maker is convinced that the suspect committed the crime prior to the evidence presented (prior odds are infinite), then whatever evidence is presented this will not change his opinion (posterior odds are infinite too). In practice these trivial cases (zero or infinite prior odds) will seldom occur.

If the decision-maker thinks that the evidence can only be observed if the suspect is innocent (LR=0), then whatever the prior odds may be the evidence will convince the decision-maker that the suspect is innocent (posterior odds=0). Hence, a LR of zero is equivalent with absolute proof that the suspect did not commit the crime. If on the other hand the decision-maker is convinced that the evidence can only be observed if the suspect committed the crime (LR is infinite), then whatever the prior odds may be the evidence will convince the decision-maker that the suspect committed the crime (posterior odds are infinite). Hence, an infinite LR is equivalent with absolute proof that the suspect committed the crime. If the LR is one, the evidence has no effect on the decision-maker’s estimate of the odds. Hence, a LR of one is equivalent with ‘neutral’ evidence.

In conclusion, the Bayesian conceptual framework for interpreting evidence is based on three definitions: (1) the definition of the hypotheses of interest, such as C and not-C, (2) the definition of the evidence E, (3) the definition of the information I. Using these definitions, three terms are evaluated: (1) the prior odds, (2) the LR measuring the strength of the
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evidence, and (3) the posterior odds. The posterior odds are obtained simply by multiplying the prior odds with the LR.
The following table shows a summary of the relationship between the LR, the strength of the evidence and the effect on the posterior odds.

<table>
<thead>
<tr>
<th>Strength of the evidence</th>
<th>Size of LR</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute proof that suspect is offender</td>
<td>infinite</td>
<td>posterior odds are infinite</td>
</tr>
<tr>
<td>Strong evidence that suspect is offender</td>
<td>much larger than 1</td>
<td>posterior odds much larger than prior odds</td>
</tr>
<tr>
<td>Weak evidence that suspect is offender</td>
<td>slightly larger than 1</td>
<td>posterior odds slightly larger than prior odds</td>
</tr>
<tr>
<td>'neutral' evidence</td>
<td>1</td>
<td>posterior odds equal prior odds</td>
</tr>
<tr>
<td>Weak evidence that suspect is not offender</td>
<td>slightly less than 1</td>
<td>posterior odds slightly smaller than prior odds</td>
</tr>
<tr>
<td>Strong evidence that suspect is not offender</td>
<td>much smaller than 1</td>
<td>posterior odds much smaller than prior odds</td>
</tr>
<tr>
<td>Absolute proof that suspect is not offender</td>
<td>0</td>
<td>posterior odds are 0</td>
</tr>
</tbody>
</table>

3.2.2 The role of the decision-maker and the expert

In legal cases with expert testimony one could ask if the expert's role is to comment on the prior odds, the LR, or on the posterior odds. Let's consider these factors in turn. Clearly, the expert should not usurp the decision-maker's role, so he should not comment on the prior odds that the suspect committed the crime. Should he comment on the prior odds of more technical hypotheses, such as "this mark was made by this tool"? Obviously, these odds cannot depend on the technical investigation since they are the odds prior to it. Hence, the expert has no special knowledge about these odds. Furthermore, since the prior odds that the tool of the suspect made the mark are clearly higher if the suspect committed the crime, it is in fact the decision-maker who should assess these odds. Hence, the expert should not make any statements concerning any prior odds, since these are the province of the decision-maker.

If we look at the LR, we see that this is indeed the part where an expert may contribute special knowledge without the need of assessing the probability that the suspect committed the crime. That is, the expert can safely comment on the probability that the evidence will occur, under the assumption that the suspect committed the crime (numerator of LR) or not (denominator of LR). For example, he can safely estimate the probability that the rapist and the suspect both have a certain DNA profile, under the assumption that the suspect is the rapist (numerator of LR) or not (denominator of LR). In doing so he does not use any estimate of the prob-
ability that the suspect is the rapist, he only uses his expert knowledge about how frequently these DNA profiles occur etc.

Considering the posterior odds, it logically follows from (9) that if the expert can only assess the LR but not the prior odds, he cannot assess the posterior odds (if he could, he could derive the prior odds from (9)). There is one exception, however, and that is if the expert thinks that the LR is infinite or zero. In this case, the posterior odds are respectively infinite and zero too, whatever the prior odds may be (Table 1). It is easy to think of a situation in which the expert concludes that the LR is zero: for example, a green glass fragment in the suspect’s clothes cannot have come from a colourless windowpane. It is not so easy to see how an expert comes to the conclusion that the LR is infinite: absolute certainty is seldom encountered in science. It requires, as Stoney\textsuperscript{12} puts it, a ‘leap of faith’. This leap may be taken far more often than people realise. For example, according to Broeders\textsuperscript{13} conclusions in speaker identification like ‘the person on the tape is probably the suspect’ etc. seem comments on the posterior odds but are in fact expressions of an infinite LR.

Hence, the Bayesian framework makes the role of the expert very explicit: he should help the decision-maker to evaluate the LR. Thus, he should state the hypotheses he has considered, the evidence, and the information, and subsequently comment on the probability that the evidence occurs under each hypothesis, given the information. The decision-maker may use the LR to convert his prior odds into posterior odds. The only situation in which the expert is allowed to comment on posterior odds is when there is absolute proof for one of the hypotheses.

3.2.3 Example
A simple example explains how Bayesian reasoning is applied in forensic science. Suppose that Mr Brown was murdered, and a bloodstain, supposedly from the murderer, is found at the crime scene. On the basis of an anonymous call, Mr Smith is apprehended as a suspect. A forensic expert compares the blood types of Mr Smith and of the bloodstain. They are both of type AB. The expert knows that this type is rather rare: only 3% of the people have this blood type.

An expert using the Bayesian approach would proceed as follows. First, he would ask what the relevant hypotheses are in this case. He could decide that these are: C: the bloodstain was left by Mr Smith, and not-C: the bloodstain was not left by Mr Smith. He then defines the evidence, for example, E: both Mr Smith and the bloodstain are type AB. Furthermore, he defines the information I: 3% of the people have blood type AB. Based on these definitions, he calculates the LR. The numerator of the LR is the probability that both Mr Smith and the bloodstain are type AB if


\textsuperscript{13} Broeders, A.P.A., Some observations on the use of probability scales, \textit{Forensic Linguistics}, in press.
Mr Smith left the bloodstain. Now if Mr Smith left the bloodstain, then obviously the bloodstain has his blood type, so the numerator reduces to the probability that Mr Smith has type AB. The numerator of the LR is hence 3%. The denominator is the probability that both Mr Smith and the bloodstain are type AB if Mr Smith did not leave the bloodstain. Now under these circumstances, and without any further information as to who left the bloodstain, the probability that the bloodstain is type AB is 3%, and the probability that Mr Smith has type AB is also 3%. Since the blood type of Mr Smith and the bloodstain can now be considered as independent, the probability that they both are type AB is simply the product of the individual probabilities, i.e. 0.09%. Hence, the denominator of the LR is 0.09%, and so the LR is about 33. The expert would then choose a way to report this LR to the decision-maker (see 4.2.2). In his report, he would also explicitly state the hypotheses C and not-C he considered, the evidence E, and the information I.

### 4 Merits and demerits of the Bayesian framework

There are many arguments pro and contra the use of the Bayesian framework for interpreting forensic evidence, but the discussion in the forensic community seems to be limited to a small number of people mainly involved in DNA analysis or statistics. Furthermore, there are many misunderstandings about its use among the many forensic scientists who have only superficial knowledge about the Bayesian framework. These misunderstandings have led many scientists to believe that it is not applicable in their field of expertise, and has given rise to a negative attitude which I think is largely unjustified.

In this section, I will list some of the arguments which I personally find most important for forensic scientists, and hope to clarify some frequently heard misconceptions. The list is my personal view, and is not intended to be either balanced or exhaustive. Furthermore, I will not explain the arguments at length but rather give references for further reading. I hope the list will help the reader to obtain a clear view of some important advantages and disadvantages of the use of Bayesian framework in practical forensic casework.

#### 4.1 Arguments pro Bayesian reasoning

4.1.1 **The Bayesian framework provides a logical unifying basis for forensics**

Is forensic science really a science or is it merely a name for a collection of techniques? It is an academic discipline at universities in e.g. the USA and in the UK, but not in many other countries such as The Netherlands. Moreover, some areas of forensic science are regarded as 'a practical skill',

e.g. handwriting. Perhaps one of the problems is that fundamental principles, which apply to all areas of forensic science and which unite these areas, seem to be missing. Bayesian theory provides a solid and logical framework for defining fundamental concepts like the strength of the evidence. It therefore provides a unifying scientific basis for forensics. In my opinion, this is one of its most important virtues.

4.1.2 The Bayesian framework clarifies the role of the expert
In most legal systems, there are rules to determine the role of the forensic expert in legal cases. A well-known rule is 'the ultimate issue' rule, which says that an expert should not comment upon the central issues of the case, which are for the court to decide. Nevertheless, it has become generally accepted that an expert states something like "I think it is highly likely that the hair in the mask came from the suspect", which comes very close to commenting on the central issue. The rule has therefore eroded quite a bit, and the role of the expert has become unclear.

In the Bayesian framework, the role of the expert is clearly defined: he should assess the LR and should not comment upon prior or posterior odds. Hence, in the example above, he could say something like "my observations are far more likely to occur if the hair in the mask came from the suspect than if it came from someone else". Statements like this do not violate the ultimate issue rule. In fact, one could interpret the rule as a prohibition for the expert to comment on prior or posterior odds. Hence, the role of the expert in the Bayesian framework is clearly defined and in compliance with the ultimate issue rule. This definition of the expert's role has important consequences for the way the evidence is interpreted and reported.

4.1.3 Bayesian reasoning guides the thought process of the expert
One of the most important benefits of using Bayesian reasoning for evaluating forensic evidence is that its logical structure guides the thought process of the expert: first, the evidence, hypotheses and information are defined, subsequently, the probability of the evidence under each hypothesis is assessed, and finally, these probabilities are compared to arrive at a statement about the strength of the evidence. These logical steps assist the

expert in deciding what exactly he will investigate, and in deriving which data are needed. This is often a difficult task.

Consider for example a 'match' between material from the suspect and from the crime scene in DNA analysis or in hair comparison. The strength of the evidence depends on the frequency of such matches in the relevant population. Since the frequency may differ between different populations, the scientist must decide which population he considers relevant: the population from which the suspect comes, the local population around the crime scene, or some other population. In DNA analysis there has been a debate which population should be chosen. The Bayesian framework makes it clear that in fact the population of interest is the population of possible offenders. The data that are needed are thus from this population. Other examples in which Bayesian reasoning has been successfully applied are: the two-trace problem, complex mixtures in DNA analysis and the strength of the evidence in case the suspect is found through a match in a database. A famous complex case which has been analysed in a Bayesian way is the Sacco and Vanzetti case.

Bayesian reasoning may also stimulate scientific research. For example, in vehicle paint analysis the Bayesian approach for some paint transfer scenarios requires the expert to consider the probability that a random vehicle will have paint not original to the car on it. Since these data were lacking, this has led to new lines of research in paint analysis (McDermott et al. 1999).

4.1.4 The LR makes efficient use of the data to measure evidential strength

Conventional ways to present the evidence do not always make efficient use of the data to convey the strength of the evidence. For example, in

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24 Kadane, J.B. and D.A. Schum, A probabilistic analysis of the Sacco and Vanzetti evidence, New York: Wiley 1996. See also the chapter of David Schum in this volume.

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DNA analysis the so-called exclusion rate is often used to present the evidence in parentage testing or in complicated cases, such as stains containing DNA from different people. However, this approach does not always value the presence of rare alleles. Other examples are the 'discriminating power', which describes the power of the system but does not make use of the specific findings in the case,\(^26\) or the use of 'match probabilities' in situations like the 'two trace problem'.\(^27\) Furthermore, there are a number of objections to classical statistical hypothesis testing which is used in e.g. glass refractive index comparison.\(^28\)

In all of these situations, the strength of the evidence is accurately represented by the LR.\(^29\) In other words, the LR makes efficient use of all available findings to express the strength of the evidence. In my opinion, this is a strong argument that the LR should be used by experts in professional discussions. Conveying the strength of the evidence to lay decision-makers in a legal trial is quite a different matter, however (see 4.2.2 for further discussion).

4.1.5 Bayesian reasoning forces the scientist to think of alternative hypotheses

Although scientific evaluations should always consider more than one hypothesis, the busy forensic expert may tend to concentrate on the hypothesis put forward by either the defence or the prosecution.\(^30\)

Moreover, the standard alternative hypothesis in statistics that "the data occurred by chance" is often not the most suitable choice.\(^31\) In my experience, one of the most important practical advantages of the Bayesian framework is that it more or less forces the scientist to think about alternative hypotheses, and to assess the strength of the evidence accordingly. This may have considerable consequences, as illustrated by the following case example from the Netherlands.\(^32\)

A young man was beaten to death by four men, who were arrested shortly after the incident. A mark of some object was found in the victim’s face, and an expert was asked whether a shoe made the mark and if so, if the mark could be linked to the shoes of any of the suspects. Since the mark was of poor quality and did not have any characteristic features, the expert concluded that it was possibly a shoe print, and that based on the


\(^{29}\) See e.g. R. Royall, Statistical Evidence — a likelihood paradigm, London: Chapman and Hall 1997.


\(^{32}\) See also A.P.A. Broeders, 'Some observations on the use of probability scales', Forensic Linguistics, in press.
sole pattern only the shoes of the youngest suspect could have made the mark. Other experts excluded most other objects that could have made the mark, such as a manhole cover. However, the prosecution decided not to prosecute this suspect because there were no witnesses who actually saw this suspect kick the victim, and presumably because the shoe evidence was considered very weak.

However, in appeal to this decision the expert explained in an additional report that if one assumes that the mark was made by a shoe and by one of the four suspects, the shoe of the youngest suspect must have made the mark since the shoes of the others could be excluded. This made the evidence appear much stronger than the original statement, which may have been one of the reasons that the suspect was indeed prosecuted. The point of this case example is that the strength of the evidence depends on whether the alternative hypothesis is that (1) the mark was made by an unknown object or a shoe from an unknown person (in this case the evidence is weak) or (2) by a shoe of one of the other three suspects (in this case the evidence is extremely strong).

Although extremely important, alternative hypotheses are often difficult to define. This is sometimes used as an argument against the use of the Bayesian framework (see 4.2.6). However, alternative hypotheses should be important in any sensible framework, so I do not think that this is a valid argument. On the contrary, the emphasis in the Bayesian framework on the alternative hypotheses helps the expert to think about this important issue instead of sweeping it under the carpet.

4.1.6 Bayesian reasoning helps to avoid classical errors of thinking
Because the Bayesian framework focuses on a logical and formal way to interpret the evidence, it avoids some classical errors of thinking which are frequently made, such as the prosecutor's fallacy, the defence's fallacy, double-counting the evidence etc.33 In a recent study, Taroni and Aitken34 show that educating people in Bayesian thinking indeed reduces error rates, and that experts who use Bayesian reasoning better succeed in avoiding classical errors than other experts.35 This is of course a major advantage of Bayesian reasoning. However, I fear that Bayesian reasoning

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when used by people who are not well trained in this area (including most forensic experts) may easily introduce other errors (see 4.2.1 and 4.2.2). This, of course, is not a criticism but a warning against its use by untrained people.

4.1.7 **The Bayesian framework combines evidence in a logical way**

In a legal case, the evidence almost always consists of a number of items. The decision-maker has to combine these pieces of evidence in some way in order to reach a conclusion. How much stronger is the combination of two pieces of evidence compared to each piece individually? A question like this is very difficult to solve intuitively, but the formal logic of the Bayesian framework allows us to give an exact answer: if the two pieces are independent, the LR of the combination of the two pieces simply equals the product of the LR of each piece separately. For example, suppose that paint chips and striation marks found on a screwdriver of a suspect match the paint type and the toolmarks in a window pane at the crime scene, and that the LR of the paint is 10 and that of the toolmarks is 5. Then the LR of the combination of paint and toolmarks is 50. If the pieces of evidence are not independent, or if there are more than two pieces, the calculations become more difficult but exact formulae are easy to derive.36

Thus the Bayesian framework provides a logical way to combine two or more pieces of evidence. Examples like the one above may clarify juridical discussion over whether the combination of several pieces of weak evidence can be enough to convict a person, or whether this requires at least one piece of strong evidence. Using other approaches, such as classical hypothesis testing,37 the correct way to combine pieces of evidence is far more complicated. Nevertheless, I think that this advantage of Bayesian reasoning lies more in providing a theoretical basis than in practical applications: in practice, the pieces of evidence are often not independent which complicates the calculations considerably. Furthermore, in practice the LR is often given in verbal form because relevant data are lacking. Finally, the formulae become a lot more complicated if one takes into account that in practice the LRs are not known exactly but have to be estimated (see 4.2.7 and 4.2.8).

4.1.8 **The Bayesian framework facilitates harmonization of expert conclusions**

Proficiency tests in e.g. shoe print analysis show that conclusions may vary considerably between experts.38 One of the causes may be the lack of a common framework for interpreting evidence: experts use different ways to assess the strength of the evidence. Since the Bayesian framework is gener-

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ally applicable in many types of forensic casework, a lot of confusion could be avoided if all experts used the LR as a measure of the strength of the evidence. Furthermore, the LR is perfectly suitable for a simple translation into terms of a verbal scale or a point scale. The Bayesian framework may thus help to harmonize the conclusions.

4.2 Arguments contra Bayesian reasoning

4.2.1 People do not reason in a Bayesian way
Psychological literature suggests that people do not intuitively reason in a Bayesian way. Therefore we cannot expect that the Bayesian framework is a good descriptive model for legal decision making, and it may be unwise to force decision-makers to reason in a way they are not familiar with. Hence, Bayesian reasoning should not be used in legal trials by untrained decision-makers such as most jury members.

4.2.2 People do not understand likelihood ratios
If legal decision-makers do not reason in a Bayesian way, this raises the question of whether they can correctly interpret expert opinion formulated as a LR in numerical form. Research seems to indicate that many of them do not. For example, statements like "my observations are a million times more likely to occur if the suspect left the bloodstain than if an unrelated other individual from the Dutch Caucasian population left the bloodstain" are difficult to grasp for many people. Hence, experts should realise that their conclusion may not be understood well if they formulate it as a LR without further explanation.

A solution might be to formulate a verbal conclusion about the strength of the evidence, for example: “my observations are very strong evidence that the suspect left the bloodstain rather than another individual unrelated to the suspect”. It is important to investigate how conclusions like this are interpreted by both experts and legal decision-makers. Another option is to educate legal decision-makers, but in case of jury members this may not be feasible.

4.2.3 There is no legal basis for estimating the prior odds

One of the elements of the Bayesian framework are the prior odds that the suspect committed the crime. As can be seen from equation (6), the prior odds critically determine the posterior odds. Because of the presumption of innocence, it is obvious that any estimate of these prior odds should be low. How low should they be? Many have argued that since there is no procedure to arrive at an estimate for the prior odds, the Bayesian model is useless in legal trials. Others believe that although it is difficult it can be done.

Fortunately, estimating prior odds is never a problem for forensic scientists since they should restrict themselves to commenting on the LR only. Nevertheless, I think that it is a serious problem indeed for legal decision-makers if they want to use the Bayesian model to actually calculate the odds that the suspect committed the crime. However, the merits of the Bayesian framework do not lie in calculating such odds, but more in guiding and stimulating thought.

4.2.4 Bayesian analysis is computationally too complex for legal decision making

Bayesian analyses of legal cases often become computationally very complex: the number of probability assessments to analyse soon becomes overwhelming; when the evidence is not independent one must assess complex conditional probabilities; and when there are more than two

47 Appeal Court ruling in Adams case, see e.g. R. Matthews, Rape case ruling undermines faith in juries, New Scientist, 1996, 8(7).
hypotheses to consider, it is hard to keep track of all combinations. This has been used as an argument that the Bayesian framework does not work in practice for legal trials.\textsuperscript{50}

In response to this criticism, Friedman\textsuperscript{51} and Robertson and Vignaux\textsuperscript{52} argue that this complexity can often be reduced to acceptable proportions by using approximations and upper/lower limits. Furthermore, graphical methods such as graphs\textsuperscript{53} and tree diagrams\textsuperscript{54} have been used in combination with Bayesian reasoning to deal with complex cases. I think that these methods in combination with simplifying assumptions can increase insight to a great extent. However, there is a trade-off between keeping things realistic and keeping things simple, and it is difficult to find a good balance between the two. For forensic casework I am optimistic that Bayesian reasoning can be applied without oversimplifying the case.

Fienberg\textsuperscript{55} admits that computations can become complex, but sees no defensible alternative since the complexity is not inherent to Bayesian theory but to the legal case itself. I agree with him: perhaps Bayesian analysis painfully exposes the complexity of legal cases, but this is not a valid argument against the analysis itself. Fienberg believes the solution lies in education. I think, however, that education can only partly solve the problem. Proper education would require at least a one year-course, which is simply impossible in case of jury members. For professional legal decision-makers such as judges, I think that education in probability theory and the Bayesian framework could be very useful, but I doubt if this would enable them to do complex computations as described above. Experts, on the other hand, could be trained to analyse routine casework in their own field of expertise.

4.2.5 The lack of relevant data precludes calculation of the LR

In many cases the LR cannot be calculated because relevant information is missing.\textsuperscript{56} Robertson and Vignaux\textsuperscript{57} respond to this criticism that the Bayesian analysis thus reveals that relevant information is missing, and which

\begin{itemize}
\item \textsuperscript{51} Friedman, R.D., Answering the Bayesioskeptical challenge, \textit{The international journal of evidence and proof}, 1997a, 1, pp. 276-291.
\item \textsuperscript{55} Fienberg, S.E., Theories of legal evidence: what properties should they ideally possess and when are they informative?, \textit{The international journal of evidence and proof}, 1997, 1, pp. 309-312.
\end{itemize}
information is relevant. It thus shows us that the evidence is incomplete, which would otherwise perhaps not be noticed. Furthermore, the expert may be able to provide an educated guess of the order of magnitude of the missing data on the basis of related databases or experience. This may be used to arrive at a verbal assessment of the LR.

It seems to me that the lack of relevant data can hardly be used as a criticism against Bayesian reasoning: this will be a problem for any type of rational reasoning. Just as with complexity, the problem lies in the legal case itself, not in the way of reasoning. I guess it is something experts and legal decision-makers just have to live with.

4.2.6 Relevant hypotheses may be thought of only after the evidence is presented

According to the Bayesian framework, the strength of the evidence can only be accurately assessed if all relevant hypotheses are known. However, hypotheses may be raised at all times during trial. Hence, a practical objection against Bayesian reasoning in court is that the logistics of the trial do not allow Bayes' theorem to be used.50 However, Donnelly,56 Fienberg55 and Robertson and Vignaux52 argue that it is not necessary for the legal decision-makers to analyse the evidence before they have heard all of it.

Nevertheless, since in practice forensic scientists are only asked once or twice in each case to express their opinion, it is essential for them to know which hypotheses must be considered. It seems to me that it indeed is a serious problem if relevant alternative hypotheses come up after they have written their reports or testified at trial. In this case they will have to review their conclusion, otherwise their testimony is incomplete. Since Bayesian reasoning emphasises the importance of alternative hypotheses, these will be considered and preferably discussed with the legal decision-makers at an early stage. Hence, one would expect that the number of additional reports and testimonies will decrease.

4.2.7 The variance of the LR is often ignored

Usually, the LR cannot be calculated exactly because the available data are incomplete in some sense, for example, they consist of samples from the population at issue. The result of the calculations therefore is only an estimate of the true but unknown value of the LR. In statistics, it is customary to accompany such estimates with an indication of how much the true value may deviate from the estimate. For example, the average of a population sample, which estimates the true mean in the whole population, is usually accompanied with a confidence interval for that true mean.

The literature on the use of the Bayesian framework in forensic science tends to focus on the estimation of the LR only.57 Since any estimate is

effectively useless if we have no clue how much it can deviate from the true value, it seems to me that the estimation of this deviation should receive far more attention than it has in the past. It should be an area of future research.

4.2.8 Broadness of informational base is not taken into account

The probability estimates used in Bayesian reasoning are based on information. The reliability of this information may vary, but this is not taken into account by the Bayesian framework. As Stein puts it: since the informational base of each piece of evidence varies, these pieces cannot simply be combined as suggested in Bayesian reasoning. For example: suppose that an expert in speaker identification observes that the person on the tape and the suspect both pronounce a certain word in an uncommon way. Using Bayesian reasoning, the expert tries to estimate the probability of this observation (i.e., the uncommon pronunciation) under different hypotheses. The reliability of these estimates will depend on the information on which it is based. It could be based on a vast amount of literature, a small experiment among students, or personal experience.

The Bayesian framework neglects differences in informational base and consequently combines pieces of evidence with varying informational base. This argument is apparently related to the previous one: the Bayesian framework treats the probabilities as if they are known exactly. Under this assumption, sampling errors and varying informational bases can safely be ignored. In practice, however, probabilities have to be estimated which necessitates more research on the effect of these uncertainties.

4.3 Misconceptions about the Bayesian framework

4.3.1 The Bayesian approach is a complete model for practical legal decision making

Some scholars have criticised the use of Bayesian reasoning in legal cases for not capturing every aspect of legal decision-making. This is a very true point, but hardly a criticism of the Bayesian framework because it does not intend to be a complete model for this. As Robertson and Vignaux put it: “it is true that Bayesian reasoning is only a method for
reasoning about hypotheses in the light of evidence." It can hence stimu-
late thought but cannot be the only process for, e.g.: 
• generating prior odds, generating hypotheses and generating evi-
dence;\textsuperscript{60,52}
• interpreting legal criteria (for example, whether or not the suspect is
guilty is a different decision than whether or not he committed the
crime, see 4.3.8), and defining legal concepts like the standard of per-
suasion;\textsuperscript{51,60,61}
• assessing evidential aspects, such as relevance;\textsuperscript{26,62}
• defining when the 'leap of faith'\textsuperscript{12} is justified to reach a categorical ex-
pert opinion such as 'this mark was made by this tool'.\textsuperscript{13}

Furthermore, many 'Bayesian enthusiasts' think that Bayesian reasoning is 
ot something that people do intuitively, and should therefore not be ap-
plied by untrained legal decision makers. Moreover, since the meaning of a 
LR is easily misunderstood, experts should be very careful when formu-
lating their conclusion. Training legal decision-makers at trial soon be-
comes too technical and should preferably be avoided or kept very sim-
ple.\textsuperscript{60,51}

I nonetheless agree with many Bayesian enthusiasts that Bayesian rea-
soning is extremely useful when used by trained persons to evaluate the 
strength of given evidence in the light of given hypotheses; and to stimu-
late thought about practical legal cases and about fundamental theoretical 
issues.\textsuperscript{60,51,52} It is especially useful for forensic scientists as a guideline in 
their thought process.

4.3.2 One needs numbers to use it
The Bayesian framework has become known to the forensic science com-
munity mainly through its use in DNA profiling. The many DNA databases 
allow well-founded numerical estimates of the LR. By contrast, in most 
other forensic fields such as handwriting, shoeprints, toolmarks, firearms 
etc. there are usually not enough data to calculate a LR. This has led a 
number of scientists to believe that the framework is useless in these ar-
eas.\textsuperscript{63} However, one can still apply Bayesian reasoning to guide one's 
thought process to arrive at a verbal assessment of the strength of the evi-

\textsuperscript{60} Friedman, R.D., Towards a (Bayesian) convergence?, The international journal of evidence 
and proof, 1997b, 1, pp. 348–353.
\textsuperscript{61} Kaye, D.H., Statistical decision theory and the burdens of persuasion: completeness, 
generality and utility, The international journal of evidence and proof, 1997, 1, pp. 313–
315.
\textsuperscript{62} Aitken, C.G.G., Statistics and the evaluation of evidence for forensic scientists, Chichester: 
Wiley 1995, chapter 6.5.
\textsuperscript{63} Davis, R., O. Facey, P. Hamer and D. Rudram, 'Interpretation of scientific evidence', 
correspondence in Science & Justice, 1997, 37, p. 64.
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dence. In fact, most of the advantages of the Bayesian framework mentioned in section 4.1 also apply if data are lacking.

4.3.3 The Bayesian framework only applies to ‘body-related’-evidence

Since the Bayesian framework in a forensic context became known through its use in DNA analysis, some people have the impression that it can only be used for evidence that is body-related, such as DNA, hair, voice, foot- and fingerprints (personal communication). However, it can just as easily be applied to other areas such as fibres. Numerous examples are given in e.g. textbooks by Robertson and Vignaux and Aitken and in recent forensic science journals.

4.3.4 I consider the whole population to estimate prior odds

As explained in section 3.2.2, the role of the expert is to evaluate the LR, and not to comment on the prior or posterior odds. Some experts claim that they can safely comment on the posterior odds because they use an objective procedure to estimate the prior odds. For example, in bullet comparison this procedure would run along the following lines: “consider the world population of firearms, and assume that each element of this population is equally likely to have fired the bullet found at the crime scene. If there are N firearms in the world, then the prior odds that the bullet was fired from this particular firearm are 1/N-1. Since bullet comparison in general yields very strong evidence, the LR usually is very large, so that conclusions like ‘It is likely that this bullet was fired by this firearm’ (which is a verbal description of large posterior odds) are justified.”

In principle this argument is correct, although one could question the estimation of N as well as the assumption that all elements are equally likely to have fired the bullet. However, as Champod argues, since N is usually very large, the LR necessary to arrive at large posterior odds is extremely large. Champod questions if forensic scientists are aware how incredibly strong the evidence must be to justify their conclusion based on this ‘world population’ prior odds. Posterior odds of e.g. 20 to 1 that the bullet was fired from the gun require a LR of 20 x (N-1). This means that if N is of the order 1 million, then the required LR is of the order 20 million. Would the forensic scientist be prepared to testify that the evidence is indeed this strong?

Furthermore, if one asks forensic scientists making statements like “it is highly likely that the bullet was fired by this firearm” how many other guns in the whole world could also have fired the bullet (based on technical bullet comparison), they come up with numbers like one or two. Now suppose that there is one other gun in the whole world that could also have

fired the bullet. Since on technical grounds the two guns are more or less equally likely to have fired the bullet, the expert must use additional information to arrive at his conclusion that it was 'highly likely' the suspect gun. This information can be, for example, that the police do not usually give random guns for bullet comparison, in other words, the prior probability of the suspect gun is higher. However, this information is also used by the legal decision-maker and is thus used twice against the suspect. Obviously, this is a violation of legal rules and should be avoided.

4.3.5 Bayesian reasoning is objective
The Bayesian approach is sometimes called the 'logical' approach. This is sometimes interpreted as a claim that the Bayesian approach is an objective way for a scientist to evaluate the evidence. For example, Allen criticises the Bayesian approach by arguing that Bayes' theorem applied by different individuals could lead to different results, and that consensus cannot be reached in the same way as in scientific research. However, objective science does not exist, assumptions and choices always have to be made. Hence, the claim that it is a logical interpretation does not mean that it is objective in the sense that it yields one indisputable 'true' outcome.

4.3.6 Bayesian reasoning is subjective
When calculating the numerator of the LR one assumes that the prosecution case is true. This may cause the misconception that the LR is based on this assumption. However, the LR only compares the probability of the evidence under two different scenarios: that of the defence and that of the prosecution. This is not based on the assumption that either the defence or the prosecution case is true.

4.3.7 Prior odds 1 are neutral
Suppose there are two hypotheses of interest. Since prior odds of 1 (or, equivalently, prior probabilities of 0.5) mean that it is equally likely either hypothesis is true, it is sometimes thought that this is a neutral position for a forensic scientist to start his investigations. This, however, is obviously in conflict with the presumption of innocence principle, which implies that very low prior odds on guilt should be assumed. It furthermore violates the principle that an expert should not usurp the role of the legal decision-makers by making assumptions about the prior odds. Nevertheless, in some areas it is common practice to assume prior odds of 1, for example in

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paternity testing. I agree with Robertson and Vignaux\(^6^8\) that there is absolutely no basis for doing so.\(^6^9\)

4.3.8 The Bayesian framework calculates the probability that the suspect is guilty

Some of the literature explaining the use of Bayesian analysis in a legal setting use words like 'guilty' and 'innocent' as a sort of short-hand notation for the hypotheses put forward by the prosecution and the defence.\(^7^0\) Since guilt and innocence also have a very specific legal meaning this notation has caused some to believe that the Bayesian framework actually calculates the probability that the suspect is guilty.\(^6^5\) However, this is a misconception that is based on an unfortunate abbreviation. The legal decision-maker can use Bayesian analysis to update his prior belief in the hypotheses put forward by the prosecution and the defence on the basis of the evidence that is presented. He can subsequently use his posterior belief to reach a decision of guilt or innocence. Bayesian theory is not involved in the latter decision process.\(^5^2, 5^6, 5^5\)

5 Consequences of applying Bayesian reasoning in forensic science

5.1 Consequences for forensic experts

Bayesian reasoning requires a different way of thinking from forensic experts. In short, it comes down to asking oneself two questions: "how likely are my observations if the hypothesis put forward by the prosecution is true?", and "how likely are my observations if the hypothesis put forward by the defence is true?". This is quite a different point of view than asking oneself: "given my observations, how likely is the hypothesis put forward by the prosecution?", which is current practice in most areas.

The power of Bayesian reasoning is that it guides the expert's thought process: starting with the definitions of the evidence, relevant hypotheses and the background information, then assessing the probability of the evidence under the hypotheses, and finally formulating a conclusion about the strength of the evidence. When following these steps, the expert can derive the relevant aspects of the evidence in a natural way.

For example, suppose that a burglar smashes a window and that a suspect is arrested a few hours afterwards. Thirty glass fragments are found in the suspect's clothes and their refraction indices are analysed. A 'classical' expert would determine how many fragments 'match' the window glass. He would report e.g. that 25 of the 30 fragments match, and that e.g. 2% of a database of window glass consists of this type of glass. He would sub-


\(^7^0\) See e.g., some of the papers in C.G.G. Aitken and D.A. Stoney (eds), *The use of statistics in forensic science*, Chichester: Ellis Horwood 1991.
Pros and Cons of Bayesian Reasoning in Forensic Science — Marjan Sjerps

sequently assess the probability that the glass fragments originate from the window. A ‘Bayesian’ expert would assess the probability of the refraction indices of the 30 fragments if indeed the suspect smashed the window and if he did not, using a database of glass fragments found in people’s clothes. He would then report e.g. that the findings strongly increase the support for the hypothesis that the suspect smashed the window against the hypothesis that he did not. Thus, the Bayesian expert does not make a match/mismatch decision, he uses a different database and he formulates his conclusion in terms of the strength of the evidence instead of the probability of a hypothesis.

Optimal use of Bayesian reasoning requires that the expert decides on the relevant hypotheses that he will consider. It is therefore important for him to learn as much as he can about the case itself. This seems contrary to the view that one should know as few case details as possible in order to preserve objectivity. Unfortunately, an objective opinion about irrelevant hypotheses is not of much help, so I do not share this view.

Applying Bayesian reasoning in forensic casework will require some training and practice. In my experience, it is sometimes difficult to distinguish between evidence and information, to formulate relevant hypotheses, and to keep track of all possibilities. Furthermore, assessing the probability of observations given a hypothesis may initially seem counterintuitive, since “it is certain that I observed this, whereas it is uncertain that the suspect committed the crime”. It can also be discouraging when Bayesian analysis reveals that many relevant data are lacking. Fortunately, however, the number of papers on applications of Bayesian reasoning in practical forensic casework is increasing rapidly, so that practical examples of applications are available in many areas of forensic science. Graphical tools may be used to keep track of all possibilities and dependencies (4.2.4). Cook et al. address the issue of formulating hypotheses. I expect that once experts get used to it, Bayesian reasoning will be highly appreciated and used routinely as a guideline in casework and research.

5.2 Consequences for legal decision-makers

A consequence of Bayesian reasoning is that experts pay more attention to alternative hypotheses. They must therefore receive enough information about the case to decide, preferably in concert with the legal decision-maker, which hypotheses will be considered. For example, suppose that a woman claims to have been raped by a suspect, and that the sperm fraction of the vaginal swabs is a mixture of semen. The expert can tell the legal decision-maker that the swabs contain semen of at least two men, and that the suspect could be one of the donors. However, he can only

71 See e.g. C.G.G. Aitken, Statistics and the evaluation of evidence for forensic scientists, Chichester: Wiley 1995.
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calculate the strength of this evidence under the assumption of the total number of donors. The legal decision-maker should therefore inform the expert which number(s) he considers relevant in this particular case. In current practice, such information is usually not provided, and the expert has to guess on the basis of very limited information which hypotheses are relevant. Thus, it is important that legal decision-makers discuss with the experts which hypotheses should be considered.

Another consequence of Bayesian reasoning is that the traditional way of expressing expert opinion will change: experts will report on the strength of the evidence rather than on posterior probabilities of hypotheses. For example, conclusions like “the results greatly increase the support for the hypothesis that this hair came from this person against the hypothesis that it came from an unknown Dutch person” will be used rather than “this hair very probably came from this person”. For legal decision-makers, the latter conclusion may seem more attractive than the first because it seems simpler and stronger. However, the latter conclusion is implicitly based on an assumption of a prior probability. There are three objections to such assumptions: first, they are not the province of an expert; second, they are not mentioned in the conclusion which is misleading; third, because they are not mentioned they lead to ‘double counting’ because the legal decision-maker uses the same information to arrive at prior probabilities.

Finally, Bayesian reasoning should make legal decision-makers more aware of the limited role of the expert. Experts may not assess prior probabilities, neither implicitly nor explicitly. This implies, however, that legal decision-makers should not ask experts to do so. As explained in the example above, questions like: “how likely is it that this hair came from the suspect?” cannot be answered by an expert. A more appropriate question is “how likely are your observations if the hair came from the suspect and if it came from an unknown Dutch person?”. Hence, the Bayesian framework does not only require experts to think differently. Legal decision-makers should ask differently too.

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4 Singular Evidence and Probabilistic Reasoning in Judicial Proof

David A. Schum

It is not uncommon to see all probabilistic reasoning in the field of law characterized as being statistical in nature. One reason is that there is a connection between the words probability and statistics, since all statistical inferences are probabilistic in nature. The trouble is that the converse is not true; not all probabilistic reasoning is statistical in nature. Whether an instance of probabilistic reasoning is statistical or not depends, among other things, on the hypotheses being entertained and on the nature of the evidence from which conclusions about the likeliness of hypotheses are to be drawn. In statistics, hypotheses commonly involve parameters or numerical characteristics of well-defined populations. Examples are population means, variances, and correlations. In law, hypotheses or major facts in issue commonly involve individual persons or organizations and their behavior in particular situations. Statistical evidence takes the form of numerical characteristics of samples of repeated observations of various events. These numerical characteristics are called statistics and include such indices as sample means, variances, and correlations. In law, so much of the evidence encountered is singular, unique, or one-of-a-kind and involves events that cannot be replicated or repeatedly observed. I do not suggest that statistical evidence is never encountered in litigation. Statistical data, summarized in various ways, do find their way into deliberations at trial or in other forms of settlement of disputed matters. For quite some time there has been considerable argument about the relevance of statistical data as evidence in inferences made in our courts that concern individual persons or organizations and their behavior in particular situations.

In this paper I will not argue for or against the relevance of statistical data in litigation. My present comments concern interesting and difficult inferential problems that arise when the evidence in probabilistic reasoning is singular, unique, or one-of-a-kind. In particular, I wish to examine the basis for probability assessments made about events that cannot be observed over and over again as is the case for statistical or frequentistic evidence. Inferences based on evidence about singular or unique events are

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certainly encountered in history, intelligence analysis, medicine, auditing, and in many other disciplines. So, the problems I address are not by any means confined to dispute resolution in our courts.

1 Enumerative and nonenumerative probabilities

A fundamental problem is that so many different interpretations can be placed on probabilities. Part of this difficulty arises because there are different contexts in which the need for probabilistic reasoning arises. One result is that we now have several formal systems of probabilistic reasoning, each of which adds to our understanding of situations in which we must base conclusions on evidence that is always incomplete, usually inconclusive, commonly dissonant, frequently ambiguous, and that comes from sources having any gradation of credibility. My own pluralistic view, expressed in other places, is that probabilistic reasoning is far too rich an intellectual activity for us to suppose that we can capture all of this richness in any single formal system. In thinking about the various formal systems of probabilistic reasoning that now exist it is useful to make a distinction between two different contexts in which probabilistic reasoning is necessary. In some situations we determine probabilities by enumerating outcomes. In games of chance, played according to well-defined rules, we determine aleatory probabilities or chances by counting outcomes. Suppose \( S \) is a finite set of possible outcomes, all assumed to be equally probable, that can happen on any trial of a game of chance. We determine the probability of some event \( E \), a subset of these outcomes, by counting the number of outcomes \( n(E) \) favoring \( E \) and dividing this by the total number of outcomes \( n(S) \). In this case \( P(E) = n(E)/n(S) \). In other situations where we have no basis for assuming equally likely outcomes, to estimate the probability of some event \( E \) we count the number of times we observe event \( E \), \( n(E) \), and divide this by the total number \( N \) of observations we have made. The result \( f(E) = n(E)/N \) is called a relative frequency and forms the basis for statistical analyses. It is clear that \( f(E) \) is just an estimate of the probability \( P(E) \) since \( N \) represents just a sample of the possible number of observations we might have made. It is also clear that Kolmogorov had aleatory probabilities and relative frequencies in mind when he formulated his axiomatic system for probabilities that we all learn about in school. In this system, probabilities are numbers between zero and one inclusive and are additive across events that are mutually exclusive.

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3 \( P(E) \) stands for Probability of some Event.
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The trouble, of course, is that these two enumerative conceptions of probability do not take us very far in capturing all of the situations in which people naturally wish to assess probabilities of events of interest. In many situations, law being a prime example, we cannot assume equally likely outcomes any more than we can count past occurrences of events to determine relative frequencies. The reason is that the events of interest, if they have occurred, they have done so only once. In such instances our only recourse is to assess or judge probabilities based on whatever information we have about these events and the situations in which they occurred or did not. A bit later, I will explain that the basis for these subjective or epistemic judgments of probabilities is what is termed ancillary evidence.

Other forms of nonenumerative probability are discussed in the works of Cohen and Shafer. In Cohen’s Baconian system of probability for eliminative and variative inference, evidence is used to eliminate hypotheses. The hypothesis best surviving this eliminative process is the one in which we should place greatest confidence. In Shafer’s system of Belief Functions, there are methods for grading the support evidence provides for various subsets of our hypotheses. Neither Cohen’s Baconian probabilities nor Shafer’s Belief Functions have the same properties as do conventional Kolmogorov probabilities. In addition, as I have explained elsewhere, the weight, force, or strength of evidence is graded quite differently in these three formal probability systems.

2 On the assessment of nonenumerative probabilities

I have mentioned the singular or unique nature of both hypotheses and evidence in court trials and in other forms of settlement of matters in dispute. Hypotheses and evidence in law concern individual persons or organizations and their alleged behavior in particular situations. So it is not unexpected that scholars and practitioners in law have questioned the applicability of any formal system for probabilistic reasoning in these matters that assumes the counting or enumeration of the occurrence of events. In doing this enumeration, we necessarily count the occurrence of events that are not at issue in the legal dispute at hand. For example, whether defendant has done A is relevant in a current legal dispute. The fact that 80% of other persons in a large sample have done A involves a count of people whose behavior is not an issue in the trial involving this defendant. Do any of the nonenumerative probabilistic systems I have mentioned fall heir to this same criticism? For example, it might be argued that, in judging an

7 Supra footnote 2, pp. 200–263.
epistemic or subjective probability for some singular or unique event E, a person mentally canvases her/his past experience in order to judge the relative frequency of occurrence of events similar or related to event E. If this is how we commonly assess epistemic probabilities, then there will also be room for criticism since the similar or related events [whatever they might be] can be perceived as having no bearing on the individual and particular matters at issue in a legal dispute. I begin by considering the work of two legal scholars who have voiced exactly this concern about the basis for epistemic or subjective probability judgments.

In a very perceptive and cleverly-written paper, Professors Paul Bergman and Al Moore [both at UCLA Law School when their paper was written] assert a number of concerns about the formal representation of probabilistic reasoning in law by means of ordinary or Kolmogorov probabilities. Among their major concerns is the basis for probability judgments about hypotheses and evidence that involve singular or unique events. Bergman and Moore argue that conventional probabilities eventually require a statistical or frequentistic interpretation and are therefore inappropriate to the individualistic judgments necessary regarding the singular historical events that are the subject of dispute in law. In their analysis, Bergman and Moore offer three interpretations of probability judgments, only one of which they argue is acceptable in inferences in law. They might have offered many other interpretations in addition to the ones they provided. Indeed, the distinction I just made between enumerative and nonenumerative probabilities is not the only one that might be made. Jonathan Cohen has argued that ordinary or Kolmogorov probabilities suffer an embarrassment of riches since so many interpretations have been placed on these probabilities. He provides an analysis of six different interpretations of Kolmogorov probabilities that have been seriously considered.

Here are the three interpretations of Kolmogorov probabilities provided by Bergman and Moore. The first interpretation they term objective frequentist probability. In this case we have the enumerative relative frequencies I mentioned above. We estimate P(E) by the relative frequency f(E) = n(E)/N. Appropriate counting is the only operation involved in determining f(E). Their second interpretation they call subjective frequency judgments. Here is the case I mentioned above in which a person, asked to judge the probability of some event E, canvases her/his past experiences and somehow mentally tabulates the relative frequency of occurrence of events that are similar or related to event E. Bergman and Moore argue that these two probability mechanisms are quite inappropriate to the probability judgments required in the settlement of disputes about unique or singular events. They argue that what is required in legal contexts are believability

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9 Supra footnote 5, 1989, p. 91.
judgments that must refer to the singular or unique events at issue and which must be based on other particular evidence about these events. The essence of the argument Bergman and Moore make is that the ordinary or Kolmogorov conception of probability invites both objective frequentist and subjective frequency interpretations, which cannot be appropriate in law, and that also provide no grounding for the believability judgments that are appropriate in law.

That objective relative frequencies are never available to sustain probability judgments for singular or unique events is uncontroversial. But subjective frequency interpretations of ordinary probabilities are possible, even though they may be quite inappropriate in law. For example, Professors Glenn Shafer and Amos Tversky have argued that probability judgments resemble thought experiments that can be performed according to different systems of rules.¹⁰ One set of rules might allow a person to think in terms of Kolmogorov probabilities and to ground her/his thought experiments involving probability judgments for any event on such enumerative processes as chances or relative frequencies. Other sets of rules might be based on concepts that come from Shafer’s system of belief functions that I mentioned earlier. The rules that people actually employ in making probability judgments about singular or unique events, when they are unassisted in any way, have never been identified. Bergman and Moore argue that the ‘similar or related’ events forming any enumerative basis for a subjective frequency judgment are also irrelevant to the unique or singular events in the case at hand.

My purpose now is to show that the believability judgments Bergman and Moore mention can in fact have a basis in concepts that come from Kolmogorov probabilities and Bayes’ rule. But to show how this happens, I must make use of other concepts that are brought to our attention in Jonathan Cohen’s Baconian system of probability. On another occasion, I have argued that the Baconian and Bayesian systems of probability are not natural adversaries; in many instances they can be mutually supportive.¹¹ I will also draw upon another work by Paul Bergman that supports the ideas offered by Cohen.¹² Later I will make a connection between Bacon and Bayes. I now return to the definition of believability judgments given by Bergman and Moore. They tell us that, for singular or unique events, these judgments must be based on other particular evidence about these events. This definition allows me to introduce the very important

distinction between directly relevant and indirectly relevant or ancillary evidence.

Evidence is said to be directly relevant if one can form a defensible argument or chain of reasoning from this evidence to a major hypothesis or fact in issue. Evidence is said to be indirectly relevant, or is ancillary evidence, if it bears only upon the strength or weakness of links in chains of reasoning set up by directly relevant evidence. As a Swedish colleague Per Olof Ekelof [Uppsala University] reminds us, what we call a 'piece of evidence' is actually an item of evidence together with auxiliary facts attached to it. Instead of using the terms ancillary or auxiliary to describe indirectly relevant evidence, we might also say that it is meta-evidence; i.e. evidence about other evidence and its probative force or strength. I will now argue that what can support a conventional probabilistic believability judgment about some singular or unique event is an appropriate collection of ancillary evidence items that also refer to singular or unique events. In short, I will attempt to provide a representation for Bergman and Moore's believability judgments that can have all the properties of ordinary Kolmogorov probabilities.

![Figure 1](image)

Shown in Figure 1 is a link in a chain of reasoning set up by some item of directly relevant evidence. Suppose we reason that event C, if true, would allow the inference that event D occurred. To defend the inference of D from C we need to assert a generalization that supports or licenses this inference. Ancillary evidence to test the applicability of this generalization.

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ference. The generalization might read: “Whenever something like C happens then something like D probably happens”. As its name suggests, a generalization is a statement about things in general. Whether this generalization applies in the particular inference at hand requires evidence suggesting that it does apply in this particular instance. As the figure illustrates, it is ancillary evidence that can either support or undermine the applicability of this generalization to the particular inference at hand. There is never any guarantee that an asserted generalization does apply in a particular instance. How strongly ancillary evidence supports generalization G also bears upon the strength of the probabilistic linkage between events C and D.

Also notice that the generalization mentioned above is hedged by the term ‘probably’. The generalization does not assert that event D always follows from event C. Thus, the generalization is inductive or probabilistic in nature since it does not say [deductively] that D follows necessarily from C. There are many ways to hedge a generalization and I have given just one example. Different hedges could be employed to suggest different strengths of an inference from C to D. For example, the generalization might read: “Whenever something like C happens, then event D is very probable”. As I have noted elsewhere, these verbally stated hedges are examples of fuzzy qualifiers that appear in the system of fuzzy or approximate reasoning made so popular in the work of Lotfi Zadeh.\(^\text{14}\) Such fuzzy hedges are entirely necessary in all instances in which we do not have any precise enumerative or statistical basis for linking one event with another in a chain of reasoning. In some cases involving replicable events, we are able to hedge a generalization in statistical terms. But in such situations we would run afoul of Bergman and Moore’s sanctions against enumerative probabilities in drawing conclusions based upon evidence about the singular or unique events so commonly encountered in law and elsewhere.

Acknowledgment of the importance of generalization-based reasoning appears in many places. Jonathan Cohen tells us that jurors come to trials already stocked with “…a vast number of commonplace generalizations about human acts, attitudes, intentions, etc…”\(^\text{15}\) Paul Bergman himself, in his work with David Binder,\(^\text{16}\) dwells on the importance of inductive generalizations in legal reasoning. There is, perhaps, no better assessment of the variety and importance of generalizations in legal reasoning than the one found in the work of Terry Anderson [University of Miami (Florida) Law School] and William Twining [School of Law, University College London].\(^\text{17}\) The importance of generalizations and their backing with

\(^{14}\) Supra footnote 2, pp. 263–265.
\(^{15}\) Supra footnote 5, 1977, pp. 274–275.
\(^{16}\) Supra footnote 12.
ancillary evidence was stressed years ago in the work of the philosopher Stephen Toulmin.¹⁸

3 An example of nonenumerative probability assessment

As an example of nonenumerative probability assessments that satisfy the requisites of such assessments as specified by Bergman and Moore, I draw upon evidence in a murder trial that is arguably America’s leading cause célèbre, the case of Nicola Sacco and Bartolomeo Vanzetti. In a recent work, Professor Jay Kadane [Carnegie-Mellon University] and I have provided a probabilistic analysis of the mass of trial and post-trial evidence in this case.¹⁹ Briefly, Sacco and Vanzetti were tried, convicted, and executed for allegedly robbing and killing a payroll guard named Alessandro Berardelli on the streets of South Braintree, Massachusetts in April of 1920. Both Sacco and Vanzetti were implacable anarchists and the issue is still in doubt today about whether they were convicted because they did murder Berardelli or simply because they were anarchists who supported causes that were publicly unpopular. Their conviction and execution resulted in waves of public outrage in America and around the world. Interest in this case will not subside. As recently as 1983 tests were still being made of the firearms evidence produced at their trial in 1921.

Figure 2 provides an example of generalization-based reasoning and nonenumerative probability assessment involving the testimony of a witness in the Sacco and Vanzetti trial named Lewis Pelser. I use this example to show how the testing of inductive generalizations based on ancillary evidence provides a basis for a conventional or Kolmogorov interpretation of the believability judgments sanctioned as legitimate in legal reasoning by Bergman and Moore. Pelser, one of the prosecution’s ‘star’ witnesses, worked in a shoe factory in front of which the shooting of Berardelli and another payroll guard occurred. Among the several events to which Pelser testified was that, looking out the window when he heard shots being fired, he saw a man at the scene of the shooting whom he identified at trial as Sacco. Pelser’s testimony was admitted as relevant by the judge in this case.

In Figure 2, \( E^* \) represents Pelser’s testimony that event \( E \) occurred; \( E \) being the event that Sacco was actually at the scene of the crime when it occurred. Notice that both \( E^* \) and \( E \) are singular or unique events. A distinction between evidence \( E^* \) and event \( E \) is necessary since \( E^* \) does not entail that event \( E \) occurred. We might of course have Pelser’s testimony that event \( E \) occurred when it did not. So, the first stage in our reasoning

needed: $P(E|H)$ and $P(E|\neg H)$

Figure 2

- **H**: Sacco shot the payroll guard
- **H'**: Sacco did not shoot the payroll guard

**G2**: "Persons who are at the scene of a crime when it occurs are often involved in committing this crime"

- **E**: Sacco was at the scene of the crime when it occurred
- **E'**: Sacco was not at the scene of the crime when it occurred

**G1**: "The events reported by witnesses testifying under oath have probably occurred"

- **E***: Pelser's Testimony

is from $E^*$ to events $E$ or $E^c$ ($E^c$ is read "E-complement" or "not-E"). A generalization that licenses an inference from $E^*$ to $E$ might read: "The events reported by witnesses testifying under oath have probably occurred". The question, of course, is whether this generalization applies to Pelser and to the specific testimony he gave on this particular occasion. Suppose, for the moment, that Sacco was at the scene of the crime when it occurred [i.e. suppose event $E$ is true]. The actual occurrence of event $E$ would seem to license an inference that Sacco was probably the one who did the shooting. A generalization at this second stage of reasoning might read: "Persons who are at the scene of a crime when it occurs are often involved in committing this crime".

Let us now suppose that we contemplate doing a Bayesian analysis of the probative force of Pelser's testimony on the hypotheses: $H = \text{Sacco shot the payroll guard, and } H' = \text{Sacco did not shoot the payroll guard.}$ In Bayesian terms, the force of evidence is given by a quantity called likelihood ratio. In the case of Pelser's testimony $E^*$, the likelihood ratio $[L_{E^*}]$ for $E^*$ is: $L_{E^*} = P(E^*|H)/P(E^*|H')$. But $E^*$ is not directly linked to hypotheses $H$ and $H'$. We must take account of both stages of reasoning shown in Figure 2. The reason is that we do not know for sure that the event Pelser reported actually occurred. When we take account of both stages of reasoning, $L_{E^*}$ can be expanded to read:

$$L_{E^*} = \frac{P(E|H)[P(E^*|E) - P(E^*|E^c)] + P(E^*|E^c)}{P(E|H^c)[P(E^*|E) - P(E^*|E^c)] + P(E^*|E^c)}$$

20 See also Marjan Sjerps in this volume.
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As this equation and Figure 2 show, we need four conditional probabilities. The first two, $P(E|H)$ and $P(E|H')$, concern the probative importance of the event to which Pelser testified. The first, $P(E|H)$, asks how likely it is that Pelser was at the scene of the crime when it was committed, given that Pelser shot the payroll guard. Perhaps everyone, including Professors Bergman and Moore, would agree that $P(E|H) = 1.0$. If Pelser shot the payroll guard, he had to have been there when it happened. But the other probability $P(E|H')$ presents an epistemic judgmental problem. How do we determine the probability that Sacco was at the scene of the crime when it happened, given that he was not the one who shot the payroll guard? Patently, there are no statistics we can draw upon to assess this probability. We are also not permitted to canvas our past experiences in assessing this probability since, according to Bergman and Moore, they would be irrelevant to this specific inference involving Sacco.

The other two probabilities in the equation above, $P(E^*|E)$ and $P(E^*|E')$, concern Pelser's credibility. The first asks: How likely is Pelser's testimony $E^*$, given that the event he reported $[E]$ actually occurred? The second asks: How likely is Pelser's testimony $E^*$, given that the event he reported $[E]$ did not occur? No one keeps any relevant statistical estimates of these probabilities concerning the credibility of witnesses, Pelser included. In addition, we must not canvass our past experiences concerning the credibility of other persons we have known, since these experiences would be irrelevant to Pelser's credibility on this particular occasion and regarding the particular event to which he testified.

So, the basic question is: Upon what basis would we be able to assess the ordinary conditional probabilities: $P(E|H)$, $P(E|H')$, $P(E^*|E)$, and $P(E^*|E')$? If these assessments are to meet the requirements of Bergman's and Moore'sbelievability judgments, they must be based only on evidence that concerns witness Pelser and the particular event to which he testified. No statistics, even if available, are relevant to these assessments, nor would any canvassing of our past experiences involving other people and situations be relevant. Pelser’s testimony is a singular or unique event and so is the matter about which he provided testimony. What we must rely upon is ancillary evidence regarding the applicability of the two generalizations, asserted in Figure 2, to this very particular inference based specifically on Pelser’s testimony. Here is where Bacon and Bayes can join company.

Shown in Figure 3 is the first stage of our reasoning based on Pelser’s testimony. What I have to say about this stage of reasoning applies just as well to the second stage shown in Figure 2. During the cross-examination of Pelser at trial, during rebuttal testimony by defense witnesses, and from records revealed in years after the trial, we learn quite a bit about Lewis Pelser that bears upon his credibility in testifying that Sacco was at the scene of the shooting of the payroll guard Berardelli. All of this information provides ancillary evidence bearing on the generalization $[G]$ we asserted in order to license an inference from Pelser’s testimony $E^*$ to event $E$. Much of this ancillary evidence is quite unfavorable to the applicability
of G, in this case involving Pelser's testimony. For example, we learn from defense witnesses that Pelser may have dived under a workbench when he heard shots and, therefore, cannot have observed the event he reported. Another defense witness testified that the window through which Pelser said he was looking at the time of the shooting was made of opaque glass and was closed at the time. The only witness who corroborated Pelser's testimony was another witness named Lewis Wade, who would only say that someone 'who looked like Sacco' was at the scene of the crime when it happened. A variety of other ancillary evidence is available concerning Pelser's credibility. It is from this singular, unique, and specific ancillary evidence that we have a basis for judging the two probabilities $P(E^*|E)$ and $P(E^*|E')$ that are required in our Bayesian analysis. In a moment I will give reasons why I have used the symbols $\Psi(E^*|E)$ and $\Psi(E^*|E')$ in Figure 3.

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**Figure 3**

- E: Sacco was at the scene of the crime when it occurred
- E': Sacco was not at the scene of the crime when it occurred

Ancillary evidence regarding Pelser's Credibility:
- A*1
- A*2
- ...
- An

Believability Judgments:
- $\Psi(E^*|E)$ and $\Psi(E^*|E')$

As illustrated in Figure 3, suppose we have a list of ancillary evidence $[A^*, A^*, ..., A^*]$ bearing upon Pelser's credibility, such as the evidence mentioned above. This evidence might consist of information about attributes of Pelser's credibility such as his *veracity*, *objectivity*, and *observational sensitivity* including evidence about the conditions under which he made his alleged observation of Sacco. In other works I have attempted to justify these attributes as being the most important ones in assessing the credibility of witnesses. Over the centuries of experience in our Anglo-American judicial system, a rather large assortment of evidential tests of a witness' credibility attributes has emerged. As I have shown elsewhere, these tests

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can all be sorted out in terms of the three credibility attributes just mentioned. 22

What is at issue is whether the generalization Gₙ in Figure 3 actually applies to witness Pelser and to the testimony he provided. Let us suppose that all of the ancillary evidence items we have [A*,₂, A*,₃, ..., A*,ₙ] are the results of relevant tests of the applicability of Gₙ to Pelser for this particular item of testimony he provided. Applying these tests to Pelser, we might observe that some of the test results seem favorable to Gₙ while others seem unfavorable. In addition, some of these test results may seem more important or have greater strength than others. For example, we may have one item that seems very strong in favoring Pelser's observational sensitivity. Another item might seem to weakly favor his veracity. What is also crucial, from a Baconian point of view, is how many of these credibility-related tests we did perform. In other words, how complete or sufficient is our ancillary evidence about whether Gₙ applies to Pelser? For example, suppose we had a collection of very favorable ancillary evidence about Pelser's visual acuity; we believe he has very good eyesight. If this is all the ancillary evidence we had about Pelser, we would not be putting generalization Gₙ to an adequate test since we have no evidence about his veracity or objectivity.

The next question is: How does this collection of ancillary evidence [A*,₁, A*,₂, ..., A*,ₙ] bear upon judgments of the credibility-related probabilities, P(E*|E) and P(E*|E'), that Bayes' rule requires in assessing the probative force of Pelser's testimony? It seems natural that the more favorable to Pelser's credibility is this evidence, and the more complete it is, the more we seem justified in judging P(E*|E) to be greater than P(E*|E'). In other words, the more favorable evidence about Pelser's credibility we have, the stronger is our belief that Pelser's testimony E* is more likely if Sacco was at the scene of the crime when it happened than this testimony would be if Sacco were not at the scene of the crime when it happened. How much larger P(E*|E) would be over P(E*|E') depends both on the strength and completeness of this ancillary evidence. If the ancillary evidence seems unfavorable to Pelser's credibility, we would judge that P(E*|E') is greater than P(E*|E) by an amount determined by how strong and complete this evidence seems. Thus, we have a marriage of Bayesian and Baconian ideas. On this view, judgments of the Bayesian conditional probabilities P(E*|E) and P(E*|E') depend both on the strength and completeness of the ancillary evidence we have to support our judgments of them.

I must now justify how these judgments of the likelihoods P(E*|E') and P(E*|E) qualify as the believability judgments Bergman and Moore claim are appropriate in legal contexts involving singular or unique events. First of all, to emphasize that these two quantities are judged epistemically or subjectively, and not determined enumeratively in any way, I use the symbols Ψ(E*|E) and Ψ(E*|E'), as I have done in Figure 3. What is the

22 Supra footnote 2 at pp. 106-108.
basis for these believability judgments in my example involving witness Pelser? The answer is that they are based on consideration of the singular or unique ancillary evidence specifically about Pelser's credibility attributes as far as the particular testimony he provided: His veracity, objectivity, and observational sensitivity. There is no assumed mental tabulation of past experiences involving the credibility of other persons. If we believe that Pelser was under a workbench when he says he was looking out the window, and if the window out of which he says he made his observation was closed and made of opaque glass, this should justify an increase in our judgment of $\Psi(E^*|E^c)$ and decrease our judgment of $\Psi(E^*|E)$. All that counts in making these judgments is what we learn about Pelser, his alleged observation, and about various sources of influence on him. For example, there is ancillary evidence that Pelser said in a pre-trial investigation that he did not see the actual shooting. Pelser may have been coached by the prosecution about what to testify at trial. The next question I must answer concerns the properties of these two numerical believability judgments $\Psi(E^*|E)$ and $\Psi(E^*|E^c)$.

People make numerical judgments of many kinds including those concerning uncertainty or doubt. Left to their own devices, people might make these numerical judgments in many ways and according to different rules. In the field of psychology, systematic study of the ability of people to quantify their beliefs goes back over a century. In our work involving epistemic probability judgments for the singular events in the Sacco and Vanzetti case, Jay Kadane and I devoted considerable attention to the very extensive research on the quantification of belief in a field called sensory psychophysics.\(^{23}\) The connection between probabilistic judgments and sensory psychophysics goes back to an assertion by David Hume. As he noted: "Thus all probabilistic reasoning is nothing but a species of sensation.... When I give the preference to one set of arguments above another, I do nothing but decide from my feeling concerning the superiority of their influence."\(^{24}\)

In research in sensory psychophysics, people make numerical judgments about many different kinds of sensory experiences such as the brightness of lights and the loudness of sounds. In this research it has never been assumed that, say, in numerically judging the relative brightness of two lights, research subjects canvass their past experiences with light sources. What counts in these judgments is just the relative brightness of these two particular light sources. Results of psychophysical research have been taken very seriously and have provided the basis for many advancements in the lighting and sound industries. Choices of which scales upon which people make numerical judgments must be made if their judgments are to be studied systematically. In the case of probability

\(^{23}\) Supra footnote 19 at pp. 159-169.

judgments concerning the credibility of witnesses such as Pelser, we could be asked to respond numerically in different ways. According to one set of rules, we might be asked to use numbers having conventional or Kolmogorov properties so that our judgments $\Psi(E^*|E)$ and $\Psi(E^*|E')$ are numbers between zero and one. Since they are likelihoods, there is no requirement that they must sum to 1.0.

On the arguments just provided, my view is that epistemic or subjective assessments, such as $\Psi(E^*|E)$ and $\Psi(E^*|E')$, made on the basis of appropriate singular or unique ancillary evidence, qualify as Bergman and Moore's believability judgments. The same kinds of believability judgments could be made for the other probabilities required in assessing the probative force of testimony such as that provided by witness Pelser. For example, in the equation for $L_E^*$ given above, we might have the believability judgments $\Psi(E|H)$ and $\Psi(E|H')$ as assessments of the required probabilities $P(E|H)$ and $P(E|H')$. All of these believability judgments can be made just on the basis of ancillary evidence specific to the matters at issue and require no canvassing of prior experiences and mental tabulations based on these experiences. Probabilistic believability judgments have the same basis in specific unique or singular evidence as do psychophysical judgments made about other sensory experiences. For the record, I acknowledge that probabilistic believability judgments might be made in accordance with other rules such as those enforced in Shafer's system of belief functions.

In discussing the basis for believability judgments such as $\Psi(E^*|E)$ and $\Psi(E^*|E')$, I brought ideas from Bacon and Bayes together. How much specific ancillary evidence we have should have a distinct bearing on how we judge $\Psi(E^*|E)$ relative to $\Psi(E^*|E')$ and how we judge $\Psi(E|H)$ and $\Psi(E|H')$. In Cohen's system of Baconian probabilities there is no requirement for any specific believability judgments such as those I have been considering. There is room for subjective judgments in applying Baconian probabilities, but these judgments concern such matters as (the) whether an item of ancillary evidence is favorable or unfavorable in the testing of a generalization. As I noted earlier, Baconian probabilities grade the extent to which the hypotheses appearing at links in chains of reasoning survive our best attempts to eliminate them. In other works I have shown how the force of evidence in chains of reasoning can be assessed entirely in Baconian terms.25

Let us return to witness Lewis Pelser in the Sacco and Vanzetti case. If we have a person's believability judgments $\Psi(E^*|E)$, $\Psi(E^*|E')$, $\Psi(E|H)$, and $\Psi(E|H')$, we might be interested in combining these judgments in order to determine what these judgments, in the aggregate, say is the probative force of Pelser's testimony on hypotheses $\{H, H'\}$ regarding

25 Supra footnote 11 at pp. 99-145; Supra footnote 2 at pp. 243-261.
whether Sacco shot the payroll guard. In Bayesian terms, the relevant equation for the likelihood ratio for Pelser’s testimony \( E^* \) becomes:

\[
L_E = \frac{\Psi(E|H)[\Psi(E^*|E) - \Psi(E^*|E^c)] + \Psi(E^*|E^c)}{\Psi(E|H^c)[\Psi(E^*|E) - \Psi(E^*|E^c)] + \Psi(E^*|E^c)}
\]

Different persons will have different believability judgments regarding three of the four essential ingredients in this equation. For reasons given earlier, most would agree that \( \Psi(E|H) = 1.0 \), since if Sacco did the shooting, he must have been at the scene of the shooting. In our analysis of the Sacco and Vanzetti evidence, Kadane and I used equations such as the one above to tell many different stories about the probative force of the evidence in this case.\(^{26}\) Our stories were told in numbers such as the believability judgments I have been discussing. But these stories can be translated into words. Many different stories are possible depending upon specific values of the believability judgments in the above equation. Each different story reflects different beliefs about the credibility of witnesses such as Pelser and the probative force of what they testify. In a recent work on stories and numbers, the mathematician John Allen Paulos noted the virtues of the approach Kadane and I took in telling numerical stories about the Sacco and Vanzetti evidence.\(^{27}\) He also noted a fact that Kadane and I acknowledged: The use of equations to tell stories only guarantees that these stories are coherently told; the equations do not tell us which one is true.

Equations such as the one above supply ‘endings’ or conclusions for each different story we tell. In many cases the story endings supplied by an equation will not be the ones we expect. There are always surprises that are due to the complexity of probabilistic arguments and the nonlinear nature of the equations that can capture these complexities. Stories based on equations and numbers have much to tell us about the wide array of evidential and inferential subtleties that lurk below the surface of even apparently simple inferences based on evidence. Stated in other terms, these equations allow us to capture a wide array of the complexities of reasoning based on evidence. In another work I attempted to show just how many elements of complex processes can be captured in terms of equations such as the one above.\(^{28}\) But at no point have I ever argued that judges or jurors at trial be required or encouraged to make specific believability judgments in Bayesian or in any other terms. The obstacles to such requirements are

\(^{26}\) Supra footnote 19 at pp. 184–240.


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simply overwhelming. The virtue of probabilistic analyses is simply that they help us understand more about the rich complexity of inference based on evidence.

4 In conclusion

I return to my initial assertion that all statistical reasoning is probabilistic but not all probabilistic reasoning is statistical. In law and in so many other fields we base probabilistic conclusions on evidence that is singular, unique, or one-of-a-kind. The probabilities involved in such reasoning resist any statistical interpretation that requires the enumeration or counting of the occurrence of events. I took very seriously the comments made by the legal scholars Bergman and Moore that subjective or epistemic probabilities for singular or unique events inevitably rest on enumerations based on past experiences and are, therefore, inappropriate to the singular or unique events at issue in trials at law. Our subjective assessments of probabilities for singular or unique events may on occasion rest on mental tabulations of our prior experiences, but they need not be. I have shown how the believability judgments sanctioned in judicial reasoning by Bergman and Moore can rest upon singular or unique ancillary evidence that is entirely specific to matters at issue in a trial or other form of settlement. These believability judgments can be made to conform to the rules in different formal systems for probabilistic reasoning. I provided examples showing how such believability judgments could be made in accordance with the properties of ordinary or Kolmogorov probabilities. But they could be made in accordance with the properties of other formal systems of probability. In any case, they need not rest upon mental counts of a factfinder’s past experiences that might be deemed irrelevant to the very specific issues and events that are the subjects of interest in the settlement of disputes in our legal systems.

References


29 Supra footnote 19 at pp. 255–265.
Singular Evidence and Probabilistic Reasoning in Judicial Proof – David Schum


Epilogue
Epilogue

Johannes F. Nijboer and Wim J.J.M. Sprangers

1 A European approach

This book aims to offer readers material for the purpose of monitoring, and perhaps improving, the quality of forensic work by and for the criminal justice system. We have opted for a cross-border perspective, that is a perspective that takes us across geographical borders as well as borders between professions/disciplines. We firmly believe that in the coming years we will see rapid, far-reaching co-operation and legal integration between nations in Europe in the legal domain too. Only an international approach to research and practice holds real promise. There are also several snags to such an approach, however, as will have become clear to the reader by now from the preceding chapters. In this epilogue we will consider the driving forces that already exist or can be developed to arrive at an international approach. After some general remarks about developments in the theory and law of evidence, we will consider three key aspects: (1) the exchangeability of data across borders, (2) the impact of the principle of equality of treatment of citizens in Greater Europe and (3) quality assurance and enhancement in the criminal justice system in general and in forensic expertise in particular.

Traditionally, problems related to ‘fact-finding and evidence’ in the administration of justice have attracted the attention of non-legal professions and disciplines as well as legal scholars and practitioners. Without going at length into the far past, we note that the late eighteenth/early nineteenth century ideal of the ‘free’ collection, presentation and assessment of evidence – which lasted as the dominant idea until recently – has gradually made way for a new paradigm: the paradigm of the specialist nature of fact-finding and evidence, particularly where the justice system increasingly seeks and/or is offered help by a wide range of scientific areas of forensic expertise. The methodology of many scientific areas is partly or strongly oriented toward the study of probabilities. (For this reason, Chapter 7 considers at some length the statistical aspects of the presentation of evidence drawing on the papers by Marjan Sjerps and David Schum.) This is not in itself strange nowadays since legal scholarship has also shifted from a "rule-oriented and court-centred approach towards the
interdisciplinary study of various processes". It is significant that the literature refers to the revival of the academic study of this domain as 'New Evidence Scholarship', which refers to the study of evidence and the law of evidence from an integrated perspective in which cognitive psychology, legal analysis, forensic science, and cognitive philosophy (logic, probability theory) have found a place.

'International' and 'interprofessional/interdisciplinary' may sound somewhat trendy, and abstract besides. The present study, however, which looks not only at general regulations but explores in much greater depth legal and forensic practice, institutionalised and standardised to varying degrees, has convinced us that we are facing enormous differences in an area beset by social and scientific problems. This — first — book is a reflection of this reality, albeit a limited one since it incorporates only part of the huge quantity of information about 'what and how' in the administration of justice (including the work of forensic experts). In the future we hope to publish much more about the subject.

Although the present volume presents only part of the empirical data gathered, it offers a veritable kaleidoscope of theoretical and practical insights and views about 'harmonisation in forensic expertise'. A foundation has been laid for the key actors (persons, organisations and associations) operating and/or influential in this sector. The following come to mind: (1) those involved in law-making, legal practice, forensic work and criminal policy-making who (could) play a role in communication, development and harmonisation between countries, professions and disciplines; (2) State, Community, non-governmental organisations (European Network of Forensic Science Institutes) that are also in a position to serve as a platform for initiative and exchange.

1.1 Overview

Even though the following paragraphs do not exactly form a matrix, they are based on a kind of framework which depicts the three driving forces we referred to above (exchangeability of forensic data; equal treatment of citizens; quality assurance) and what has been done or could be done at the international, national and professional level.

2 Exchangeability of data

The need for exchangeability of data is the first of the driving forces in the harmonisation process in the area of forensic expertise. Efforts to control organised crime, transborder crime and terrorism require information that

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is comparable and exchangeable between countries. The communication of international data can be equally important, even essential, when the common-or-garden variety (volume) crime is involved. In addition, mutual recognition is essential and a strong motivator of harmonisation. All kinds of initiatives at the international political level (eventually) lead to harmonisation.

2.1 **EU plan of action to combat organised crime**

The 'EU plan of action to combat organised crime' announced April 1997 proposes several measures. The European Union is well aware of the area of tension between improvement of co-operation in day-to-day practice and adjustment or harmonisation of legislation. Finding a good balance between the two is a major problem. Legislative adjustment or harmonisation is and remains a long-term aim of the European Union and needs to be implemented gradually and cautiously. To avoid treading on national sensitivities, the European Union is staking its hopes on consultative structures to support police and justice agencies rather than tinker with the structures of the national organisations involved in combating organised crime.

The Presidency Conclusions of the Tampere European Council of October 1999 again announce even farther-reaching measures to combat crime. This time not only by strengthening co-operation against crime. Now there is special mention of desired better comparability and convergence between legal systems. The cornerstone of this policy is the mutual recognition of judicial decisions and the necessary approximation of legislation. A simple transfer should replace the present formal extradition procedure for people fleeing from justice after having been finally sentenced. The judicial decisions in one country should be recognised by the other Member States; this principle should also apply to pre-trial orders to enable the authorities to secure evidence and to seize assets, which are easily movable. In addition, legally obtained evidence should be admissible before the courts of other Member States. In this way, it is hoped that a genuine European area of justice will be created with respect for the fundamental legal principles of the Member States.

This striving for mutual recognition nevertheless demands more harmonisation in matters of substance than one might expect at first glance. Harmonisation is probably still a bridge too far in many legal matters, but realistic in the medium term in the area of the forensic expert and (forensic) evidence.

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2 *Official Journal of the European Communities* No. 97/C 251/01.
3 SN 200/99.
5 In accordance with Article 6 TEU.
2.2 Other examples

The initiatives in DNA profiling are other examples of instigations to harmonisation as taken by the Council of Europe Recommendation No. R (92) 1, the Council of the European Union in 1997, Interpol and the European Union’s Police Co-operation Working Group (PCWG). The main aim of all these bodies is to make data exchangeable and comparable between countries to aid investigation of offenders wanted internationally. Initially, this concerns data crucial to criminal investigation rather than to presentation as evidence in court. Perhaps this distinction between indicating (identifying) persons and presentation as evidence has been drawn unintentionally. Nevertheless, recent developments in Tampere represent an initial step toward easier exchange of data that may also be used in the presentation of evidence. EUROJUST will be created to strengthen the fight against serious organised crime. National prosecutors, judges and police officers will be seconded from the Member States to EUROJUST to support and co-ordinate the activities of the national authorities in tracking down offenders. Close co-operation with Europol (crime analysis) and the European Judicial Network can be expected.

Other examples that merit mention here are the Council of Europe Medico-legal Autopsy Rules which harmonise through ‘soft law’ and

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6 Recommendation No. R (92) 1 on the use of analysis of deoxyribonucleic acid (DNA) within the framework of the criminal justice system.
7 Official Journal of the European Communities No. C 193
9 See Recommendation No. R (99) 3, adopted by the Committee of Ministers on 2 February 1999; "The Committee of Ministers, under the terms of Article 15.b of the Statute of the Council of Europe, Considering that the aim of the Council of Europe is to achieve a greater unity between its members; Having regard to the principles laid down in the Convention for the Protection of Human Rights and Fundamental Freedoms and, in particular, the prohibition of torture or inhuman or degrading treatment or punishment, and the right to life; Conscious that it is normal practice for autopsies to be carried out in all Council of Europe member States to establish the cause and manner of death for medico-legal or other reasons or to establish the identity of the deceased; Considering the importance of compensation for victims and families in criminal and civil proceedings; Underlining the need for investigation, description, photographic documentation and sampling during medico-legal autopsy to follow primarily medical and scientific principles and simultaneously consider legal requirements and procedures; Conscious that the increasing mobility of the population throughout Europe and the world, as well as the increasing internationalisation of judicial proceedings, require the adoption of uniform guidelines on the way autopsies to be carried out and on the way autopsy reports are to be established; Considering the Council of Europe Agreement on the Transfer of Corpses (European Treaty Series No. 80) and having regard to the difficulties often experienced by the receiving country when a dead body is repatriated from one member state to another; Aware of the importance of proper autopsy procedures, in particular with a view to bringing to light illegal executions, and murders perpetrated by authoritarian regimes; Underlining the need to protect the independence and impartiality of medico-legal experts, as well as to make available the necessary legal and technical facilities for them to carry out their duties in an
Europol initiatives like the LOGO project by which the logos of XTC pills are collected from all countries in the EU in order to chart the drug trafficking routes used by drugs organisations.

All this indicates that European bodies are transmitting strong signals urging harmonisation in some form or other without losing sight of national feelings. Although consideration of the different perspectives often slows the harmonisation process down, substantial changes have steadily taken place.

2.3 National level
At the national political level, developments are less clear. There is still a strong tendency toward viewing things from a national perspective. National parliaments, in particular, are given to a strong national (local) orientation, which is understandable since representatives of the people are commonly chosen via a national electoral system or, in some countries, via a regional (district) electoral system. Greater involvement of national parliaments in international political developments is desirable and would have a positive effect on harmonisation processes. As the EU Parliament becomes more powerful, its influence can be expected to grow. We do not mean to imply that there is no interest in European developments nationally, but simply want to point out that this interest is not very strong. Much is left to the national institutions like police forces, national forensic science services, experts and/or their professional organisations. This explains why the national political level has only minimal direct influence on harmonisation processes.

2.4 Institutes
Forensic science services are slowly taking small steps towards harmonisation. However, these services and the professionals they employ have a national responsibility and therefore have no natural inclination to work on international harmonisation of methods especially in view of the considerable variation in national legislative frameworks from country to country. Besides, national forensic science services carry out few cross-border forensic examinations. Generally, international organisations, like the European Network of Forensic Scientific Institutes (ENFSI) and the Association of European Police Colleges (AEPc), take the lead in harmonisation proj-

appropriate way and to promote their training; Considering the importance of national quality control systems to ensure the proper performance of medico-legal autopsies; Underlining the need to strengthen international co-operation with a view to the progressive harmonisation of medico-legal autopsy procedures at a European level; Having regard to Recommendation 1159 (1991) on the harmonisation of autopsy rules adopted, at its 43rd ordinary Session, by the Parliamentary Assembly of the Council of Europe; Having regard to the Model Autopsy Protocol of the United Nations, endorsed by the General Assembly of the United Nations in 1991; Taking into account the “guide on disaster victim identification” adopted by the International Criminal Police Organisation (Interpol) General Assembly in 1997, etc."
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ects. Again this depends to no small degree on the individuals who represent the national forensic science services in these international associations/networks. Initiatives will continue to depend on individuals at least until these international organisations have been institutionalised and can earmark part of their budgets for this purpose. National interests often take priority above promising international co-operation in these international networks as well. As a consequence, real joint activity like the counterfeit document database and the automobile paints database is slow to develop.\(^{10}\)

The exchange of professional (discipline-oriented) information is the paramount need felt by forensic science services and their scientists. The computer crime field illustrates this well. Joint projects to facilitate greater international co-operation are set up only in a later stage. A kind of harmonisation occurs when forensic scientists exchange information related to their scientific area, however, this always occurs at a later time and in most cases not extensively. New developments especially can lead to far-reaching harmonisation as a result of good international co-operation.

It is primarily up to the management of forensic science services and European bodies like the EU-PCWG, Europol and Interpol to challenge scientists to work at developing international exchangeability of data. ENFSI and other international forensic organisations can also play a major role in motivating professionals to work towards harmonisation of methods and techniques through joint projects.

Developments aimed at advancing exchangeability of data can be expected to increase at all four steering levels (EU, national, forensic science services, international professional networks). Intervention by means of Directives is especially likely where the interests of the EU are endangered. Increased influence of the EU on harmonisation will result as more states join the EU and as more common aims, like those recently formulated for police and justice, are agreed upon. This is likely to have impact on national policy. The EU pressure for harmonisation will become visible in the form of Recommendations and on national level states will introduce legislative measures. Forensic science services will learn how to better anticipate needs for harmonisation and will in good time stimulate their experts to develop new methods through international co-operation that will render the data internationally exchangeable (compatible with other methods and systems).

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10 For the automotive paint database see the contribution of Marjan de Boer in this volume.
3 Equality

As we have already indicated, equal treatment of citizens is one of the driving forces in the harmonisation process. If we accept that this aspect of the principle of equality is related to the harmonisation problem, realisation of equality could imply viewing the necessity of harmonisation as a logical consequence of the principle (as soon as we include not only the national population, but the entire population of the European Union or of the countries that belong to the Council of Europe). Viewed in this way, there is quite a compelling legal argument in favour of harmonisation. Still, matters are not so simple. First of all, there is the classic problem of putting the theory of equal treatment into practice. It sounds very uncomplicated: equal treatment of individuals in the same cases, but when are cases the same? Practically every democratic Western nation has a huge amount of jurisprudence spawned by various courts (criminal, civil, administrative and constitutional) dealing precisely with this question. The problem is that, frequently, although what is sauce for the goose may be sauce for the gander does not make the goose the same as the gander. Secondly, for years the European Court of Human Rights has held the opinion that legal regulation of issues related to fact-finding and evidence are pre-eminently matters for national domestic law.\(^1\) Incidentally, the necessary qualifications can be made on this latter point, if we look at the impact of some of the decisions handed down by the Strasbourg court examined by Joan Holthuis, Livia Jakobs and Wim Sprangers in this volume: Boenisch, Brandstetter, Mantovanelli concerning expert opinions prepared for the defence; Hertel concerning freedom of expression, and Kostovski and Van Mechelen, among others, on questioning witnesses. The two objections do not completely negate the argument. Although the equality alluded to may not be so easily regarded as a directly enforceable requisite of positive law, the nonobservance of which is liable to punishment, it is nevertheless a regulatory principle. Viewed this way, the normative (harmonisation; standardisation) aspect is related, for example, to the principle of first-hand evidence construed as a rule of evidence ("use direct sources of evidence as much as possible"). Maximisation is as it were a prerequisite. In the case of equality this means as much equality as possible in Europe, irrespective of the degree to which this is realised in the short and intermediate term.

3.1 Reduction of noncommitment

For all practical purposes, the entire criminal justice enterprise is primarily a national matter when fact-finding and evidence are involved, especially with respect to the utilisation of forensic experts in the criminal justice

\(^{11}\) Another aspect, 'equality of arms', which relates to arms (prosecutorial and defense powers) of the parties to the criminal proceedings is not under discussion here.

\(^{12}\) Schenk case, published, among others, Nederlandse Jurisprudentie 1988, 851.
process. This is the case not only as far as legal frameworks are concerned, but also holds for the institutional organisation and, frequently, even for procedures up to a point. However, this is not an unalterable fact. Now and again there are impulses against the lack of commitment. International bodies, national governments and international bodies (governmental or non-governmental, like ENFSI) can prime the pump. It bears mentioning that where the EU is concerned, the political unification of Europe has stimulated transnationalisation of the matters discussed in the present volume.

Comparison of the four levels distinguished in our analysis, (1) international political and supranational level, (2) the national political and national administrative level, (3) institutional level and (4) the professional level (areas of forensic expertise) indicate that we can expect little more from the third level than what has so far been achieved in the Interpol and ENFSI working groups (see Wim Sprangers in the focus of this book). As for the professions, much depends on how internationally the field works and thinks. Some forensic experts work on a very local scale. Not much can be expected of them in the way of innovation with regard to transnationally accepted standards etc. The situation in other scientific areas, though difficult at times, is clearly different. From this perspective, striking achievements have been booked in co-operation and consonance of standards in DNA technology.

3.2 Temporal aspects
Harmonisation, when it involves change, bears reference to the past as well as the future. It can result in standardisation and improve quality in many countries. This raises another aspect of equality which concerns a very wide-ranging extensive and significant legal problem, namely temporal equality: to what extent should 'old' cases benefit from new possibilities? In legal circles this problem is known both as legislative change and jurisprudential change. So-called intertemporal or transitory law is one part of this domain. It is here that changes in forensic scientific examination (better methods, new technology) are likely to be involved. In criminal justice in most European countries procedural principles such as ne bis in idem (no double jeopardy) and litis finiri oportet (the case must be concluded) coupled with the entire 'force of procedural and substantive law' doctrine make reopened investigations that may lead to prosecution practically impossible. In other cases there is to a certain extent more leeway, although the right to trial within a reasonable time laid down by Article 6.1 of the European Convention on Human Rights and Fundamental Freedoms can be construed as limitative. Often review is possible only in the case of a possible wrongful conviction. In the United States a great deal of attention has been devoted to the fact that in several review proceedings non-governmental groups have succeeded in demonstrating that the defendant on death row did not in fact commit the crime of which he was convicted.
4 Quality improvements

This driving force contributes most at the level of the forensic science services and the national political developments. If we consider improvement of quality we see an interesting development in the private sector in the past ten years. Initially, efforts were directed at improving the quality of the products through better control of the production process rather than focusing on control at the end. Next, the entire organisation was subjected to a thorough examination in order to focus the internal procedures that directly and indirectly support the production first and foremost on prevention of mistakes and secondly on improvement of the supporting processes. Only then did attention turn to the entire chain of which the producer was a part and the need arise to agree with producers and customers upon (their contribution to) quality. This has led to concern about the quality of the entire chain and to Total Quality Management (TQM). A similar process is currently still underway in the field of forensic expertise. The cultural differences between jurists and forensic scientists constitute an extra complicating factor.13

4.1 European Foundation for Quality Management

There is no noticeable direct interest at the international political level in quality as a steering mechanism in harmonisation processes. Nevertheless there is a European Foundation for Quality Management (EFQM). The EFQM developed the European Foundation for Quality Management Model of Excellence, a kind of total quality management model. This model devotes considerable attention to the chain effects and is highly applicable to the criminal justice chain of which forensic expertise is a part. In a few countries a cautious start has been made at the national level with a national derivative of the EFQM model. European organisations seldom refer to this model, let alone stimulate its use or set an example by putting it into practice.

If European organisations would urge use of the EFQM model, this could have an immense positive effect on the harmonisation processes. Reflecting on quality and ways to improve quality sets all kinds of processes in motion. If these processes were to take place more or less simultaneously in a large number of European countries, they could be addressed while working together. This would automatically lead to certain forms of harmonisation. There is still a long way to go inasmuch as views on quality, quality improvement and quality management (particularly views concerning their positive effects) differ considerably in the forensic science community in various countries. The saying 'unknown, unloved' certainly applies to the EFQM model.

4.2 Quality as driving force
Sometimes there is in a sense a need at the national political level to regulate matters using quality as the driving force. Action is then aimed at a single discipline (police, prosecution) and the relationship between the links of the chain is as a rule neglected. Action at this level is generally very effective and often exercises extensive influence. This effectiveness can be ascribed to the fact that the action stems from a some political wrong that has come to the attention of the public demanding action on the part of those who bear political responsibility. In addition, socially sensitive topics requiring regulation by law can lead to more stringent legislation. The DNA legislation in the Netherlands is an example. This legislation stipulated that an accredited laboratory must carry out DNA profiling in criminal cases. This gave the initial impetus to accreditation of the entire laboratory instead of a limited accreditation of the laboratory unit performing DNA analysis. Partners in the chain who also conduct DNA analyses now participate in the DNA quality control system as a consequence of the measures the forensic science service needed to take in order to assure its own quality. Similar moves have been observed in other countries.

Only a very few countries have cautiously begun to work according to the EFQM model. The dependence on the chain has been an incentive to national harmonisation. The nations that have taken the initiative should be aware of their pioneering role and disseminate the results internationally as well as nationally to encourage other countries to join in. This will speed up European harmonisation.

4.3 The process as a chain
Closer examination of the effect on harmonisation of the drive for quality within the forensic science services indicates that this driving force has been almost entirely national in focus and is currently operating in several disciplines. There are certain limitations as a result. Forensic experts work for the criminal justice chain, but constitute a single link in this chain. In a few other countries the other links (police, prosecutorial office, courts) are also aware of the qualitative aspect of their work. Each organisation in the criminal justice chain is engaged in its own search for ways to improve its own quality quite apart from other organisations. So far no comparisons have been drawn with the professionals in the other links of the chain. Because each link is so busy solving its own problems, too little attention is paid to dependence on the chain. For a stronger criminal justice chain, a more horizontal notion of quality needs to be further developed. Comparison with the private sector is valid and we can expect the management of these various forensic science services to develop initiatives in the direction of total quality improvement/management as soon as they are ready for Total Quality Management (or the EFQM model). This development will then also have to continue at the international level.
In the areas of expertise there are already signs that quality improvement is gaining momentum. This is the result of the need for international exchange of certain information about applied methods and techniques. This acceleration will ensure that all European countries can advance quickly toward the 'state of the art'. Organisations such as ENFSI, Interpol, Eu-PCWG and Europol are extremely stimulating catalysts. Now that these institutions will be working together and exchanging information, harmonisation of methods and techniques in a number of areas (DNA, paint) will occur rapidly and will trigger the process in other areas of expertise.

4.4 Professionals
A few more words about the professionals themselves. 'Good professionals' often think they need no quality assurance system for their methods of examination. The prevailing view is that quality assurance systems lead to unnecessary fuss and bureaucracy, and that they stifle the creativity essential to R&D.

It is true that professionals are natural exponents of quality. The point is to validate this quality in an objective way, to set standards and to be able in the unlikely event of substandard work to take steps to remedy the situation. In short, quality must be measurable and made recognisable to others. This also creates a certain field of tension. International cooperation between professionals can have a positive influence here. For one thing, professionals rely strongly on each other and in several countries a number of forensic science services already have quality management systems in place that spur constant improvement in the quality of forensic work (including state of the art). For another thing, a number of areas of forensic expertise are forced to devote attention to quality assurance (DNA, paint). Professionals in other areas of forensic science can look to these examples. It is important for professionals to remain open to drives for quality.

At present, prospects are looking good in a number of European countries thanks especially to ENFSI's influence via, among others, the working groups. European organisations could wield more influence on this process than they have thus far. By addressing specific questions to those professionals who are currently organised (indirectly via ENFSI, EU-PCWG, and so forth), harmonisation within the areas of expertise can be speeded up considerably. If the European bodies would subsidise projects aimed at harmonisation, the rate of harmonisation could increase even further.

Considering the difficult discussions within the EU-PCWG, subsidisation as an incentive to harmonisation will remain problematic. The situation in Europe has changed drastically in favour of international cooperation owing to the creation of ENFSI. This strong impulse for harmonisation in scientific areas has become an enduring phenomenon. Hopefully, international politics will take note of the possibilities for promoting harmonisa-
tion not only within scientific areas, but also particularly in the criminal justice chain as a whole.

5 In a nutshell

Considering the three driving forces at work in the harmonisation process in the forensic sciences, we conclude that the exchangeability of data is a major force. Nevertheless, international politics and the European organisations make little systematic use of it.

As for the equality of treatment of citizens, it is important to realise that the principle of equality is difficult to put it into practice. Just the same, all parties must accept the challenge in order to achieve this equality where possible to the greatest possible extent. Here inspiration and aspiration play a dominant role.

Quality is another under-utilised driving force in the harmonisation process with strong potential. At the national political level the day-to-day domestic workload is a highly constraining factor. This applies to the national forensic science services as well. More attention for EFQM could spark a strong impulse toward harmonisation at the international political level in particular. In addition, subsidies aimed specifically at supporting harmonisation projects can greatly accelerate progress.

5.1 Tampere, Conclusion 36

For European development, in particular development of the European Union, it is also important that Conclusion 36 of the EU summit in Tampere (15 and 16 October 1999) on the subject of freedom, security and justice directed: "evidence lawfully gathered by one Member State’s authorities should be admissible before the courts of other Member States, taking into account the standards that apply there". Although this statement refers primarily to legality of evidence, the reliability aspects (in most countries probably under the terms of "the standards that apply there") are bound to cause complex and difficult problems during implementation. Consider the example of the fingerprints mentioned in the introduction to this book. We believe that more insight into forensic and legal practice in the different European countries is essential and consider this to be an important next step following publication of this book.

5.2 The Hertel case

Looking at Europe in the (near) future, it is also interesting to examine the classic trio of ideals dating from the era of the Enlightenment and the French Revolution (end of the eighteenth century), namely “liberty, equality and fraternity”. The ideal of equality in the form of equal treatment for citizens of Europe has been dealt with above. In a certain sense this is also true for an aspect of fraternity: international co-operation in the
administration of justice is itself a form of solidarity between countries. This ideal can be extended to other levels: professional associations, institutions, and colleagues too. Finally, as for the ideal of liberty, our project has made us more sensitive to a dimension that has perhaps best been expressed in the Hertel decision of the ECHR, namely the danger of official and practical monopolies or oligopolies in forensic expertise. For more about the relevant consequences of this decision, we refer you to the paper by Jakobs and Sprangers.

5.3 Centralisation
This book has also now and then called your attention to the relationship between centralisation and decentralisation. In Europe this relationship is in the picture when the question arises as to how much emphasis should be given to 'Brussels' or 'Strasbourg' in harmonisation of forensic expertise. It is not difficult to see the connection between the above-mentioned drawbacks to monopolies and oligopolies, but we face two additional relevant, related issues here that complicate matters and that make it difficult to form an opinion. These two issues are the lack of democracy in supranational Europe (that holds not only for the EU but also to some extent for the Council of Europe) and the danger that more or less technocratic forms of interaction will dominate in the areas of forensic work – also in decision-making – in the diverse forensic disciplines. In the case of the danger of technocratic dominance, an all out effort will have to be made to take down the fences put up by the disciplines or at least to keep them below eye level.

6 Closing remarks

To attain the desired 'legal area' in Europe referred to in the above-mentioned Presidency Conclusions of Tampere will require considerable investment in working together on that one Europe. For forensic expertise, this means efforts not only on the part of technology, but also by the police, judiciary, prosecution, and defence bar.

Traditionally, law and forensic expertise present each other with the customary challenges. This volume shows that these challenges are not diminishing but are in the process of changing where the international dimensions of law have become important. And that this is bound to increase as more and more areas of the law become involved in the 'internationalisation' of the justice system in the broadest sense of the word.

Finally, large segments of the population in virtually every country tend to view and treat forensic expertise as a marginal social phenomenon (reserved for specialists). It is hoped that this book will help heighten public awareness of the great importance of this domain.
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Edwin Kube graduated in law at the University of Mainz, Germany, in 1964. In 1994 he received his PhD at the University of Lodz, Poland, on subjects in criminology and criminalistics. From 1982-1993 he was head of the ‘Research and Training Institute’ at the Bundes Kriminal Amt (BKA) in Wiesbaden, Germany and since 1994 he has been head of the ‘Forensic Science Institute’ at the BKA. He is member of the board of the society Neue Kriminologische Gesellschaft (NKG) and member of several scientific societies. Currently he is also a university lecturer at the University of Lodz, Poland, and as a Professor of Criminology and Criminalistics at the University of Giessen, Germany.

Iris de Kwant will graduate in law in 2000 at Leiden University, the Netherlands, with a specialization in civil law and in criminal law. During her study she worked as an intern at a law firm. During the past year she worked part time as an assistant on the Research Project ‘Harmonisation in Forensic Expertise’ and as member of the editorial board.

Marieke Lugt graduated in law at Leiden University, the Netherlands, in 1993. Since then she has been a correspondent for EU Food Law (Agra Europe) and she worked as a food law adviser at Schuttenaar & Partners
Consultancy for Societal Communication in The Hague, the Netherlands. Since March 2000 she works as a policy official for the Society for the Bakery and Candy Industry.

**Pierre Margot** graduated in Forensic Science at the University of Lausanne in 1974 in Switzerland. In 1977 he obtained his MSc and in 1980 his PhD in Forensic Science, both at the Strathclyde University, Great Britain. From 1980-1982 he was a post doctoral fellow at the Center for Human Toxicology in Salt Lake City, Utah, USA. Since 1982 he worked two years at the Federal Institute of Technology in Switzerland, in the area of analytical chemistry (chromatography). From 1984-1986 he directed a research on fingerprint detection at the Australian National University. In 1986 Pierre Margot became Professor of Forensic Science and the Director of the ‘Institut de Police Scientifique et de Criminologie’ at the University of Lausanne.

**Harald Merckelbach** graduated in psychology at Utrecht University, the Netherlands in 1985. He received his PhD in 1989 from Maastricht University, the Netherlands. Since then he mainly did research in the area of the experimental psychology. Currently he is Professor at the Faculty of Psychology at Maastricht University. His research interests concern phobias, obsessive compulsive disorder, schizophrenia and memory functioning in mental disorders and he has co-published about 200 articles about these topics. Harald Merckelbach fulfils various editorships of specialist journals. Occasionally he serves as an expert witness in criminal and civil cases.

**Willem Neuteboom** studied analytical chemistry at Delft University of Technology, the Netherlands. In 1978 he joined the Netherlands Forensic Institute in Rijswijk as a scientist. In 1988 he became head of the Blood-alcohol Department. In 1989 he was appointed as quality assurance manager and started the implementation of a quality management system. In 1995 he became member of the management team as head of the Quality Assurance, Logistics and Public Relations Department. Since 1999 Willem Neuteboom has been head of the Central Staff Department of the Netherlands Forensic Institute

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Jean Pradel graduated in law in 1960 at the University of Poitiers, France. He succeeded at the competition of ‘Agrégation de Droit’ in 1969 (national competition). After that he was affiliated with the Department of Criminal Law at the University of Poitiers. Currently he is Director of the Institute of Criminal Sources of Poitiers, President of the French Association of Criminal Law and President of the French Society.

He has published various books, notably ‘Droit pénal comparé’ and together with G Corstens, (judge at the Dutch Court of Cassation); ‘Droit pénal européen’. Occasionally he has acted as an expert for the United Nations.

Mike Redmayne graduated in 1990 at Birmingham University, United Kingdom, where he read Law with French. In 1996 he received his PhD on expert evidence in the criminal justice system, at the same university. Subsequently he taught law at the University of Manchester and Brunel University, both in the United Kingdom. Currently he is working at the Law Department of the London School of Economics. His principal research interests are evidence and criminal justice, on which topics Mike Redmayne has published widely.

Olivier Ribaux graduated in mathematics in 1987 at the University of Neufchatel, Switzerland. He received his PhD in forensic science from the University of Lausanne, Institut de Police Scientifique et de Criminology (IPSC) in 1998, where he received the faculty of law’s award for his thesis. In 1991 he worked for the Police of Geneva in the Computer Department. In 1992 he became project leader in the computer department of a private company in Geneva. In 1994 he returned as a researcher to the IPSC in Lausanne, for the Swiss National Science Foundation. Since 1997 he has been employed by the Police of the canton Vaud as analyst for the police forces of the west (French) part of Switzerland, and is senior researcher at the IPSC.

Jaap Roording graduated in 1990 in law at the University of Nijmegen, the Netherlands, where he received also his PhD in 1994. Afterwards in 1995 he studied law enforcement issues of the English legal system, while working at the Institute of Criminology of the University of Cambridge,
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United Kingdom. In September 1995 he joined the Ministry of Justice in The Hague, the Netherlands, as a lawyer at the Department for Legislation.

David Schum graduated in psychology and biology (BA) at the Southern Methodist University Dallas, Texas, USA, in 1956, where he subsequently graduated in psychology (MA) in 1961. He received his PhD degree in psychology from the Ohio State University in Columbus Ohio, USA in 1964. Since 1966 he worked at the Rice University in Houston, Texas, USA, where he held the rank of Professor in the Departments of Psychology and Mathematical Sciences. In 1985 he joined the George Mason University in Fairfax, Virginia, USA, as Professor in the Departments of Psychology and Mathematical Sciences. He has had a career-long interest in studying the properties, uses and discovery of evidence in probalistic reasoning. Of particular interest to David Schum are inferences based on masses of evidence.

Julian Schutte finished his law studies at Leiden University, the Netherlands, in 1969. In 1970 he studied French constitutional law at the Université de Paris I in Paris, France. In 1971 he started his career at the Legal Department of the Ministry of Defence in The Hague, the Netherlands, where he was responsible for military criminal law and humanitarian law in armed conflicts. In 1975 Julian Schutte continued at the Ministry of Justice in The Hague as a legal adviser. Since 1987 he served as a substitute judge in the Court of Appeal in Amsterdam. In 1990 he became extra-ordinary Professor at the Law Faculty of the University of Amsterdam (European Cooperation in Criminal Matters). Since 1995 he has been Director in the Legal Service of the Council of the European Union, where he bears responsibilities in the field of Justice and Home Affairs.

Marjan Sjerps graduated in mathematics in 1988 at the University of Nijmegen, the Netherlands. She received a PhD in theoretical biology from Leiden University in 1994. In 1993 she joined the Netherlands Forensic Institute in Rijswijk as a statistical consultant. Her main current research interests are in statistical forensic DNA analysis, statistical environmental legal control and in the application of likelihood (or Bayesian) methods to forensic science.

John Spencer graduated in art and law at the University of Cambridge, United Kingdom, and has held the degrees of MA and LLB since 1969. From 1970 he taught law in various capacities at Cambridge, United Kingdom. He is a Fellow of Selwyn College, Cambridge. Since 1995 he has been a Professor in the University Law Faculty of the University of Cambridge and has spent a number of periods at French Universities as a visiting professor. From 1995-1997 he was Chairman of the Cambridge Faculty. Since 1995 he has been part of the international team of criminal lawyers working on the EU Corpus juris. His interests include criminal evi-
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Leo Toornvliet graduated in experimental psychology and research technology at Leiden University, the Netherlands, in 1967. From the outset of his scientific research activities he has been concerned with the aetiology of juvenile delinquency and criminality, especially in relation with personality. Leo Toornvliet also has been active in evaluating several crime prevention projects in the Netherlands. He is co-author of a Dutch introduction to criminology.

Willem Albert Wagenaar studied psychology at Utrecht University, the Netherlands, where he graduated cum laude with a major in Experimental Psychology in 1965. In 1972 he received his PhD in Social Sciences from Leiden University. In 1973-1974 he practised a Fulbright scholarship and was visiting Professor in Pennsylvania State University, USA. From 1985 until the present he has been Professor of Experimental Psychology at Leiden University. From 1987-1989 he was Dean of Social Sciences and since 1997 he has been Rector Magnificus of Leiden University. In 1991 he occupied the Franqui Chair of Experimental Psychology at the University of Leuven, Belgium. Since 1992 he is overseas fellow of Churchill College in Cambridge, United Kingdom. Since 1984 he is a member of the Royal Dutch Academy of Science and in 1993 he became Chairman of the European Association for Decision Making. Since 1999 he is a member of the Dutch National Transportation Safety Board. He has acted as expert witness in many trials involving questions of human perception and memory.
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Lia van der Westen—Baptist graduated in criminalistics (1985) and criminal law (1989) at Leiden University, the Netherlands. She worked from 1974-1984 at the Netherlands Forensic Institute. Since 1992 she has worked at Leiden University, in the first year as a teacher in criminal law, later as a researcher within the ‘Seminarium voor Bewijsrecht’ (Seminar for the Law of Evidence). Lia van der Westen carried out a project on the effectiveness of human scent identifications with tracker dogs. In the Research Project ‘Harmonisation in Forensic Expertise’ she was member of the editorial board.

Sijtze Wiersma graduated in law at the State University of Groningen, the Netherlands, in 1973. Since then he has been working at the Ministry of Justice, The Hague, the Netherlands. He first worked at the Child Care and Protection Board in several management functions and since 1997 he has been Secretary of the Advice Counsel of the Netherlands Forensic Institute in Rijswijk, and policy adviser at the same institute. In the Research Project ‘Harmonisation in Forensic Expertise’ he was member of the editorial board.