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PAPER

ODONTOLOGY

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Context Effects and Observer Bias—Implications for Forensic Odontology

ABSTRACT: Psychologists have long recognized the effects of contextual and extraneous information on decision making. Such information renders the subject susceptible to both motivational and cognitive bias; yet, it is difficult to assess the extent to which these influence forensic odontologists opinions as there have been no studies to date on this subject. This article explores the various types of contextual effects and biasing influences that potentially impact on the analysis of bitemarks in forensic odontology. It appears that the current practice of bitemark analysis is rich in sources of potentially biasing influences. In addition to the fundamental recognition that some form of bias is likely to exist, ways in which these should be minimized include: separation of the collection and analysis phases; limiting the amount of contextual information available to the odontologist responsible for the analysis; and ensuring that evidence that is ambiguous or of poor quality is identified as such prior to analysis.

KEYWORDS: forensic science, odontology, bias, emotion, observer effects, confirmation bias

Psychologists have long recognized the effects of bias introduced via the psychological and cognitive state of the subject (1). There is a growing body of literature in other disciplines suggesting that observer effects induced by extraneous or emotive information play a significant role in the outcome of forensic decision making. Nordby noted that "the expert's role is to refine the context of observation based on expert understanding […] and any implicit, hidden observational expectations influencing the supplied interpretations must also be examined" (2, p. 1123). Indeed, the ignorance of contextual effects is a recognized psychological phenomenon in itself and has been termed the "bias blind spot" (3).

True objectivity has been described as a chimera in forensic analysis, given the nature of interpretation and source of its samples (4), however, the potential for decisions to be influenced by conscious or unconscious practitioner bias potentially robs the trier of fact of independent information. Forensic evidence is often taken as an independent verification of a guilty (or not guilty) hypothesis—if a forensic examiner reaches a conclusion that includes consideration of other factors other than the evidence before them, their conclusions should not carry the independent weight that the trier of fact has assumed is inherent in such testimony. For example, if a fingerprint examiner is aware that a particular latent print belongs to a person whose license plate closely matches the description given by a victim of some crime, but the print is somewhat ambiguous, psychological theory suggests they may unconsciously resolve the ambiguity in favor of calling a match. To the jury, it appears that the fingerprint examiner has reached his conclusion independent of any other information and the presence of the fingerprint and existence of a closely matching license plate represent two independent coincidences that together significantly strengthen the hypothesis of guilt. In fact, these conclusions are anything but independent and the weight of the fingerprint examiner's evidence is far less than it appears. This has been described as the most corrosive aspect of cognitive bias in forensic testimony, as each piece of evidence needs to be considered independent of the other in order for the trier of fact to effectively summate them, and arrive at a realistic probability of guilt or innocence (1).

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The Bias Blind Spot

While forensic science is becoming aware of the potential for practitioner bias, the few articles that have been published by forensic scientists appear to have missed several key concepts regarding the influence of contextual effects. One author, among several suggestions, recommends that the forensic practitioner "accept bias, remain objective, and limit overconfidence" (5). These recommendations are admirable, but unachievable in practice and demonstrate a failure to realize that contextual effects occur at a subconscious level. They cannot be avoided by simply adopting an open mind. Proficiency testing has been recommended as a method to avoid confirmation bias (6); however, this also fails to directly address the issue (7).

Some forensic scientists claim that the notion that subjectivity can affect reliability is refuted via anecdotal evidence (6). Anecdotal evidence is unfortunately a very weak form of proof when such statements are refuted by carefully controlled, blinded studies (8,9), and Krane et al. (7) take specific issue with the assumption that bias is not a significant issue in the forensic sciences when there is no experimentally derived data to support these claims. There is, albeit equally weak, anecdotal evidence that suggests the *opposite* of that claimed by Budowle et al. (6) suggesting that expert evidence *is* susceptible to distortion, whether intentional or not, to fit preconceived misassumptions. One only needs to consider the Chamberlain (10) and Splatt (11) cases in Australia by way of illustration.

A more recent example is provided by that of Brandon Mayfield in the United States, who was arrested as the suspect responsible for the Madrid bombings in 2004 on the basis of an incorrectly "matched" fingerprint that was supposedly "verified" by several experienced fingerprint examiners (12). The U.S. Department of Justice report into the matter noted that one of the main contributing factors to the misidentification of the Madrid Bomber was "circular reasoning," and in their explanation of this incident neatly describe several incidences of unconscious practitioner bias that were directly attributable to context effects. Other authors have determined that cognitive bias has played a key role in numerous forensic misidentifications occurring in the 20th and 21st centuries (13).

However, it appears that a significant proportion of the forensic community does not genuinely understand the terms "cognitive bias" or "observer effects." After face-to-face discussions with more than 15 odontologists, only two were able to give a clear and convincing definition of either term. Most commonly, it was thought that these terms referred to bias induced by police or prosecution pressure to arrive at a particular conclusion. While this certainly plays a large role in the potential for bias, this is more accurately described as motivational bias. So-called role and conformity effects introduce motivational bias by virtue of one's perceived role and the desire to conform to the belief and perceptions of others. The institutional context of forensic work and its close association with law enforcement agencies has received criticism because of the creation of motivated reasoning and a coalitional alliance toward serving a common goal (14), but this is a separate (yet interrelated) phenomenon to the issue of cognitive bias.

Cognitive bias specifically refers to the psychological sway toward one opinion versus another as a result of having information extraneous to the task at hand—in other words, bias induced by "knowing" something. Context effects—psychological influences on decision making induced by knowledge of circumstantial information extraneous to the immediate task at hand—most obviously give rise to motivational bias, which may be conscious or unconscious; however, they may also give rise to cognitive bias, particularly when there is ambiguity in the choice between two alternative hypotheses (15). This latter form of bias is easily overridden when the evidence presents an obvious choice between two hypotheses, but becomes problematic when evidence is "borderline," of poor quality, or ambiguous. Bitemark analysis is particularly susceptible to both manifestations of bias because of the context in which it is collected and analyzed, which is rich in subliminal information that renders the practitioner susceptible to motivational bias, and the nature of the evidence itself—its ambiguity and potential for interpretation.

Context Effects

The contextual details surrounding analysis of bitemarks are often highly emotive. Typically, the bitemark involves interaction with another human, usually a victim of a violent crime such as rape, assault, or homicide. Collection of the evidence is usually performed, or at least assisted, by the odontologist, to ensure accurate documentation of the physical evidence. In the process, the practitioner meets or deals with the victim (living or deceased), which potentially induces a flood of emotional cognitive input, particularly when the case involves other significant trauma or injury. Dror et al. (8) have already demonstrated that these emotive influences have a significant effect on forensic decision making. To suggest that forensic odontologists are somehow immune to emotive influences sits at odds with other evidence, such as the higher incidence of posttraumatic stress disorder in forensic workers exposed to death and the dead (16–18). It has also been suggested that the presentation of evidence in a suggestive way, such as the labeling of evidence as "defendant" or "victim," feed the examiner unnecessary and potentially biasing information (19).

The close relationship that forensic practitioners engender with law enforcement agencies renders them susceptible to cognitive bias through the wider problem of information sharing. This form of bias occurs when practitioners use selective external information, consciously or unconsciously garnered from their associates, to assist their conclusions. Confirmation bias—this specific manifestation of cognitive bias—is well-studied phenomenon in eyewitness line ups, where witnesses who are initially tentative with their identifications become positive after learning that the person they identified is the prime suspect according to the police (15). Confirmation bias is not only of concern to forensic practice, it may also manifest in research where the testing of a hypothesis is carried out by searching for confirmatory instances, rather than potentially falsifying ones (20).

Confirmation bias has played a role in numerous forensic scandals and was recently acknowledged as one of the leading causes of the misidentification of the 2004 Madrid bomber (12). It has been claimed that experts, particularly those with experience, are less vulnerable to confirmation bias; however, Dror et al. (21) have provided evidence to refute this claim. In their study, five fingerprint experts were given two prints each from casework archives that they had each identified approximately 5 years earlier as a definitive match. These pairs were also blindly verified by two independent latent print examiners as being "matches" prior to the study commencing. After being told by one of their colleagues that they were the same pair of prints that were used to erroneously identify the Madrid bomber, but to ignore this information and concentrate only on the print before them, the five subjects were asked to decide whether the two fingerprints matched. This time, only one of the five participants identified the prints as a match. Three changed their opinions to "no match" and the other decided that there was insufficient information to make a definite decision. Other studies (9,22) using less emotive contextual influences verified that even low-level extraneous information affects "match" versus "nonmatch" decisions.

Despite its reputation as the "gold standard" forensic science, DNA analysis has also been the subject of criticism regarding subjective interpretation and confirmation bias. The use of low copy number analysis, partial samples, and mixtures to obtain a DNA profile suggests that the incidence of ambiguity and subsequent interpretation in DNA casework occurs in more than a trivial fraction of cases (4). The existence of ambiguity regarding which peaks belong to which donor, in addition to the problems of allelic drop out (and drop in), often require the analyst to make a judgment call on the significance of electropherogram peaks. If the analyst has prior knowledge of a suspect's profile, as commonly occurs in many laboratories, then they may be more inclined to include some ambiguous readings and dismiss others by claiming them as artifacts. This "target shifting" naturally occurs in favor of supporting the prosecution theory, as the profile used for comparison is usually that of the defendant (23). This phenomenon also potentially occurs in forensic odontology. The examining odontologist is usually presented with a bitemark that is rarely analyzed independently from knowledge of the suspect's dentition. Such procedures can lead to selective, confirmatory hypotheses akin to painting the target around an arrow.

Other Sources of Cognitive Bias

Observer Effects

Experimenter or observer effects involve the unintentional transfer of behavior to subjects of the experiment via the researcher's

expectancy. The Hawthorne effect describes a phenomenon that results in subjects performing better or more deliberately when they know they are being studied (24,25). Of interest in many inter-observer odontology studies is that dental students often out-perform general dental practitioners and in some instances, forensic odontologists themselves (26,27). This finding is often reported in studies, but little discussion of its significance follows, and is perhaps a manifestation of the Hawthorne effect in a population "conditioned" to perform well. While obviously being applicable to research, experimenter effects can exert influence in the work environment of the odontologist, where the police, managers, and colleagues could be considered the "researchers" and the odontologist the "subject." In conjunction with role and conformity effects, this further increases the likelihood of confirmation bias.

Acknowledgment of the existence of experimenter effects in research has given rise to research methods that have attempted to minimize them. While it is acknowledged these "ideal" experimental conditions are difficult to achieve in forensic science, a few such studies have been attempted. None of the results of these blinded studies have suggested that forensic practitioners are immune to such effects. A study conducted recently on the effects of emotional information on fingerprint analysis (28) concluded that fingerprint examiners were *not* particularly susceptible to emotional bias; however, all of the participants knew that the information they were given was part of a mock case. The actual emotional effect experienced by each examiner is thus difficult to assess. The design of this study has been criticized on a number of points, and it is suggested that the conclusion reached by the authors is not supported by the data they obtained (29). Perhaps of more concern in this study was that conclusions from 70 practitioners varied across the entire allowable spectrum: "positive identification," "some detail in agreement but not sufficient to identify," "not suitable for comparison," and "exclusion"—yet all of them were supposedly given the same two prints to compare.

The Contrast Effect

It is rare that forensic examiners are presented with perfectly preserved evidence. Similarly, forensic odontologists rarely have the opportunity to analyze the perfectly created and preserved, "ideal," bitemark. More often than not, the evidence is of poor quality and, therefore, is open to interpretation via a number of alternative hypotheses. One such effect that becomes significant in this circumstance is the contrast effect. This phenomenon describes the tendency to shift the judgment standard after repeated exposure to stimuli of a certain threshold and is particularly inherent in subjective comparison work, such as that performed by forensic odontologists (30). The susceptibility to contrast effects is demonstrated when the odontologist gradually begins to "see" the association between the mark and the dentition after lengthy analysis. The fact that such analysis is performed in conjunction with a reference such as the suspect dentition also introduces bias via a "target-shifting" mechanism. In this situation, there is a real risk that the threshold for determining the significance of a mark is lowered as the analysis proceeds and the odontologist essentially becomes susceptible to seeing things that simply are not there.

The Overconfidence Effect

The effect relates to the fact that practitioners are generally overconfident in their ability to perform, particularly when performing routine or often repeated tasks. It has been well established in the literature that there is only a very weak link between confidence and accuracy (1,31). It has also been suggested that the overconfidence effect related more to tasks involving vocabulary and general knowledge and that tasks involving perception and sensory information (such as those the forensic odontologist would be involved in) are subject to an *under*confidence effect; however, recent studies have refuted this notion (32). Overconfidence of the expert carries with it the sequelae of an unconscious biasing effect on juries and judges, who despite claims of impartiality, are still encouraged to include assessment of witness demeanor as part of the process of assessment of the expert's evidence (33).

Shynkaruk and Thompson (34) recently affirmed that there is a striking dissociation of practitioner accuracy and confidence, particularly in deductive reasoning, and statements regarding confidence are poor substitutes for those concerning reliability and accuracy. Unfortunately, this principle appears to be poorly understood in forensic science. A recent U.S. Department of Justice report noted that FBI fingerprint examiners were routinely overconfident in their ability to declare matches based on latent evidence, yet goes on to explain that examiners are required to have 100% certainty in their identification conclusions (12). The two statements are clearly at odds with one another and serve as an example of the recognition yet simultaneous dismissal of well-founded criticism.

Minimizing Cognitive Bias

As far as bias and forensic odontology is concerned, ignorance should not be considered bliss. Forensic odontology practice is littered with opportunities for the induction of motivational and cognitive bias. Odontologists need to be aware of the potential for contextual and other effects to develop systems that minimize their influence. Cognitive bias cannot be "willed away," as many forensic practitioners would insist is possible, because by its very nature, it is not under the conscious control of the individual (35).

Role and conformity effects can be minimized by engaging as little as possible with the victim, law enforcement agencies, and lawyers. The analysis should be conducted independent of these influences. This is most practically achieved by separating the phases of collection and analysis of odontological evidence. Where possible, the odontologist who is responsible for collecting the evidence should not be actively engaged in any subsequent analysis. This is already routine practice in other areas of forensic pattern analysis; for example, the crime scene examiners who lift latent prints, collect hair and fibers, and gather bullet cartridges are rarely involved in the subsequent analysis or conclusionary phases of the same evidence. Such a protocol would go part way in ensuring the odontologist is not exposed to the highly emotive contextual information that naturally accompanies such procedures.

Emotive influences can further be avoided by limiting the amount of extraneous information available to the odontologist responsible for analysis of the bitemark. This includes analysis of the bitemark independent of knowledge surrounding the case to minimize emotional influences, before any viewing of the suspect's dentition to minimize target shifting and before any other circumstantial evidence is revealed, such as the presence of the suspect's fingerprint, or DNA, to minimize confirmation bias. Such a protocol is already in place in several DNA laboratories in the U.S., known as sequential unmasking. Proponents of the method claim it allows an unbiased analysis of the evidence by sequencing the laboratory work-flow such that evidentiary samples are interpreted, and the interpretation is fully documented, before reference samples are compared (36). This still provides the practitioner with the necessary information to draw conclusions about the evidence, but does so in a way that minimizes observer effects.

In forensic odontology, a similar approach could be followed. Minimal information should be initially revealed to the analyzing odontologist. The first question to be answered is "could this be a bite mark?" The answer to this question does not depend on the type or nature of the case, and thus the odontologist has minimal, if any, need for this information at this stage. Assuming the answer is "yes," the odontologist should then attempt to identify the potentially relevant features of the mark that indicate the class and individual characteristics of the dentition, for example, marks from the upper versus lower teeth; marks that indicate the relative position of the incisal edges and position of the canine cusp tips; unusual or distinctive spatial arrangements, or the potential presence or absence of certain teeth. Analysis of the dentition should proceed separately from that of the bitemark. Ideally, more than one dentition, from persons who are unknown as to their involvement in the case to the odontologist, should be presented for analysis to avoid the generation of a purely confirmatory hypothesis. Again, class and individual characteristics should be noted at this stage.

Only having analyzed both the mark and the dentition separately should the odontologist then attempt to combine this information in a single analytical technique. Following the combined analysis, other information, such as the reported position of the biter relative to the victim in an assault case, can be revealed so that the odontologist can assess the relevance of this new information to the former conclusion. This process still ensures that the odontologist receives information that affords them the greatest opportunity to generate meaningful conclusions while removing unnecessary and potentially biasing detail.

Odontologists should consider avoiding analysis of bitemark evidence that is of poor or dubious quality, where the risk for contrast effects is greatest. The bitemark severity scale developed by Pretty (37) may prove a useful starting point for assessment of bitemark evidence in this regard. Recent research has suggested that bitemark evidence of poor quality leads to greater disagreement among odontologists' conclusions (38). This in turn suggests that contextual effects and the types of bias discussed herein play a much greater role than appreciated in analysis of bitemarks, especially those considered a lower quality. Further research is certainly warranted to better quantify the relationship between the quality of bitemark evidence and the accuracy of practitioner performance.

Last, it is suggested that odontologists should avoid giving statements of "certainty" in their reports. Research has long demonstrated that there is no link between certainty and ground-truth, and any statement regarding certainty is potentially misleading and irrelevant to proper assessment of the evidence. It is outside the role of the forensic expert to offer an opinion on the value of their evidence—this remains a task for the trier of fact alone.

Conclusion

It is well established that contextual effects are universal phenomena, which may not be eradicable, but nonetheless can be minimized, through carefully designed collective and analytical processes. Yet, despite the longstanding recognition of these effects, there have been no studies to date on the influence of cognitive bias in forensic odontology and yet it is the expert's responsibility to provide the trier of fact with reasonable information regarding these influences to allow them to make an assessment of their evidence. Furthermore, such quantification is critical for developing and evaluating training and procedures within the odontology community to improve practitioner performance.

Dror and Rosenthal were careful in their interpretation of results from studies on cognitive bias in fingerprint examiners: "The fact that fingerprint experts can be unreliable and biasable does not mean that they are not ordinarily reliable and unbiasable. It is not our place to determine what is the acceptable norm for expert performance. We do however develop and provide the experimental methodology and quantitative statistical tools to examine and quantify their performance, specifically in terms of reliability and biasability…" (39, p. 903). Similarly, the purpose of this article is not to claim that odontologists are routinely biased, inaccurate, or overconfident, but to point out that until studies quantifying the degree to which practitioners are subject to these effects, they remain an unknown and potentially significant factor to consider when evaluating the weight of expert witness testimony.

Several authors have already called for a paradigm shift in the way that bitemark analysis is conducted, questioning the ability to make positive identifications under even the most ideal conditions (40,41). Given the current criticisms of bitemark analysis, and the potential future direction it will take, it would seem logical to at least take steps to minimize potential biasing effects until there is experimental data available to qualify under what circumstances, and to quantify to what extent, they influence our analysis and interpretation of bitemark evidence.

References

1. Risinger DM, Saks MJ, Thompson WC, Rosenthal R. The *Daubert/Kumho* implications of observer effects in forensic science: hidden problems of expectation and suggestion. Calif Law Rev 2002;90: 1–55.
2. Nordby JJ. Can we believe what we see, if we see what we believe?—expert disagreement. J Forensic Sci 1992;37:1115–24.
3. Pronin E, Kugler MB. Valuing thoughts, ignoring behavior: the introspection illusion as a source of the bias blind spot. J Exp Soc Psychol 2007;43:565–78.
4. Whitman G, Koppl R. Rational bias in forensic science. Law, Probability and Risk 2010;9:69–90.
5. Byrd JS. Confirmation bias, ethics, and mistakes in forensics. J Forensic Identification 2006;56(4):511–525.
6. Budowle B, Bottrell MC, Bunch SG, Fram R, Harrison D, Meagher S, et al. A perspective on errors, bias, and interpretation in the forensic sciences and direction for continuing advancement. J Forensic Sci 2009;54(4):798–809.
7. Krane DE, Ford S, Gilder JR, Inman K, Jamieson A, Koppl R, et al. Commentary on: Bottrell MC, Bunch SG, Fram R, Harrison D, Meagher S, et al. A perspective on errors, bias, and interpretation in the forensic sciences and direction for continuing advancement. J Forensic Sci 2009;54:798–809. J Forensic Sci 2010;55:273–4.
8. Dror IE, Péron AE, Hind S, Charlton D. When emotions get the better of us: the effect of contextual top-down processing on matching fingerprints. Appl Cogn Psychol 2005;19:799–810.
9. Dror IE, Charlton D. Why experts make errors. J Forensic Identification 2006;56:600–16.
10. Chamberlain v. The Queen (No. 2) 1984, 153 CLR 521, http://www.lindychamberlain.com/content/legal/findings_and_trancripts (accessed June 13, 2010).
11. Shannon CR. Royal commission of inquiry in respect to the case of Edward Charles Splatt (S. Aust). Canberra, Australia: Australian Government Printer, 1984.
12. US Department of Justice. A review of the FBI's handling of the Brandon Mayfield Case. 2006, http://www.nlada.org/Defender/forensics/for_lib/Documents/1145382069.31/document_info (accessed March 28, 2010).
13. Cole SA. The prevalence and potential causes of wrongful conviction by fingerprint evidence. Gold Gate Univ Law Rev 2006;37:39–105.
14. Koppl R. How to improve forensic science. Europ J Law Econ 2005; 20:255–86.
15. Giannelli PC. Confirmation bias. Crim Justice 2007;22:60–2.
16. McCarroll JE, Fullerton CS, Ursano RJ, Hermsen JM. Posttraumatic stress symptoms following forensic dental identification: Mt Carmel, Waco, Texas. Am J Psychiatry 1996;153:778–82.
17. McCarroll JE, Ursano RJ, Fullerton CS, Liu X, Lundy A. Somatic symptoms in Gulf War mortuary workers. Psychosom Med 2002;64:29–33.

18. Ursano RJ, Fullerton CS, Vance K, Kao T-C. Postraumatic stress disorder and identification in disaster workers. Am J Psychiatry 1999;156: 353–9.
19. Jonakait RN. Forensic science: the need for regulation. Harv J Law Tech 1991;4:109–91.
20. Ask K, Granhag PA. Motivational sources of confirmation bias in criminal investigations: the need for cognitive closure. Journal of Investigative Psychology and Offender Profiling 2005;2:43–63.
21. Dror IE, Charlton D, Peron AE. Contextual information renders experts vulnerable to making erroneous identifications. Forensic Sci Int 2006;156: 74–8.
22. Lagenburg G, Champod C, Wertheim BA. Testing for potential contextual bias effects during the verification stage of the ACE-V methodology when conducting fingerprint comparisons. J Forensic Sci 2009;54:571–82.
23. Thompson WC. Painting the target around the matching profile: the Texas sharpshooter fallacy in forensic DNA interpretation. Law, Probability and Risk 2009;8:257–76.
24. Holden JD. Hawthorne effects and research into professional practice. J Eval Clin Pract 2001;7:65–70.
25. Wickstrom G, Bendix T. The Hawthorne effect: what did the original Hawthorne studies actually show? Scand J Work Environ Health 2000;26:363–7.
26. McNamee AH, Sweet D. Adherence of forensic odontologists to the ABFO guidelines for victim evidence collection. J Forensic Sci 2003;48:382–5.
27. Whittaker DK, Brickley MR, Evans L. A comparison of the ability of experts and non-experts to differentiate between adult and child human bite marks using receiver operating characteristic (ROC) analysis. Forensic Sci Int 1998;92:11–20.
28. Hall LJ, Player E. Will the introduction of an emotional context affect fingerprint analysis and decision making? Forensic Sci Int 2008;181:36–9.
29. Dror IE. On proper research and understanding of the interplay between bias and decision outcomes. Forensic Sci Int 2009;191:e-17–8.
30. Saks MJ, Risinger DM, Rosenthal R, Thompson WC. Context effects in forensic science: a review and application of the science of science to crime laboratory practice in the United States. Sci Justice 2003;43:77–90.
31. Krug K. The relationship between confidence and accuracy: current thoughts of the literature and a new area of research. Appl Psychol Crim Justice 2007;3:7–41.
32. Pallier G, Wilkinson R, Danthiir V, Kleitman S, Knezevic G, Stankov L, et al. The role of individual differences in the accuracy of confidence judgments. J Gen Psychol 2002;129:257–99.
33. Porter C, Parker RWR. The demeanour of expert witnesses. Austral J Forensic Sci 2001;33:45–50.
34. Shynkaruk JM, Thompson VA. Confidence and accuracy in deductive reasoning. Mem Cognit 2006;34:619–32.
35. Loftus EF, Cole SA. Contaminated evidence. Science 2004;304:959.
36. Krane DE, Ford S, Gilder JR, Inman K, Jamieson A, Koppl R, et al. Sequential unmasking: a means of minimizing observer effects in forensic DNA interpretation. J Forensic Sci 2008;53:1006–7.
37. Pretty IA. Development and validation of a human bitemark severity and significance scale. J Forensic Sci 2007;52:687–91.
38. Bowers CM, Pretty IA. Expert disagreement in bitemark casework. J Forensic Sci 2009;54:915–8.
39. Dror IE, Rosenthal R. Meta-analytically quantifying the reliability and biasibility of forensic experts. J Forensic Sci 2008;53:900–3.
40. Pretty I, Sweet D. A paradigm shift in the analysis of bitemarks. Forensic Sci Int 2010;201:38–44.
41. Clement JG, Blackwell SA. Is current bitemark analysis a misnomer? Forensic Sci Int 2010;201:33–7.

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