JOURNAL OF FORENSIC SCIENCES

J Forensic Sci, May 2020, Vol. 65, No. 3
doi: 10.1111/1556-4029.14265
Available online at: onlinelibrary.wiley.com

PAPER

GENERAL

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ISO Standards Addressing Issues of Bias and Impartiality in Forensic Work

ABSTRACT: The ISO/IEC 17020 and 17025 standards both include requirements for impartiality and the freedom from bias. Meeting these requirements for implicit cognitive bias is not a simple matter. In this article, we address these international standards, specifically focusing on evaluating and mitigating the risk to impartiality, and quality assurance checks, so as to meet accreditation program requirements. We cover their meaning to management as well as to practitioners, addressing how these issues of impartiality and bias relate to forensic work, and how one can effectively evaluate and mitigate those risks. We then elaborate on specific quality assurance policies and checks and identify when corrective action may be appropriate. These measures will not only serve to meet ISO/IEC 17020 and 17025 requirements, but also enhance forensic work and decision-making.

KEYWORDS: forensic science, quality assurance, cognitive bias, ISO standards, accreditation, risk management, blind verification, proficiency testing, linear sequential unmasking (LSU)

ISO/IEC 17020, the standard for "Conformity assessment—Requirements for the operation of various types of bodies performing inspection," is an international standard that has been incorporated into the accreditation programs of forensic agencies that provide inspection or examination services (i.e., the accreditation programs offered by ANAB and A2LA). Forensic disciplines for which an ISO 17020 accreditation program may be appropriate include crime scene investigation, latent prints, firearms, forensic anthropology, and forensic pathology. The objective of ISO/IEC 17020 within the forensic domain is to improve the work and confidence in bodies performing forensic examination (1). The standard itself focuses on the various activities surrounding the work of an examiner, both on the administrative and technical levels. The standard covers all aspects of the processes, putting safety and quality at the forefront of the operation.

ISO/IEC 17020:2012 (hereafter, ISO 17020) is very similar to ISO/IEC 17025:2017 (hereafter, ISO 17025), "General requirements for the competence of testing and calibration laboratories," the standard commonly followed by accredited crime laboratories. The main difference between the two standards is the magnitude of reliance on the human examiner's own judgment, versus more on objective data (1). Forensic service providers that have disciplines that rely more on subjective analyses and interpretation should follow ISO 17020, whereas forensic disciplines which are considered more objective, rely more on instrumentation and/or objective quantification (e.g., toxicology and drug analysis) should follow ISO 17025. Compliance with standards and maintaining accreditation in forensic work are important for the various forensic stakeholders (see Fig. 1).

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Received 10 Aug. 2019; and in revised form 16 Oct. 2019; accepted 6 Dec. 2019.

The first section of requirements in ISO 17020 (section 4) addresses impartiality, independence, and confidentiality; each of these principles is a source of concern for those utilizing forensic services. The requirements for independence and confidentiality are fairly straightforward. The impartiality requirements, however, pose more complex challenges to laboratory management as well as the practitioners.

To begin with, there is a lack of understanding of the concept and issues involved (2–4). The issue of impartiality does not only pertain to intentional misconduct, which is a relatively small problem and falls within the domain of professional ethics. The wider and more challenging issue with impartiality is cognitive bias, which is widespread and implicit (2,4). It pertains to hardworking, dedicated, honest, and competent forensic examiners, trying to do their job impartially, but nevertheless, are actually biased (3).

The impact of such implicit bias is a serious concern, as it not only impacts the judgment of the examiner, but also creates *bias cascade* and *bias snowball* (4). These effects are common and relate when bias in one part or phase of an investigation cascades and snowballs to others. For example, when a crime scene investigator who was exposed to biasing context at the crime scene also conducts the analysis back in the crime laboratory (such as fingerprinting), then the bias from the crime scene can cascade to the work in the laboratory. Hence, biases are not compartmentalized and impact the whole investigation and perhaps the objective of administering fair justice (4).

New to the 2017 version of ISO 17025 are impartiality requirements that mirror those of ISO 17020, and an emphasis on risk-based thinking. This change reinforced the significance of the role of the human examiner, even when quantification and instrumentation are used. The change recognizes that use of instrumentation does not guarantee freedom from bias. Hence, forensic service providers must take steps to ensure that all their forensic examinations are undertaken in an impartial manner as much as possible, regardless of whether the analyses are

FIG. 1—*Different stakeholders of forensic examination (a modified version of the figure from Almazrouei et al. [10]). Internal stakeholders: Forensic Services Domain (A). External stakeholders: Investigative Domain (B), Judicial Domain (C), Regulatory Domain (D), and Public Domain (E). The forensic examiner must interact with members of each domain, regardless if they have direct or indirect involvement with their cases. [Color figure can be viewed at wileyonlinelibrary.com]*

considered to be more subjective or objective, as all examiners who render conclusions almost always have at least some subjectivity involved—even seemingly objective domains, such as forensic toxicology (5) (see also a case of bias in forensic toxicology: Forensic Science Regulator [6]), and even DNA (7,8), have subjective interpretation and judgment. With the revised ISO 17025 standard paralleling the requirements of ISO 17020, testing laboratory personnel and management must address how to best comply with these particular requirements of impartiality. This may be somewhat daunting, as these concepts go beyond forensic science per se and require cognitive insights.

Definition of Impartiality in ISO Standards

Both ISO 17020 and ISO 17025 initially define "impartiality" as the "presence of objectivity." The standards then further elaborate on the term, via two Notes:

"NOTE 1: Objectivity means that conflicts of interest do not exist, or are resolved so as not to adversely influence subsequent activities of the *laboratory*" (ISO 17020 replaces the word "laboratory" with "inspection body"; ISO 17025 p. 1 [1,9]).

"NOTE 2: Other terms that are useful in conveying the element of impartiality include 'freedom from conflict of interests', 'freedom from *bias'*, 'lack of prejudice', 'neutrality', 'fairness', 'open-mindedness', 'even-handedness', 'detachment', 'balance'." (ISO 17020 also adds the word "independence" to this list; *bias* emphasis added; ISO 17025 p. 1 [1,9]).

Indeed, even the more objective, instrument-reliant disciplines using ISO 17025 must follow specific criteria regarding impartiality. The first five subclauses of both standards' General Requirements (4.1.1 through 4.1.5) require that activities are carried out in an impartial manner and that there is

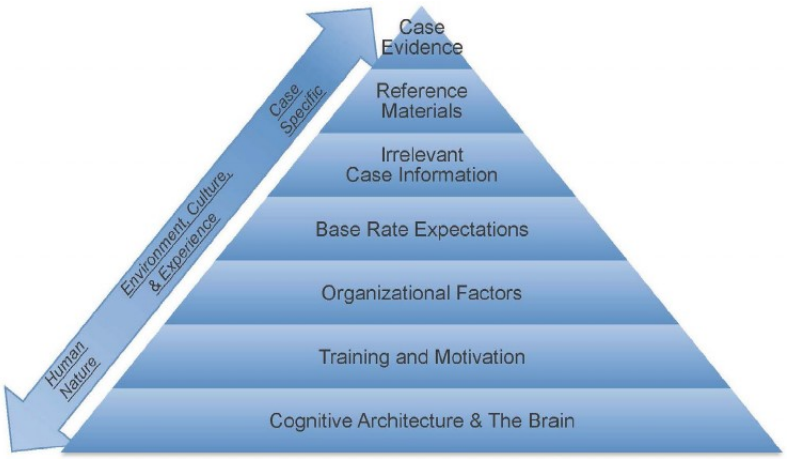

FIG. 2—*Taxonomy of seven sources of factors that may unconsciously affect the decision-making of forensic experts (Dror, 2017 [28], p. 543). [Color figure can be viewed at wileyonlinelibrary.com]*

upper management commitment and an established responsibility to impartiality, an ongoing effort to identify risks to impartiality, and systems in place to minimize or eliminate any identified risk to impartiality (1,9).

We are focusing on the terms of bias and impartiality within the ISO standards applicable to forensic service providers, but these terms also relate to the various stakeholders (see Fig. 1). For example, within the legal domain other terms relating to impartiality and bias are utilized, such as "fair administration of justice," and within the human resources (HR) domain, related terms such as "equal treatment of all" are utilized. These are all encompassed in our discussion of the ISO terms of impartiality and bias.

Accreditation Program Requirements

What Does It Mean to Management as Well as to Practitioners?

Given the two ISO standards' requirements and definition of impartiality (see above), the management of a forensic service provider seeking accreditation must thoroughly explore and understand what impartiality encompasses, and appreciate how it relates and underpins much of the work carried out in forensic agencies. As noted above, both ISO standards require that there is commitment, as well as ongoing effort and systems in place, to ensure that activities are carried out in an impartial manner (1,9). In short, the goal is that forensic examiners and management demonstrate that they have taken reasonable steps to make sure forensic conclusions are minimally influenced by cognitive bias by way of risk assessments and preventive actions, covering both internal and external biasing factors, and allow for transparency regarding potential influences (i.e., documented, included in the report, and are disclosed—see the requirements of the Forensic Disclosure, Almazrouei et al. [10]).

Moreover, systems should be in place to regularly check, on an ongoing basis, that the provider's quality assurance measures are sufficient to identify and minimize biasing factors in forensic work, rather than responding to problems in an ad hoc manner. Often, measures are taken only to address nonconformities and scandals (11), which means that forensic laboratories are too often reactive to "symptoms" that arise, rather than proactively engaging in review and self-assessment as routine practice (this is, of course, true for other domains as well).

These ongoing efforts should aim at maximizing the forensic examiners' independence of mind. This is not only in accordance with the ISO standards, but also in accordance with the 2009 NAS report, which stipulates, "Forensic laboratories should establish routine quality assurance and quality control procedures to ensure the accuracy of forensic analyses and the work of forensic practitioners. Quality control procedures should be designed to identify mistakes, fraud, and bias" (Recommendation 8 [12]). The potential for bias should be monitored and documented regularly and be a subject of ongoing quality assurance checks. This article is about how the ISO requirements can drive such a positive change.

How Does the Issue of Impartiality and Bias Relate to Forensic Work?

In order to appreciate the various types of biasing factors that come into play in forensic examinations (see Fig. 2), one must think about the nature of the relationships and interactions with various people, entities, and stakeholders (see Fig. 1). Certain interactions, contextual information, and expectations have the potential to affect the service provider's impartiality, eventually diminishing it to a level that can cause biased and possibly erroneous conclusions. The various, and even conflicting, interests can arise from a variety of sources, including organizational factors (e.g., science within an adversarial legal system), and require attention.

Consider law enforcement agencies, for example, who, by their very nature, are a substantial source of potential influence on forensic service providers—both on the agency level and on the individual level of experts doing their work. As the initial investigators of criminal activities and main submitters of forensic evidence, crime laboratories and medical examiner offices exchange information and interact with law enforcement officers

on a regular basis. During such interactions, task-irrelevant biasing information may be provided to the forensic examiners. Information they do not need to know to perform their tasks and information that can bias their observations and conclusions are often disclosed (3,13,14). Therein lies the problem: Law enforcement officers are concerned with their investigations, yet forensic examiners should only be concerned with the science.

A critical element to accomplishing impartiality is for the forensic examiner to conduct all aspects of casework without regard of motivation to deliver "helpful" or expected results to law enforcement. Exposure to such information can implicitly influence and bias the forensic work. Furthermore, forensic scientists who see their role as supporting the police, or fighting crime, enter the *bias danger zone* (circumstances where bias is more likely to have an impact). Forensic examiners who see themselves as scientists doing scientific work are more likely to be impartial and, at the end of the day, contribute more to fighting crime.

Attorneys' potential for influencing forensic results parallels that of law enforcement officers—the results and expert interpretations of forensic examinations are crucial to their case outcomes. When forensic work is regarded as a tool to help the attorneys win their cases (be it prosecution or defense) rather than to help reveal the truth, then impartiality is in danger. Forensic examiners should only be motivated and committed to produce scientifically based, accurate, and reliable results, without regard to other factors. However, once exposed to such influencing factors and pressures, cognitive bias kicks in. The willpower of the examiners to stay impartial is well intended, but not effective.

A proper cognitive understanding of the concept of bias and impartiality entails an appreciation that these effects are mainly implicit. The widespread problem of bias and impartiality is not an ethical issue of examiners intentionally giving into pressures to support a case. Rather, irrelevant contextual information, personal expectations, reference materials, and other factors implicitly and without awareness impact the hardworking and dedicated forensic examiners (see Fig. 2).

This has far-reaching implications for meeting the ISO standards, because willpower is insufficient to address the requirements of bias and impartiality. Specific procedures and quality assurance measures must be implemented within the forensic service to satisfy ISO 17020 and ISO 17025.

Another type of cognitive bias is a consequence of forensic work that is not driven by the evidence, but by the reference of the "target" suspect. Rather than working from the evidence to the suspect (i.e., examining the evidence first, in isolation, and only thereafter having exposure to the suspect's reference data), bias occurs when the evidence is examined simultaneously with the suspect's data. Be it the fingerprint of the suspect, their DNA profile, their handwriting, or the striae on the cartridge cases fired from their firearm—all of these may have a biasing impact and reduce the impartiality in examination of the actual evidence from the crime scene. Impartial evidence analysis requires that it is carried out independently from the suspect's reference data (8,15).

Another source of bias is commercial interests. This applies to privatization of forensic work, when commercial laboratories are used directly by police, or when crime laboratories outsource and use vendors as contractors. These commercial interests create pressures to provide "good results," to keep the consumer happy and returning for more business, which may result in a provision of biased services. Therefore, another element of safeguarding impartiality relates to evaluating the quality of the services provided by those with commercial interests, and to determine their merit, and selecting the ones that best suit the needs. When it comes to vendors, management also has to worry about cost, and keeping costs down often entails compromising on quality (16). This conflict, which may lead to less than ideal practices, is not limited to costs with vendors, but also relates to workflow (e.g., turnaround times, cost of output, and workflow vs. quality).

Entering into a financial relationship with another party creates an additional source of potential influence, whether explicit or implicit. If an examiner, manager, or agency representative accepts or offers monetary funds, whether via a grant or a contract for service, attention must be paid to the meaning of that payment. For instance, a funding agreement through a grant for the agency must not be tied to any personal gain for the examiners involved. Similarly, a fee schedule for providing service (i.e., subcontractor), or additional work, must not be contingent on the types of results obtained; rather, it should be based on the hours, effort, and/or resources involved in the work. Practices that deviate from these guidelines jeopardize the integrity of the examination results, both explicitly and implicitly.

Evaluating and Mitigating the Risk to Impartiality

Awareness and understanding of the potential sources of influences and cognitive biases are not enough to satisfy the requirements of the ISO standards. It is merely a first and necessary step, but not sufficient. Mitigating and controlling risks to impartiality need to become a regular part of the provider's quality management system.

This is achieved by adopting policies, procedures, and best practices for monitoring these risks and, when necessary, acting to prevent or mitigate them. Below, we specify some of these actions that, when correctly applied, can help fulfill ISO 17020 and ISO 17025 impartiality requirements. These actions predominantly encompass information and context management: who gets what information, when, in what sequence, etc. These are covered, in part, in the Forensic Science Regulator guidance on bias (14), in "Practical Solutions to Cognitive and Human Factor Challenges in Forensic Science" (17), in the National Commission on Forensic Science document "Ensuring that Forensic Analysis Is Based upon Task-Relevant Information" (13), and in the Forensic Disclosure (10).

Of course, adopting such policies, procedures, and best practices is not enough, because they are not effective without accompanying training. Staff need to be properly trained about cognitive bias, so they understand why these policies, procedures, and best practices are in place and their importance, and therefore willingly accept and follow them.

Processes (Risk Management SOP)

Management should first implement a procedure for risk management. Not only is a sound risk management procedure a good business practice, but it also effectively addresses some of the impartiality clauses in both ISO 17020 and ISO 17025. "Risks" to an agency include factors that threaten the health and safety of staff (including mental health [18]), the environment, the organization's facilities, the financial health of the agency, operational productivity, and the *quality of the service*. Therefore, any risk to impartiality becomes a factor that may prevent the

agency from achieving its quality objectives, as well as compliance with the applicable ISO standard, and must be managed just like other risks.

An effective risk management standard operating procedure (SOP) typically contains five elements: preparation, identification, analysis/evaluation, control, and review (see, e.g., the Risk Management SOP of the Harris County Institute of Forensic Sciences in the Appendix S1). The starting point of risk management is the preparation, which mainly involves the gathering of data so management can properly identify potential risks. There are numerous sources for data that can be reviewed to assist with discovering areas of potential risk. Examples include, past incident reports, internal/external audit findings, process maps, and financial records. The preparation does not have to be limited to passive collection of documents and information; it should also include active preparations, such as utilizing fake cases to reveal ecologically valid data on performance and bias. Identification of a risk to impartiality involves asking questions and examining the documents and data to determine whether certain activities, contextual information, procedures, or relationships could lead to potentially influencing an examiner's decision-making.

However, both of these elements, as well as the subsequent phases in risk management, all require a cognitive understanding of bias. Forensic experts and management are well equipped with knowledge and understanding of forensic issues, but most often lack the necessary background and insight to cognitive issues that underpin bias and impartiality. This leads to mis-conceptualizing what bias is, which then results in misguided and wrong ideas about how it can be identified or mitigated. Classic examples (2,19–21) of that are as follows:

1. Bias does not impact me, what is known as the *bias blind spot* (19,20). Most people incorrectly believe that they are not biased, which is the hallmark of implicit cognitive bias and makes it challenging to address, especially in the forensic domain where examiners do not have the cognitive background to understand and appreciate such biases.
2. Willpower is an effective way to deal with bias. Another widespread incorrect belief about cognitive bias is that it can be overcome by sheer willpower, the illusion of control. Understanding the cognitive architecture and brain mechanism that underpin bias reveals that one cannot control such implicit biases, let alone overcome them by mere willpower.
3. Experts are immune from bias. Another commonly held incorrect belief about bias is that only laypeople are biased, whereas experts are immune. Bias impacts experts, and, in some ways, experts are more susceptible to certain type of biases. The very making of expertise, such as experience and training, entails expectations, automaticity, chunking, selective attention, base-rate regularities, and other factors, all of which can especially bias experts (21).
4. Cognitive bias is an ethical issue. Bias is often misunderstood and hence mischaracterized as an ethical issue. Indeed, books and conferences often misplace discussions about cognitive bias within the realm of ethics. Cognitive bias is not about bad or unprincipled examiners; rather, it is about hard-working, motivated, dedicated, and competent examiners, who, without their awareness, are biased in their work.

Once a risk is identified, management should assess the magnitude of the risk, and the gravity of its effects, and determine if and what course of action should be taken. Assessments may be qualitative or quantitative. Management may decide in some instances to allow certain types of events to continue without any intervention, but elect to intervene in other situations, depending on the results of their evaluation. In short, bias is a real risk, but "for forensic science to successfully take on the issue of contextual bias, it is important that one correctly considers the risks, that measures are taken when needed, and that they are proportionate and appropriate" (22).

The risk of bias (the "bias danger zone," which is comprised of the likelihood of the bias, the magnitude and power of biasing context, the direction of the bias, the difficulty of the decision, the nature of the decision, and the loss of function) relative to the gravity of its effects needs to be combined together, so management can evaluate and prioritize the need for action—see Fig. 3.

The purpose of the assessment and "grading" of each risk is to determine and prioritize actions, which ultimately assist management with developing an appropriate response to the identified issues. Undoubtedly, a risk graded with a high numerical score or a high qualitative assessment should receive a large amount of attention, either by taking action to prevent the risk from happening or expending resources to mitigate it, while risks assigned a lower value may either be accepted or handled using minimal resources. Of course, the risk level needs to be taken into account along with the potential harm that it can cause, and the effort and resources needed to deal with it (22)—see Fig. 3. However, regardless of the action, or lack thereof, transparency is critical. Thus, if a risk is deemed to be negligible, or its impact minimal, or, that fixing or mitigating it requires too much effort and resources, inaction is permissible, as long as there is a transparency about the existence of the risk (10).

The control of risk is about planning and implementing an effective preventive or mitigating action plan, when one is deemed to be needed. Finally, the review phase involves looking at the agency's history of risk identification, assessment, and control, which should always be reviewed by management. This review should be in place not only to ensure that risk management has been effective (via "follow-ups"), but also to learn from and track any trends in the types of risks that arise. "Results of risk identification" is actually listed as one of the inputs needed for the regularly scheduled management system reviews required by ISO 17025 (subclause 8.9.2). Documentation and transparency of what took place in the risk management process, including the reviews, are an important part of effectively managing risks. Moreover, publishing and sharing such practices with other agencies will further improve forensic science practice.

Policies for Mitigating Impartiality and Bias

In addition to a risk management procedure that is regularly utilized, agency policies (in addition to training) can be used to communicate management's expectations to staff, with regard to avoiding conflicts of interest and maintaining impartiality. At the explicit level of intentional bias, that is relatively easy to achieve; whereas implicit and unintentional cognitive bias is more challenging. Such policies actually go hand in hand with a risk management SOP, because, when written effectively, the expectation outlined in the policy helps drive the need to systematically evaluate each major event or relationship that presents itself for risks to impartiality. For example, if the agency establishes that all outside (secondary) employment must be reported to management for review and approval, then management can follow the risk management procedure to evaluate any

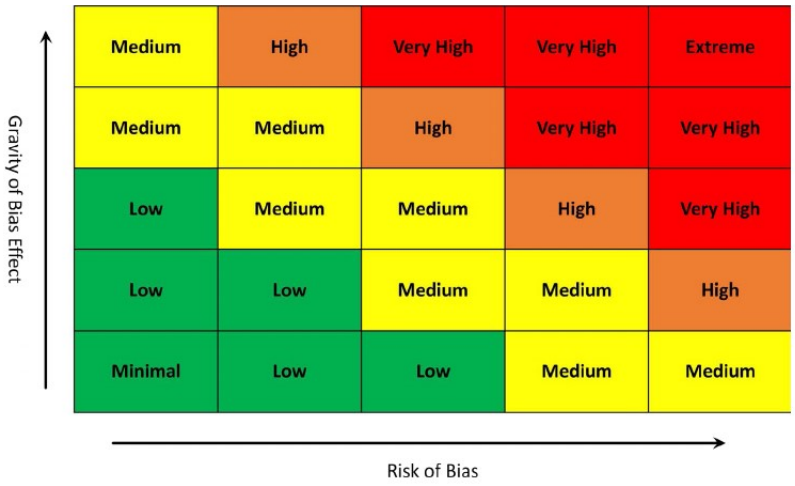

FIG. 3—*Risk Matrix (a modified version from Robertson et al. [29]) that takes together the risk of bias relative to the gravity of its effects in order to prioritize actions required to minimize and mitigate bias. [Color figure can be viewed at wileyonlinelibrary.com]*

risks involved with a staff member being employed by another company while still working for the forensic service provider. If no risks to conflict of interest exist, the outside employment venture can be approved. If any risks are identified, they can be assessed for magnitude, and discussions on how to appropriately and effectively address the risks should then ensue. An agreement with the employee would then follow that the outside employment opportunity can be pursued only if the proposed measures to mitigate the risk are followed. This plan would be documented, as well as a documented follow-up to ensure the measures or action items are being carried out.

Implicit cognitive bias is very different from explicit intentional bias, and it can arise from a whole range of factors (see Fig. 2), each associated with different countermeasures to eliminate or minimize them. One factor that can cause bias is being exposed to task-irrelevant contextual information. To deal with this, a first step would be to avoid, as much as possible, the exposure to such information (we are only referring to task-irrelevant information, not what examiners need to do their job). If they are exposed to such irrelevant information nevertheless, then they would need to document these interactions and the information provided. For example, what information the investigating detective or prosecutor conveyed to the forensic examiner. This ideally needs to be documented and included in the forensic report, as mandated by the Forensic Disclosure (10).

Indeed, section 7.8 of ISO 17025, which outlines reporting requirements, stipulates that laboratories must report results unambiguously and objectively, and document the basis of their decisions and what was directly communicated with the customer. Subclause 7.8.2.2, for example, requires that "Data provided by a customer shall be clearly identified. In addition, a disclaimer shall be put on the report when the information is supplied by the customer and can affect the validity of results" (9). Moreover, subclause 7.8.7.1 requires laboratories to document "the basis upon which the opinions and interpretations have been made" (9).

It is best if such interactions and exposure to task-irrelevant information are minimized in the first place, or avoided all together, so as to enable the forensic examiner to be independent and impartial, as much as possible. *Case managers* and other best practices utilized to handle workflow can help buffer and control what information reaches the examiner doing the forensic work (17).

Not only is there a concern about what information is presented and available to the forensic examiner (e.g., examiners should be blind to whether the suspect confessed to the crime, their past criminal record, the existence of other types of evidence), but also the sequence in which information is presented and analyzed. To ensure that the evidence is driving the forensic decision, rather than the data generated from the suspect, it is important to work *linearly*, starting with the evidence itself. Linear sequential unmasking (LSU) specifies how to carry out forensic work while minimizing bias by information about the target suspect. It allows flexibility, but organizes the workflow to make sure the evidence is the focus, rather than fitting it to the suspect (15). LSU does not blind examiners to the relevant information they need, but just optimizes the sequence in which they examine this information. This applies to many forensic domains where evidence from the crime scene is compared to that of the suspect, including DNA (8).

Policies such as LSU are essential for meeting forensic accreditation program requirements. For example, ANAB's AR 3125 (23), 7.2.1.1.2 and AR 3120 (24), 7.1.3.5 stipulate that: "All test methods that involve the comparison of an unknown to a known shall require the evaluation of the unknown item(s) to identify characteristics suitable for comparison and, if applicable, characteristics suitable for statistical rarity calculations, prior to comparison to one or more known item(s)." For further details on LSU, such as the circumstances that allow going back to the unknown after exposure to the known, as well as documentation requirements, see Ref. (15).

Quality Assurance Checks

The established measures for assurance against breech of impartiality should be periodically checked and routinely re-

assessed by management. These checks should occur without being prompted by any event or an actual occurrence of bias and should take place regardless if any potential risks to impartiality appear to arise. Some of the checks proven to be especially valuable include blind verification, blind proficiency testing, and quality assurance fake test cases, on which we elaborate below.

Blind Verification

In line with the ISO standards, we recommend that all casework is subject to peer review prior to reporting. Part of the peer reviewer's job is to ensure data interpretation and conclusions drawn are truly supported by the test or examination data, and arrived at by following the applicable SOPs. This type of review assists with ensuring the reliability of reported results.

Verification occurs when results and conclusions are confirmed as correct by a second analyst prior to reporting. If the peer reviewer has knowledge of the reporting analyst's conclusions (or even who completed the first analysis) before performing the verification step, the verification is subject to confirmation bias. Blind verification, on the other hand, is used to determine whether two analysts can independently arrive at the same conclusion without prior knowledge of each other's work.

Blind verification is a true verification, not a "rubber stamp," as it forces the verifier to properly examine the evidence and enables one to see if they reach the same conclusion. Any knowledge about the first conclusion (what it is, who did it, how they reached their conclusion, etc.) biases and degrades the power of the verification. We highly recommend that, when possible, blind verification is applied to all forensic conclusions subject to be verified (e.g., not only "identification," but also "inconclusive" decisions [25]).

If verifiers do not agree, then *appropriate* steps need to be taken. Verifiers and initial examiners should not attempt to resolve the disagreement on their own, among themselves. Disagreements should be brought to the attention of management for investigation and documentation of resolution (e.g., understanding the source/reason for the disagreement and soliciting additional opinions), as well as used for learning purposes. Incidentally, recording the resolution of discrepancies arising from verification is required by ANAB's forensic accreditation programs (AR 3125 [23], 7.7.1.g.1 and AR 3120 [24], 7.3.1.6). Furthermore, the initial disagreement, as well as the outcome of the differing opinions or interpretations of the evidence, must be clearly stated in the report.

Quality Assurance Fake Test Cases

To study how the forensic work is actually done, any kind of observation or tests must be conducted on what is believed to be real casework. If a study or test has been conducted with the knowledge that it is a test or that they are observed, then the results do not necessarily reflect what happens in real casework. Using real casework is not helpful, because ground truth is not known, and there is little control in what is tested. The solution is to include fake cases within the normal stream of real casework. For example, an examiner is asked to verify a similar looking nonmatch, and it is included within the normal verification stream. This is important to include, because verifiers almost always verify identifications, and including such a nonmatch case will provide quality assurance that the verifiers are not "rubber stamping" the identification results due to base-rate bias (see Fig. 2).

Another opportunity for the use of fake cases is proficiency testing. Proficiency testing programs are essential, but they are most informative when they are done blindly. An open proficiency test, which is a practical test given to an analyst who is aware of being tested, is useful for testing an examiner's knowledge and skills. However, it does not necessarily reflect how actual casework is conducted, when nobody is supposedly "looking". For instance, are SOPs consistently followed, no matter the case scenario, or are they circumvented? A blind proficiency test is a practical test taken by an examiner who is unaware that it is a test.

Blind testing involves preparing mock evidence, packaging it in a manner that mimics normal casework, and submitting it to the laboratory for analysis as if law enforcement or other type of customer submitted it. Of course, in order for it to be a valid proficiency test, the expected results must be known beforehand. The implementation of a blind proficiency testing program requires smart planning and diligent preparation by a removed party (e.g., quality assurance staff), but the extra effort is paramount. Blind proficiency testing, when executed successfully, can offset most of the weaknesses that arise with open proficiency testing.

Corrective Actions Leading to Learning and Improvements

As with any nonconformity identified through peer review, verification, and proficiency testing, corrective action should be taken if less than impartial analysis is suspected. Following a root cause analysis to determine the underlying source of the bias in a particular case, action items should be designed and implemented to address the root cause and prevent it from affecting future analyses. From that point forward, whatever activity or relationship was the cause must now be considered as a risk to impartiality. Therefore, the corrective action process always leads to management learning more about risks to its operations and thus provides opportunities for management improvement.

ISO 17020 and ISO 17025 require that a forensic service provider demonstrates how it eliminates or minimizes risks to impartiality. Corrective action is a reactive means for eliminating or mitigating risks, because the action addresses an incident that already occurred. The goal of the above-mentioned ISO requirements is to facilitate preventive actions in response to identifying a risk to impartiality prior to that risk manifesting in casework—being proactive, rather than only reactive. This is where the risk management SOP ties in; it should outline how the provider chooses to assess risks to impartiality and give guidance on creating preventive action plans to address the risks worth addressing.

Management Commitment to Impartiality

The last requirement for this topic stresses that upper management must be committed to impartiality, highlighting the importance of upper management's involvement in quality management issues. If upper management is involved in planning, implementing, and/or monitoring the measures listed above (i.e., specific policies, procedures, and practices to evaluate and address risks to impartiality), then these actions are a first step in demonstrating management's commitment to impartiality.

Additional ways to demonstrate this commitment include upper management initiatives and support for the continuing

education and training of staff on the subject of impartiality and cognitive bias. Staff need to properly understand what cognitive bias is, so they "buy in" to these policies, procedures, and best practices.

The recommendation for training on bias has been put forward by many bodies, inquires, and expert working groups (26,27). For example, NIST, 2012: "Recommendation 8.5: Training materials should include topics beyond the technical aspects of friction ridge analysis, such as. . .Human factors issues such as fatigue, bias, cognitive influences, perceptual influences, and error," as well as "Hands-on exercises relating to bias and cognitive processing should be included" (26). As a practical example, an independent external audit of the Washington D.C. Department of Forensic Sciences DNA Laboratory listed as an action item that "Training and continuing education of staff should include lectures on cognitive bias, how it affects interpretation, and tell-tale signs to identify when it may arise" (27).

It is important that training is cognitively informed, so misconceptions (e.g., that cognitive bias is an ethical issue, that can be controlled by mere willpower) are not propagated. The training must converge knowledge about the human brain and cognitive architecture with knowledge about forensic science and the daily operations of forensic agencies. Together, when correctly combined, the dangers of bias are apparent, as well as a variety of ways to minimize bias in forensic work.

Obstacles to Achieving Impartiality and Independence

Even when appropriate actions are identified by management to effectively control risks to impartiality, obstacles exist that might prevent them from carrying it out. A major obstacle for forensic service providers tends to be the will to preserve and maintain the close and interactive working relationships they have with their stakeholders—the very same ones who may influence their judgment in the first place—the officers, the attorneys, the vendors, their financial supporters, etc. While these are difficult waters to navigate, especially when these decisions become political ones and can affect the agency's livelihood, action is still needed to move forward, and to work toward fulfilling the requirements of the applicable ISO standards. Having a discussion with the stakeholders about the reasoning behind new policies and procedures, explaining how impartiality is crucial to a quality service, and a part of the forensic service's accreditation program, should assist with preserving the relationship. More often than not, openly communicating these concepts and inviting a productive conversation about it with the various stakeholders will reinforce how they benefit from these quality assurance practices and even strengthen the relationship between agencies.

Another obstacle is that because this is implicit cognitive bias and the forensic examiners are not aware of it, they do not understand and even resist the need for extra measures. That is where proper cognitive training is crucial, as discussed above. Other obstacles may be financial, but many of the suggested measures above do not require additional resources, and even those that do, the forensic service providers must make the case for their need to maintain accreditation and deliver reliable scientific work. Improving forensic work is an ongoing endeavor and takes time and effort. However, because of the importance of forensic evidence and the commitment to its scientific examination, all stakeholders should come together to support the forensic examiners in achieving impartiality in their work.

Conclusions

Addressing impartiality is not simple, but not a monumental task either. Written procedures for risk management and implementation of appropriate preventive actions are the foundation for effectively addressing risks to impartiality in any agency. Even small, but well-thought-out steps can address many of the associated problems and, at the same time, assist with meeting industry-accepted practices. In this regard, we made several suggestions, but noted that these ideas may not suite every agency. There are different ways to satisfy a standard, and each agency must determine how to do so within its organizational constraints and parameters. In addition to actions to identify and countermeasure bias, as well as proper training of staff in this area, it is critical to have adequate documentation and transparency of the operations of the service provider and the measures taken to deal with bias and impartiality.

ISO 17020 and ISO 17025 both include requirements for impartiality and the freedom from bias. Meeting these requirements mandates that forensic agencies delve somewhat into what underpins implicit cognitive bias, so they can take proper and effective measures. Examining the various factors and sources of cognitive bias in forensic work suggests, among other things, that exposure to task-irrelevant information can cause bias. Similarly, suspect-target bias can be caused when the reference materials, rather than the evidence itself, drive the forensic decision-making process. When verification is not blind, then the information provided to the verifier biases their work. These, and other sources of bias, degrade the impartiality of the forensic examiners—an explicit expectation of forensic accreditation programs.

Over the past decade, we have seen an impressive shift in how forensic laboratories respond and take aboard the issue of bias. There is still more progress to be made, but great and important steps have already been taken in many laboratories across the United States and the United Kingdom, as well as many other countries. The ISO 17020 and 17025 requirements for impartiality mandate directly dealing with issues such as cognitive bias, as we outline in this paper, and help focus accredited forensic service providers to continuously improve in this area.

References

1. ISO/IEC (International Organization for Standardization/International Electrochemical Commission). ISO/IEC 17020: conformity assessment—requirements for the operation of various types of bodies performing inspection, 2nd edn. Geneva, Switzerland: International Organization for Standardization/International Electrotechnical Commission, 2012.
2. Nickerson RS. Confirmation bias: a ubiquitous phenomenon in many guises. Rev Gen Psychol 1998;2(2):175–220.
3. Dror IE. A hierarchy of expert performance (HEP). J Appl Res Mem Cogn 2016;5(2):121–7.
4. Dror IE. Biases in forensic experts. Science 2018;360(6386):243.
5. Hamnett HJ, Jack RE. The use of contextual information in forensic toxicology: an international survey of toxicologists' experiences. Sci Justice 2019;59(4):380–9.
6. Forensic Science Regulator. Lessons learnt: contextual bias in forensic toxicology. 2019. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800561/Lessons_Learnt_May19__L-B03_-final.pdf (accessed October 15. 2019).
7. Dror IE, Hampikian G. Subjectivity and bias in forensic DNA mixture interpretation. Sci Justice 2011;51(4):204–8.
8. Jeanguenat AM, Budowle B, Dror IE. Strengthening forensic DNA decision making through a better understanding of the influence of cognitive bias. Sci Justice 2017;57(6):415–20.
9. ISO/IEC (International Organization for Standardization/International Electrotechnical Commission). ISO/IEC 17025: general requirements for the competence of testing and calibration laboratories, 3rd edn. Geneva,

Switzerland: International Organization for Standardization/International Electrotechnical Commission, 2017.
10. Almazrouei MA, Dror IE, Morgan R. The forensic disclosure model: what should be disclosed to, and by, forensic experts? Int J Law Crime Justice 2019;59:100330.
11. Cole SA. Scandal, fraud, and the reform of forensic science: the case of fingerprint analysis. West VA Law Rev 2016;119(2):524–48.
12. Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council. Strengthening forensic science in the United States: a path forward. Washington, DC: The National Academies Press, 2009.
13. National Commission on Forensic Science. Ensuring that forensic analysis is based upon task-relevant information. 2015. https://www.justice.gov/archives/ncfs/file/818196/download (accessed October 15, 2019).
14. Forensic Science Regulator. Cognitive bias effects relevant to forensic science examinations. 2015. https://www.gov.uk/government/publications/cognitive-bias-effects-relevant-to-forensic-science-examinations (accessed October 15. 2019).
15. Dror IE, Thompson WC, Meissner CA, Kornfield I, Krane D, Saks M, et al. Context management toolbox: a linear sequential unmasking (LSU) approach for minimizing cognitive bias in forensic decision making. J Forensic Sci 2015;60(4):1111–2.
16. Charlton D. Standards to avoid bias in fingerprint examination? Are such standards doomed to be based on fiscal expediency? J Appl Res Mem Cogn 2013;2(1):56–7.
17. Dror IE. Practical solutions to cognitive and human factor challenges in forensic science. Forensic Sci Policy Manage 2014;4:105–13.
18. Jeanguenat AM, Dror IE. Human factors effecting forensic decision making: Workplace stress and wellbeing. J Forensic Sci 2018;63(1):258–61.
19. Pronin E, Lin DY, Ross L. The bias blind spot: perceptions of bias in self versus others. Pers Soc Psychol Bull 2002;28:369–81.
20. Kukucka J, Kassin S, Zapf P, Dror IE. Cognitive bias and blindness: a global survey of forensic science examiners. J Appl Res Mem Cogn 2017;6(4):452–9.
21. Dror IE, Kukucka J, Kassin S, Zapf P. No one is immune to contextual bias—not even forensic pathologists. J Appl Res Mem Cogn 2018;7(2):316–7.
22. Dror IE. Combating bias: the next step in fighting cognitive and psychological contamination. J Forensic Sci 2012;57(1):276–7.
23. ANSI National Accreditation Board. AR 3125 - ISO/IEC 17025:2017: forensic science testing and calibration laboratories accreditation requirements. Milwaukee, WI: American National Standards Institute (ANSI) National Accreditation Board, 2019;9–12.
24. ANSI National Accreditation Board. AR 3120 - ISO/IEC 17020:2012: forensic inspection bodies accreditation requirements. Milwaukee, WI: American National Standards Institute (ANSI) National Accreditation Board,2019;12–4.
25. Dror IE, Langenburg G. "Cannot decide": the fine line between appropriate inconclusive determinations vs. unjustifiably deciding not to decide. J Forensic Sci 2019;64(1):10–5.
26. National Institute of Standards and Technology (NIST). The Report of the Expert Working group on Human Factors in Latent Print Analysis. Latent print examination and human factors: improving the practice through a systems approach. 2012. https://tsapps.nist.gov/publication/get_pdf.cfm?pub_xml:id=910745 (accessed October 15, 2019).
27. Budowle B, Bieber FR. Final report on the review of mixture interpretation in selected casework in the DNA section of the Forensic Science Laboratory Division (FSL), Department of Forensic Sciences (DFS), District of Columbia. Washington, DC: District of Columbia Department of Forensic Sciences, 2015.
28. Dror IE. Human expert performance in forensic decision making: seven different sources of bias. Aust J Forensic Sci 2017;49(5):541–7.
29. Robertson J, Metz H, Scudder N, Hodgson V. A quality system review: Australian Federal Police Forensic and Data Centres. Forensic Sci Policy Manage 2010;1(4):209–13.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Risk Management