



# NATIONAL COMMISSION ON FORENSIC SCIENCE

**NIST**  
National Institute of  
Standards and Technology  
U.S. Department of Commerce

## Ensuring That Forensic Analysis Is Based Upon Task-Relevant Information

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### Subcommittee

Human Factors

### Commission Action

On December 8, 2015, the Commission voted to adopt this Views document by a more than two-thirds majority affirmative vote (93% yes, 7% no, 0% abstain).

### Type of Work Product

Views Document

### Statement of the Issue:

What is the proper evidentiary basis for a forensic science opinion? In other words, what facts should forensic science service providers (FSSPs) consider and what facts should they not consider when drawing conclusions from physical evidence? These are questions of fundamental importance to forensic science. The need for clear answers has become increasingly important as FSSPs are being called on to address the challenge of contextual bias.

It is the view of the National Commission on Forensic Science that:

1. FSSPs should rely solely on task-relevant information when performing forensic analyses.
2. The standards and guidelines for forensic practice being developed by the Organization of Scientific Area Committees (OSAC) should specify what types of information are task-relevant and task-irrelevant for common forensic tasks.
3. Forensic laboratories should take appropriate steps to avoid exposing analysts to task-irrelevant information through the use of context management procedures detailed in written policies and protocols.

### 1 – Pertinent Principles

This document sets forth principles that FSSPs should use to assess the relevance of information to specific forensic tasks. It uses the term *task-relevant* to describe information that FSSPs should consider when performing a particular task; it uses the term *task-irrelevant* to describe information that should not be considered.

When discussing what is task-relevant, it is useful to distinguish three phases at which forensic FSSPs may be involved in a criminal investigation. There is often a preliminary phase, in which FSSPs survey a crime scene, decide what evidence to collect, and determine what examinations are needed. This is followed by an analytic phase, during which specific items of evidence are examined, analyzed, and compared. This may be followed by an evaluative phase, in which FSSPs help police and lawyers understand the implications of the analytic findings and put them in context.

Evidence that is task-relevant during the evidence collection and evaluative phases may not be task-relevant during the analytic phase. For example, statements of witnesses about what happened during a crime may be task-relevant when deciding what evidence to collect at a crime scene or what examinations are needed. Such statements may also be task-relevant when making an overall assessment of the case in light of the forensic evidence. But witness statements generally are not relevant to the task of interpreting analytic tests. The results of analytic examinations and comparison should depend on the physical evidence examined, not on what witnesses say.

What is relevant to a particular forensic task will also depend on the propositions the FSSP is asked to assess. As used here, the term *proposition* refers to a theory or hypothesis about the event in question that a FSSP is asked to assess (Cook et al., 1998). FSSPs are often asked to assess propositions about the source of an item. They might be asked, for example, to assess whether a biological specimen came from a suspect or from someone else, or whether a shell casing was fired by a particular gun rather than by some other gun. FSSPs might also be asked to assess propositions about the activity that produced a particular item of evidence. For example, bloodstain pattern analysts might be asked whether a particular bloodstain was produced by a high-velocity impact, by arterial bleeding, or by expiration (coughing) (Kish et al., 2005; Laber et al., 2014).

When performing analytic tasks, FSSPs should draw conclusions solely from the physical evidence that they are asked to evaluate (along with any task-relevant context), and not from any other evidence in the case. Fingerprint examiners should draw conclusions from fingerprints, tool mark examiners from tool marks, DNA experts from biological evidence. It would be inappropriate, for example, if analytic conclusions were influenced by whether the suspect made incriminating statements or had a criminal record, or whether other forensic evidence implicated the suspect. Those are matters to be considered by police, prosecutors, and jurors, not matters that should influence a scientific assessment of evidence.

FSSPs should base their conclusions on methods that are accepted as valid within their specific disciplines. They should draw conclusions only from methods or techniques that they are trained and competent to use.

From these considerations, it follows that information is *task-relevant* for analytic tasks if it is necessary for drawing conclusions:

- (i.) *about the propositions in question,*
- (ii.) *from the physical evidence that has been designated for examination,*
- (iii.) *through the correct application of an accepted analytic method by a competent analyst.*

Information is *task-irrelevant* if it is not necessary for drawing conclusions about the propositions in question, if it assists only in drawing conclusions from something other than the physical evidence designated for examination, or if it assists only in drawing conclusions by some means other than an appropriate analytic method.

As previously indicated, FSSPs will sometimes need contextual information in order to perform a particular task. For example, a fingerprint examiner may need information about the surfaces from which the prints were lifted in order to assess whether discrepancies between prints could have been caused by curvature or distortion of one of the surfaces. A bloodstain pattern analyst may need information about the location of the blood in order to assess various propositions about how it was deposited. The test of whether such ancillary contextual information is relevant to a forensic assessment is whether it helps the examiner draw an accurate forensic conclusion from the physical evidence designated for testing using accepted methods. It is task-relevant if it helps the analyst assess the strength of the inferential connection between the physical evidence being examined and the propositions the analyst is evaluating.

But contextual information often supports inferences about a proposition only through a chain of logic that does not involve assessment of the physical evidence. Contextual information of this type is task-

irrelevant. A more formal definition of task-relevance and task-irrelevance is offered in the technical appendix to this document.

Let us consider several examples involving a latent print examiner who is asked to evaluate the proposition that a fingerprint on an item at a crime scene came from a particular suspect.

Information about the suspect's criminal history. FSSPs sometimes have access to "rap sheets" of suspects and may be tempted to look at them. But the suspect's criminal history (or lack thereof) is not necessary for drawing conclusions *from the physical evidence designated for examination* and therefore is task-irrelevant.

Information that the suspect confessed to the crime. This information may well support an inference that the fingerprint found at the crime scene was that of the suspect. But this inference has nothing to do with comparison or evaluation of the prints. Hence it fails to meet the requirement that it help the analyst draw conclusions *from the physical evidence that has been designated for examination and through correct application of an accepted analytic method*. It is an inference that neither requires nor entails expertise in fingerprint comparison.

Information that the suspect was implicated by other physical evidence at the crime scene (e.g., DNA evidence). This information also supports an inference that the fingerprint found at the crime scene was that of the suspect. But once again, this inference does not arise from the comparison or evaluation of the fingerprints. Hence it fails in the same ways as the evidence of the confession.

Information that another latent print examiner identified the suspect as the source of a print found on a different item at the same crime scene. Even though this information involves fingerprints, it does not help the analyst draw conclusions *from the physical evidence that has been designated for examination, through correct application of an accepted analytic method*. An examiner might reason that a person who touched one item at a crime scene is also likely to have touched another, but that kind of reasoning does not constitute scientific assessment of the evidence in question, nor does it constitute the application of an accepted analytic method. Latent print examiners should draw conclusions by examining and comparing prints, not by reasoning about whether a particular suspect is likely or unlikely to have touched a particular item.

Of course, information that is irrelevant to analytic tasks such as comparing fingerprints may sometimes be relevant to other forensic science tasks. The FSSP who surveys a crime scene to determine what evidence to collect or confers with the assigned detective to determine what evidence to analyze, what examinations are required, and with what priority, will obviously need more contextual information than the analysts who compare specific items of evidence. FSSPs who confer with police or lawyers to help them understand the picture emerging from the examination of multiple items of evidence from a crime scene will also need more contextual information than those whose job it is to perform a specific analysis or comparison. What is task-relevant will always depend on the nature of the task.

Analysis of forensic evidence often involves a sequence of different tasks. A particular piece of information may be task-relevant at some points in the sequence but task-irrelevant at other points. This fact poses a challenge for those who are designing protocols and procedures for forensic laboratories. The laboratory procedures must assure that examiners receive the task-relevant information they need to do effective work. As discussed next, however, there are risks entailed in exposing examiners unnecessarily to task-irrelevant information.

## **2 – Contextual Bias: Unwanted Influence of Task-Irrelevant Information**

In 2009, the National Research Council concluded that “forensic science experts are vulnerable to cognitive and contextual bias” (p. 4, note 8). This concern arose, in part, from empirical studies showing that forensic scientists are sometimes influenced by information that is task-irrelevant. For example, fingerprint examiners were less likely to report a match between a latent print from a crime scene and a suspect when they were told that the suspect had a solid alibi (Dror & Charlton, 2006; Dror, Charlton, & Peron, 2006; Dror & Rosenthal, 2008; see generally, Expert Working Group on Human Factors in Latent Print Analysis, 2012). Studies of decision making in the fields of bloodstain pattern analysis (Laber, et al., 2014), forensic anthropology (Nakhaeizadeh, Dror & Morgan, 2013), bite mark analysis (Osborne, et al., 2014), and DNA analysis (Dror & Hampikian, 2011; Thompson, 2009) have also found evidence of contextual bias.

Contextual bias is not a problem that is unique to forensic science. It is a universal phenomenon that affects decision making by people from all walks of life and in all professional settings (Kassin, Dror, & Kukucka, 2013; Expert Working Group, 2012). People are particularly vulnerable to contextual bias when performing tasks that require subjective judgment and when they must rely on data that are somewhat ambiguous.

Studies show that the contaminating impact of contextual bias can occur beneath the level of conscious awareness (Kassin, Dror & Kukucka, 2013; Thompson, 2011). This finding means that contextual bias is by no means limited to cases of misconduct or bad intent. Rather, exposure to task-irrelevant information can bias the work of FSSPs who perform their job with utmost honesty and professional commitment. Moreover, the nonconscious nature of contextual bias also means that people cannot detect whether they are being influenced by it. It follows that task-irrelevant information can bias the work of FSSPs even when they earnestly and honestly believe they are operating with utmost objectivity.

## **3 – Ways to Minimize Contextual Bias: A Path Forward**

The most effective way to address the challenge of contextual bias is to avoid exposing analysts to task-irrelevant information (Risinger, et al., 2002). Blinding procedures are used in many areas of science in order to prevent bias. It will be challenging to implement such procedures in forensic science because, as noted earlier, FSSPs must perform a variety of tasks, and information that is irrelevant and potentially biasing for some tasks may well be necessary and relevant for other tasks. But these challenges can be met if forensic laboratories adopt appropriate context management procedures (Stoel, et al., 2015).

One way to minimize the potential for bias is to divide duties among different people. The FSSP who evaluates the crime scene and decides what specimens to collect and what examinations are warranted need not be the same person who performs those examinations and interprets the results. Some laboratories divide duties between a case manager, who is fully informed about the facts of the underlying case, and analysts, who are told only what they need to know to perform specific tasks (Thompson, 2011; Found & Ganas, 2013). Under this approach, case managers communicate with investigators, decide what evidence needs to be examined or tested, and assign the evidence to analysts, who conduct the examinations and tests. The case manager decides what information is task-relevant and task-irrelevant for each task to be performed and conveys to the analyst only information that is relevant to that task. The analyst may eventually learn the broader facts of the case, but only after the analytic task has been completed and the results recorded. Laboratories might designate a single individual to serve as case manager for a number of analysts, or they might rotate the role of case manager among analysts, allowing them to diversify their experience. A rotating arrangement might be particularly suitable for smaller laboratories with a limited number of analysts. Even if there were only two analysts in a particular section, each might act as case manager for the cases examined and analyzed by the other, so that both could be shielded from exposure to task-irrelevant information while performing important analytic tasks.

A second approach is to design the workflow in the laboratory in a manner that assures that analysts make critical assessments before they become aware of potentially biasing information. This strategy is helpful in instances in which information that is irrelevant for some tasks is relevant and necessary for other tasks that are performed by the same analyst. For example, information about the DNA profile of a suspect is irrelevant and potentially biasing when a DNA analyst is attempting to determine what genotypes are present in an evidentiary profile (Dror & Hampikian, 2011; Thompson, 2009), but is necessary and relevant when the analyst evaluates whether the suspect could be a contributor to the DNA in the evidentiary profile.

To reduce the potential for bias in DNA testing, some laboratories require analysts to follow a procedure known as “sequential unmasking” (Krane, et al., 2008; Dror, et al., 2015), in which evidentiary samples from crime scenes are typed and interpreted before analysts learn of the profiles of any known or suspected contributors. The DNA profiles of known contributors and possible suspects are then “unmasked” in a specific sequence to minimize the likelihood that information about the reference profiles will influence interpretation of the evidentiary samples. This procedure has been adopted successfully by the Netherlands Institute of Forensic Sciences (Stoel, et.al., 2015).

Similar procedures have been recommended by the Expert Working Group on Human Factors in Latent Print Analysis (2012) and have been adopted by laboratories in the United States. For example, the FBI laboratory has reportedly adopted a similar procedure for latent print analysis, as has the Virginia Department of Forensic Science and the Minnesota Bureau of Criminal Apprehension. Called “linear ACE-V,” the FBI’s procedure involves temporary masking of reference prints while analysts make and record their initial assessments of the evidentiary prints (Office of the Inspector General, Department of Justice, 2011).<sup>1</sup>

Many laboratories have adopted computerized Laboratory Information Management Systems (LIMS), in which case files, laboratory notes, and other records are maintained. These systems can and should be programmed to facilitate context management by preventing analysts from premature access to potentially biasing task-irrelevant information (e.g., by preventing bench-level analysts from accessing witness statements and police reports until after they complete their evaluations of evidentiary samples). Those developing such systems should pay careful attention to what information is task-relevant at various stages in the laboratory process and should cooperate with forensic laboratories to assure that the appropriate information is available when needed.

Forensic laboratories should begin to implement context management procedures. As they do so, they should systematically monitor laboratory performance in order to identify strengths and weaknesses of the new procedures, document unanticipated consequences, and learn from trial and error which context management procedures are most successful and practical.

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<sup>1</sup> The acronym ACE-V designates four critical steps of latent print analysis: analysis, comparison, evaluation, and verification.

## References

- Cook, R., Evett, I.W., Jackson, G., Jones, P.J., & Lambert, J.A. (1998). A hierarchy of propositions: deciding which level to address in casework. *Science & Justice*, 38.
- Dror, I.E., & Charlton, D. (2006). Why experts make errors. *Journal of Forensic Identification*, 56, 600–616.
- Dror, I.E., Charlton, D., & Peron, A. (2006). Contextual information renders experts vulnerable to making erroneous identifications. *Forensic Science International*, 156, 174–178.
- Dror, I.E., & Hampikian, G. (2011). Subjectivity and bias in forensic DNA mixture interpretation. *Science & Justice*, 51(4), 204–208.
- Dror, I.E., & Rosenthal, R. (2008). Meta-analytically quantifying the reliability and biasability of forensic experts. *Journal of Forensic Sciences*, 53(4), 900–903.
- Dror, I.E., Thompson, W.C., Meissner, C.A., Kornfield, I., Krane, D., Saks, M., & Risinger, M. (2015). Context management toolbox: a linear sequential unmasking (LSU) approach for minimizing cognitive bias in forensic decision making. *Journal of Forensic Science*, 60(4): 1111–12.
- Expert Working Group on Human Factors in Latent Print Analysis (2012). *Latent Print Examination and Human Factors: Improving the Practice through a Systems Approach*. U.S. Department of Commerce, National Institute of Standards and Technology.
- Found, B., & Ganas, J. (2013). The management of domain irrelevant context information in forensic handwriting examination casework. *Science & Justice*, 53(2), 154–158.
- Kassin, S. M., Dror, I.E., & Kukucka, J. (2013). The forensic confirmation bias: problems, perspectives, and proposed solutions. *Journal of Applied Research in Memory and Cognition*, 2: 42–52.
- Kish, P.E., Sutton, T.P., & James, S.H. (2005). *Principles of Bloodstain Pattern Analysis: Theory and Practice* 3ed. Boca Raton: CRC Press.
- Krane, D.E., Ford, S., Gilder, J., Inman, K., Jamieson, A., Koppl, R., et al. (2008). Sequential unmasking: a means of minimizing observer effects in forensic DNA interpretation. *Journal of Forensic Science*, 53(4):1006–7.
- Laber, T., Kish, P., Taylor, M., Owens, G., Osborne, N., & Curran, J. (2014). *Reliability Assessment of Current Methods in Bloodstain Pattern Analysis*, Final Report for NIJ.
- Nakhaeizadeh, S., Dror, I.E., & Morgan, R.M. (2013). Cognitive bias in forensic anthropology: visual assessment of skeletal remains is susceptible to confirmation bias. *Science and Justice*, 54: 208–14.
- National Research Council (2009) *Strengthening Forensic Science in the United States: A Path Forward*. Washington, D.C.: The National Academies Press.
- Office of the Inspector General, U.S. Department of Justice (2011). *A Review of the FBI's Progress in Responding to the Recommendations in the Office of the Inspector General Report on the Fingerprint Misidentification in the Brandon Mayfield Case*, Office of the Inspector General, U.S. Department of Justice, Washington, D.C.
- Osborne, N.K., Woods, S., Kieser, J., & Zajac, R. (2014). Does contextual information bias bitemark comparisons? *Science & Justice*, 54(4): 267–73.

- Risinger, D.M., Saks, M.J., Thompson, W.C., & Rosenthal, R. (2002). The Daubert/Kumho implications of observer effects in forensic science: hidden problems of expectation and suggestion. *California Law Review*, 90: 1–55.
- Stoel, R.D., Berger, C.E., Kerkhoff, W., Mattijssen, E., & Dror, I. (2015). Minimizing contextual bias in forensic casework. In: Strom, K., & Hickman, M.J. (Eds.) *Forensic Science and the Administration of Justice*. New York: Sage.
- Thompson, W.C. (2011). What role should investigative facts play in the evaluation of scientific evidence? *Australian Journal of Forensic Science*, 43(2–3): 123–34.
- Thompson, W.C. (2009). Painting the target around the matching profile: the Texas sharpshooter fallacy in forensic DNA interpretation. *Law, Probability & Risk*, 8: 257–76.

## Technical Appendix: Formal Definition of Task-Relevance

The distinction between task-relevant and task-irrelevant information can be described formally as follows:

Let  $P$  and  $NP$  designate two mutually exclusive propositions that a forensic science service provider (FSSP) is asked to evaluate. For example,  $P$  might designate the proposition that a particular suspect was the source of a fingerprint found at a crime scene, and  $NP$  designates the proposition that someone other than the suspect made that print.

Let  $E$  designate the features or characteristics of the physical evidence that has been designated for examination. For a fingerprint examination,  $E$  will typically consist of the observable features of the questioned latent print and the reference prints from a suspect.

The only logical way for the examiner to draw conclusions about  $P$ ,  $NP$  from  $E$ , is to consider the conditional probability of  $E$  under those alternative propositions. It follows that any information that could assist the examiner in making that evaluation is task-relevant, whereas information that has no bearing on that evaluation is task-irrelevant. Specifically:

- (1) information is task-relevant if it has the potential to assist the examiner in evaluating either the conditional probability of  $E$  under  $P$ —which can be written  $p(E/P)$ —or the conditional probability of  $E$  under  $NP$ —which can be written  $p(E/NP)$ ;
- (2) information is task-irrelevant if it has no bearing on the conditional probabilities  $p(E/P)$  or  $p(E/NP)$ .

Consider, for example, information about the surface from which the latent print was lifted. This information might be needed to understand how discrepancies could arise between the reference prints and the latent prints; hence, it could be helpful for assessing  $p(E/P)$  in a fingerprint examination. If so, it is task-relevant.

By contrast, consider information about the suspect's prior criminal record, statements to police, and alibi. This type of information might affect the examiner's evaluation of the likelihood that  $P$  or  $NP$  is true, but it has no effect whatsoever on the relevant conditional probabilities,  $p(E/P)$  and  $p(E/NP)$ . If the suspect is the source of the latent print, then a high degree of similarity between the prints is to be expected, regardless of whether the suspect confessed, has an alibi, or has a criminal record. If the suspect is not the source of the latent print, then a low degree of similarity is to be expected, regardless of these other factors.

Because information of this type does not affect the relevant conditional probabilities, it does not help the analyst assess the strength of the inferential connection between the evidence designated for examination and the relevant propositions. It might help the analyst draw conclusions about the propositions, but it does not help the analyst draw conclusions *from the physical evidence that has been designated for examination* through *correct application of an accepted analytic method*. Any inferences analysts might draw from the task-irrelevant information involve matters beyond their scientific expertise that are more appropriately considered by others in the justice system, such as police, prosecutors, and jurors.