

THE NAS REPORT ON FORENSIC SCIENCE: A FORENSIC SCIENTIST'S RESPONSE

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[Crime Reconstruction](#)

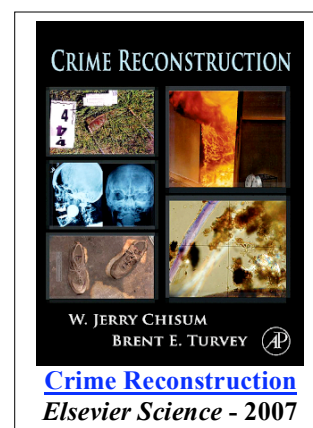
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Forensic scientists come in many forms, and their numbers include many examiners who do not work in crime labs. They also lack uniform standards in education and methodology; their conclusions often lack scientific rigor and are overly confident; and they are too often marked by improper alignment with law enforcement and prosecutorial agencies. As consequence, the forensic science community is fragmented and broken, cannot identify let alone fix its own problems, and does not speak with a single voice about what is best for its future. Moreover, it has proven incapable of holding itself accountable for anything that it does. Such are the findings in the recently published report by the National Academy of Science (NAS), *Strengthening Forensic Science in the United States: A Path Forward* (Edwards and Gotsonis, 2009). Subsequently, it falls to those of us who are relatively free to respond of their own accord, without political affiliation, censure, or fear of reprisal, to do so. This commentary is prepared in that spirit.

CONTEXT

First, as a forensic scientist, I am deeply grateful for the efforts of the NAS Committee on [Identifying the Needs of the Forensic Science Community](#) in conducting their inquiry. I am also grateful to the United States Congress, which provided the necessary funding. Those of us practicing science in this community have waited a long time for an impartial and critical review by fellow scientists.

Forensic scientists offering similar critical findings and recommendations (see Chisum and Turvey (2007), cited in the NAS report) have previously been shouted down and even sanctioned with false ad hominem attacks sponsored by some of the professional organizations discussed in the NAS Report². Many prominent legal scholars have also been afforded like treatment for deigning to publish their research on bias, error, and the overall absence of scientific methodology in forensic science. The NAS Committee, it would seem, suffered to



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² For example, see Gardner, R. (2007) "Crime Reconstruction" *Journal of Forensic Identification*, 57 (6), pp.797-806 and Chisum, W.J. and Turvey, B. (2008) "Re: The Commentary "Crime Reconstruction"" *Journal of Forensic Identification*, 58 (2), pp.133-155.

overcome the same political environment. And it literally took an act of Congress to prevail, as explained in Moore (2009):

Donald Kennedy, a Stanford scientist who helped select the report's authors, said federal law enforcement agencies resented "intervention" of mainstream science — especially the National Academy — in the courts.

He said the National Institute of Justice, a research arm of the Justice Department, tried to derail the forensic study by refusing to finance it and demanding to review the findings before publication. A bipartisan vote in Congress in 2005 broke the impasse with a \$1.5 million appropriation.

So on behalf of myself, and many colleagues practicing silently and under political duress to toe the agency line in law enforcement affiliated crime labs across the nation, I thank you for this much needed support.

Second, it is important to bear in mind that because the majority of government funded crime labs are law enforcement affiliated there can be very little objective response to the NAS Report from the forensic science community at large. Those who want change can't voice it for fear of political sanction, or because speaking publicly about their concerns may somehow violate agency policy. Just as common, many at the supervisory level have a vested interest in the status quo, which is why things haven't changed for so long and an independent inquiry was needed. Worse, there are some individuals and agencies in the forensic community who believe themselves above external critique or review who will continue to act as they always have – with impunity. These are the very professionals and groups that are, as explained in the NAS Report (Edwards and Gotsonis, 2009; p. S-13) "too wedded to the current "fragmented" forensic science community, which is deficient in too many respects."

It should be mentioned that as of this writing there have been a few public responses to the NAS Report from the larger forensic science organizations, such as the AAFS, SOFT, the IAI, and ASCLD. These responses, while positive, have been ridiculously brief and amount to little more than public relations with a positive spin. In fact, reading them one gets the distinct impression that these organizations agree with the NAS Report and that they are already in step with its recommendations. Were this true, the findings of the report would have been much different. The recent press releases issued by these organizations collectively ignore the well-founded criticisms in the NAS Report, their own deep law enforcement affiliations or culture that the report warns against and argues must be abolished, and their complicity in creating and even fostering the current broken forensic environment. For instance, the NAS Report observes (Edwards and Gotsonis, 2009; p.2-19):

The forensic science community lacks the necessary governance structure to pull itself up from its current weaknesses. Insufficiencies in the current system cannot be addressed simply by increasing the staff within existing crime laboratories and medical examiners offices. Of the many professional societies that serve the forensic science community, none is dominant, and none has clearly articulated the need for change or presented a vision for accomplishing it. And clearly no municipal or state forensic office has the mandate to lead the entire community. The major federal resources—NIJ and the FBI Laboratory—have provided modest leadership, for which they should be commended. NIJ has contributed a helpful research program and the FBI Laboratory has spearheaded the SWGs. But again, neither entity has recognized, let alone articulated, a need for change or a vision for affecting it. Neither has the full confidence of the larger forensic science community. And because both

are part of a prosecutorial department of the government, they could be subject to subtle contextual biases that should not be allowed to undercut the power of forensic science.

Ironically, some of these professional organizations also seem to now have their hands out for funding of one type or another, as though the conclusion of the NAS Report was that funding a broken system, and the partisan organizations that helped to break it, was its proposed solution.

Funding any part of the forensic science community without meaningful change is a waste of time, effort, and resources. An acknowledgement of shortcomings and total regime change away from law enforcement governance must be part of that change for any existing organization that seeks funding or acknowledgement under the banner of forensic science. Similarly, anything that serves only or primarily the interests of law enforcement must be excised.

Third, because of the explosive content of the NAS Report and, unfortunately, its length, many in the forensic community are not reading it very carefully. Still others are reading it selectively. Many more, however, will not read it at all. As a consequence, false statements about the report's authors and content are already surfacing – such as “it has nothing to do with DNA”, and “it was written by people who don't understand forensic science”, and “the only detractors of forensic science are its adversaries in court.” Such assertions, made by the ignorant or partial, are intended to keep subordinates and colleagues from reading the report. Or to blunt its findings as somehow stemming from the adversarial nature that has come to characterize forensic science culture because of its appropriation by law enforcement³.

There are also published responses from various law enforcement and prosecutorial community that the NAS Report does not bear on certain labs and examiners. Their reasoning indicates that they haven't read it, don't understand it, or are intentionally misrepresenting it's contents. Take for example the reassurances coming out of Larimer County, Colorado (Taylor, 2009):

Fort Collins Chief of Police Dennis Harrison said he's confident in both CBI analysis and analysis by regional fingerprint examiners⁴.

"As far as fingerprint work goes, I'm not concerned because they have to follow a pretty strict protocol that can be rereviewed by defense attorneys," he said.

...

Larimer County District Attorney Larry Abrahamson said he's confident in the analysis being done by the Colorado Bureau of Investigations and other law enforcement laboratories.

...

Abrahamson said any forensics expert asked to testify has to be qualified as an expert by a judge based on training, and forensic conclusions are usually reached by more than one examiner.

³ See Chisum and Turvey (2007; p.xiv): “The paradigm of sides presents the forensic scientist with a false choice between prosecution or defense; between scientific fact or legal truth. Pressure to choose can be brought to bear in many ways—personal, professional, and financial. Furthermore, the pressure on a forensic scientist in such environments, to be part of the “team” and help “get the bad guys,” can be seductive and overwhelming to the point of assimilation.”

⁴ The Colorado Bureau of Investigation (CBI) is a state law enforcement agency with its own crime lab, supervised by sworn agents of the CBI; url: <http://cbi.state.co.us/lab/default.asp>.

"Very seldom do we rely solely on the conclusions of the expert," Abrahamson said. "In most every case there has to be supporting evidence apart from the forensic evidence.

"Often when there is expert testimony regarding an item in controversy the jury will have the opportunity to hear from both a prosecution expert and an expert hired by the defense. If there are differences in opinion the jury will have to make the decision."

Positions such as these, largely from law enforcement and those currently benefiting from the broken forensic system, ignore a fundamental concern of the report: the unacceptable subordination of forensic science to law enforcement oversight, which can cause bias even across multiple examinations of the same item of evidence.

Moreover, such statements ignore the report's finding that courts, and the adversarial process, are not up to the task of determining scientific reliability or validity – only legal admissibility. Though many jurists often confuse the two. As explained in the NAS Report (Edwards and Gotsonis, 2009; pp. S-19):

The adversarial process relating to the admission and exclusion of scientific evidence is not suited to the task of finding "scientific truth." The judicial system is encumbered by, among other things, judges and lawyers who generally lack the scientific expertise necessary to comprehend and evaluate forensic evidence in an informed manner, trial judges (sitting alone) who must decide evidentiary issues without the benefit of judicial colleagues and often with little time for extensive research and reflection, and the highly deferential nature of the appellate review afforded trial courts' *Daubert* rulings. Given these realities, there is a tremendous need for the forensic science community to improve. Judicial review, by itself, will not cure the infirmities of the forensic science community.

The point, which cannot be stressed enough, is reiterated later in the report with less diplomacy (p.1-14):

The bottom line is simple: In a number of forensic science disciplines, forensic science professionals have yet to establish either the validity of their approach or the accuracy of their conclusions, and the courts have been utterly ineffective in addressing this problem. For a variety of reasons—including the rules governing the admissibility of forensic evidence, the applicable standards governing appellate review of trial court decisions, the limitations of the adversary process, and the common lack of scientific expertise among judges and lawyers who must try to comprehend and evaluate forensic evidence—the legal system is ill-equipped to correct the problems of the forensic science community. In short, judicial review, by itself, is not the answer.

Consequently, any police agency or prosecutor arguing that their forensic analysts are reliable and trustworthy because they have been qualified by the court and cross-examined by the defense in response to the NAS Report telegraphs precisely the kind of ignorance the report warns against. But of course those vested in the current system are going to claim the report is irrelevant and that they aren't concerned about their own forensic personnel. Anything else is an admission that findings from their forensic personnel are the result of unproven methods and overconfident findings from under-trained, overworked, and too often biased analysts. This would put their respective court cases in jeopardy. Which of course is precisely the case.

It is my great hope that forensic professionals of all types, and their students, will read the NAS Report for themselves. In doing so they will find that it is intensely relevant to their work and study, regardless of their specialization. They will also find that it is

the result of scientists working in the interest of good science – with advice and counsel from many different actors in the forensic community.

COMMENDATIONS

As already mentioned, the NAS Report was a welcome scientific rendering of the current state of forensic science in the United States. The only professionals that will have a problem with its findings are those vested in maintaining law enforcement control over the forensic community while being unfamiliar with the nature and needs of actual science. Unfortunately, as the report makes all too clear, that number is in the majority. If it weren't, things would have been able to change from within and the NAS Report would have been completely unnecessary.

From this forensic scientists perspective, there are many areas where the committee is to be commended for spelling things out and taking a stand. They will be helpful to the forensic science community, the courts, and all students seeking careers in the criminal justice system. These areas include, but are certainly not limited to, the following:

Science

Chapter 4 of the NAS Report is entitled “The Principles of Science and Interpreting Scientific Data”. The inclusion of an entire chapter on a subject this fundamental is important for a number of reasons. It makes clear what science is, what it involves, and defines it as a culture with its own philosophy, mission and objectives. As provided in the NAS Report (Edwards and Gotsonis, 2009; p.4-11):

The methods and culture of scientific research enable it to be a self-correcting enterprise. Because researchers are, by definition, creating new understanding, they must be as cautious as possible before asserting a new “truth.” Also, because researchers are working at a frontier, few others may have the knowledge to catch and correct any errors they make. Thus, science has had to develop means of revisiting provisional results and revealing errors before they are widely used. The processes of peer review, publication, collegial interactions (e.g., sharing at conferences), and the involvement of graduate students (who are expected to question as they learn) all support this need. Science is characterized also by a culture that encourages and rewards critical questioning of past results and of colleagues. Most technologies benefit from a solid research foundation in academia and ample opportunity for peer-to-peer stimulation and critical assessment, review and critique through conferences, seminars, publishing, and more. These elements provide a rich set of paths through which new ideas and skepticism can travel and opportunities for scientists to step away from their day-to-day work and take a longer-term view. The scientific culture encourages cautious, precise statements and discourages statements that go beyond established facts; it is acceptable for colleagues to challenge one another, even if the challenger is more junior. The forensic science disciplines will profit enormously by full adoption of this scientific culture.

Its inclusion is also a clear admission that the mandates of good science need to be written out and explained. This is because they are so poorly understood both within the forensic science community and amongst its end-users – the courts and law enforcement. And finally, the report makes clear at multiple points that forensic science is often developed and practiced outside of scientific culture, and that the forensic community has yet to fully embrace these mandates.

This is an echo of warnings expressed in Thornton and Peterson (2002), that forensic scientists are rarely trained in the scientific method, do not understand its

implications, and that this ignorance leads to its abuse⁵. Similarly concerned, Chisum and Turvey (2007) wrote (p.85) “most practicing [forensic examiners] would probably have a great deal of enthusiasm for strict adherence to standards that embrace diminished bias, analytical logic, and the scientific method, if only they understood what these things are.”

The NAS Report also provides for the need to separate the forensic science community from law enforcement culture. This is discussed in many sections, and all throughout Chapter 6, “Improving Methods, Practice, and Performance in Forensic Science”, where it is explained (Edwards and Gotsonis, 2009; p.6-1):

The majority of forensic science laboratories are administered by law enforcement agencies, such as police departments, where the laboratory administrator reports to the head of the agency. This system leads to significant concerns related to the independence of the laboratory and its budget. Ideally, public forensic science laboratories should be independent of or autonomous within law enforcement agencies. In these contexts, the director would have an equal voice with others in the justice system on matters involving the laboratory and other agencies. The laboratory also would be able to set its own priorities with respect to cases, expenditures, and other important issues. Cultural pressures caused by the different missions of scientific laboratories vis-à-vis law enforcement agencies would be largely resolved. Finally, the forensic science laboratories would be able to set their own budget priorities and not have to compete with the parent law enforcement agencies.

The NAS Committee’s recognition of the incompatibility between scientific and law enforcement / prosecutorial goals, and the bias this can and has created, is perhaps its most significant contribution to the future of the forensic science community. This is consistent with the discussion found in Cooley and Turvey (2007; p.79):

To correct institutional bias, which accounts for many of the unwanted observer effects discussed in this chapter, it may be time to consider separating the forensic scientist once and for all from police culture. In other words, it may be time to consider separating all state crime lab systems physically, philosophically, and fiscally from law enforcement and to advocate for the creation of wholly independent state divisions of forensic science that are publicly funded but available to all.

The idea is not new. [Dr. Paul L.] Kirk and [Lowell] Bradford (1965, pp. 22–23) advocated for independent crime labs four decades ago²⁴:

An independent operation, not directly a part of any other law enforcement agency, but available to all, would certainly find it easier to maintain the high degree of scientific objectivity that is so essential to good operation. It is very probable that the quality of service furnished would be higher than is now possible, because there would be no dependence on budgets of the other organization with their inevitable competition for available funds, and there would be no question of comparable rank of personnel, which is a problem in some organizations under the common American system.

Fn 24 - Similarly, Professor [James] Starrs (1993) urged that the “inbred bias of crime laboratories affiliated with law enforcement agencies must be breached.” Professor [Paul] Gianelli (1997) also advocated for independent crime labs, stating, “These laboratories should be transferred from police control to the control of medical examiner offices, agencies that are already independent of the police.”

If forensic scientists take nothing else from the NAS Report, let it be that science cannot not survive, and therefore does not belong, in the culture of law enforcement.

⁵ [Dr. Joseph L. Peterson](#) is referenced multiple times in the NAS Report, and also presented before the NAS Committee as part of their inquiry.

Error Rates

In May of 2005, I composed a brief email to an email discussion list dedicated to forensic science issues: forensic-science@yahoogroups.com. Responding to a thread on the accuracy of forensic science, I wrote a simple yet bitter fact that was not well received:

[Dr. John I.]Thornton wrote once that "if there is no science, there can be no forensic science."

At some point we are going to have to live up to this. And we are going to have to start defining the legitimate role and limits of forensic science with more integrity. Like for example, being upfront with the fact that error rates for crime lab testing on all levels are essentially unknown.

This sparked a heated debate that lasted for a month and ended without end. At the time, Dr. John Thornton was the only forensic scientist I know of who was unequivocally on record about the lack of a known error rate in crime labs across the country, discussed in his landmark article on the *Daubert* decision (Thornton, 1994). Now, with the publication of the NAS Report, we have reached that point where belligerent ignorance must give way to scientific reality.

Too many in the forensic science community have falsely believed and testified that the error rates of their methods and examinations are essentially zero or are too complex for measurement. As such, it is argued, they need not be studied at all. This misconception about error rates and whether they may be reliably gauged, or relevant, often starts at the top. The seed of arrogance and ignorance of senior examiners is planted in the forensic community – in soil of loyalty or fear. It is gathered and spread as junior examiners are trained to parrot responses that they cannot question and do not understand. Once this happens enough times on the record, they are vested and stuck for life with the errors of previous testimony. Consider, for example, the continued testimony of [Dr. Bruce Budowle](#), the FBI's top forensic scientist⁶. He has, on numerous occasions, testified in precisely the fashion warned against by the NAS Report. As provided in *U.S. v. Llera Plaza et al* (2002; p.510):



Dr. Budowle's testimony with respect to methodology error was as follows:

Q: Tell us how it [error rate] applies to scientific methods, methodology.

A: Well, this transcends all kinds of forensic, it transcends all disciplines in that, but in the forensic area particularly, this has been an issue discussed repeatedly in lots of disciplines, whether it is DNA chemistry and latent fingerprints.

We have to understand that error rate is a difficult thing to calculate. I mean, people are trying

⁶ Dr. Bruce Budowle is referenced multiple times in the NAS Report, and also presented before the NAS Committee as part of their inquiry. Apparently the NAS Committee disagreed with his opinions regarding the need to study error rates, and whether they are in fact essentially zero. That is, unless he told them something different.

to do this, it shouldn't be done, it can't be done...

An error rate is a wispy thing like smoke, it changes over time because the real issue is, did you make a mistake, did you make a mistake in this case? If you made a mistake in the past, certainly that's valid information that someone can cross-examine or define or describe whatever that was, but to say there's an error rate that's definable would be a misrepresentation.

So we have to be careful not to go down the wrong path without understanding what it is we are trying to quantify.

Now, error rate deals with people, you should have a method that is defined and stays within its limits, so it doesn't have error at all. So the method is one thing, people making mistakes is another issue.

The report makes clear that any testimony suggesting near or complete infallibility regarding a method or an examiner is unscientific and, worse still, false. Furthermore, there was great concern by the NAS Committee regarding the number practitioners in the forensic science community who were unwilling to concede that they had an error rate of “more than zero”⁷. As discussed in the NAS Report (Edwards and Gotsonis, 2009; pp.1-9 - 1-10):

In testimony before the committee, it was clear that some members of the forensic science community will not concede that there could be less than perfect accuracy either in given laboratories or in specific disciplines, and experts testified to the committee that disagreement remains regarding even what constitutes an error... Failure to acknowledge uncertainty in findings is common: Many examiners claim in testimony that others in their field would come to the exact same conclusions about the evidence they have analyzed.

...

The insistence by some forensic practitioners that their disciplines employ methodologies that have perfect accuracy and produce no errors has hampered efforts to evaluate the usefulness of the forensic science disciplines. And, although DNA analysis is considered the most reliable forensic tool available today, laboratories nonetheless can make errors working with either nuclear DNA or mtDNA—errors such as mislabeling samples, losing samples, or misinterpreting the data.

The NAS Report puts these issues to rest, clearly identifying a need for humility and future research when it explains that based on its inquiry (Edwards and Gotsonis, 2009; p.1-6):

The fact is that many forensic tests—such as those used to infer the source of toolmarks or bite marks—have never been exposed to stringent scientific scrutiny. Most of these techniques were developed in crime laboratories to aid in the investigation of evidence from a particular crime scene, and researching their limitations and foundations was never a top priority. There is some logic behind the application of these techniques; practitioners worked hard to improve their methods, and results from other evidence have combined with these tests to give forensic scientists a degree of confidence in their probative value. Before the first offering of the use of DNA in forensic science in 1986, no concerted effort had been made to determine the reliability of these tests, and some in the forensic science and law enforcement communities believed that scientists' ability to withstand cross-examination in court when giving testimony related to these tests was sufficient to demonstrate the tests' reliability. However, although the precise error rates of these forensic tests are still unknown, comparison of their results with

⁷ For an excellent discussion of this issue, see Cole, S. A. (2005) “More Than Zero: Accounting for Error in Latent Fingerprint Identification,” *J. Crim. L. Criminology*, Vol. 95.

DNA testing in the same cases has revealed that some of these analyses, as currently performed, produce erroneous results.

The report goes on to define the type of errors that can occur in forensic casework, explains that they can indeed be measured when clearly distinguished, and warns “[t]he assessment of the accuracy of the conclusions from forensic analyses and the estimation of relevant error rates are key components of the mission of forensic science” (p.4-9).

The forensic sciences have long needed a voice of scientific humility to reference against wave after wave of overconfident, unscientific examiners proclaiming the impossible in their sworn testimony for the state. The NAS Report has succeeded in this regard. The forensic community, and its students, will be better for it.

Examiner Bias

The NAS Report discusses the issue of examiner bias and subconscious observer effects at length. This is, again, a welcome departure from the response that these ideas have garnered from the law enforcement community. It explains (Edwards and Gotsonis, 2009; p.4-9):

Human judgment is subject to many different types of bias, because we unconsciously pick up cues from our environment and factor them in an unstated way into our mental analyses. Those mental analyses might also be affected by unwarranted assumptions and a degree of overconfidence that we do not even recognize in ourselves. Such cognitive biases are not the result of character flaws; instead, they are common features of decisionmaking, and they cannot be willed away⁹.

A familiar example is how the common desire to please others (or avoid conflict) can skew one’s judgment if coworkers or supervisors suggest that they are hoping for, or have reached, a particular outcome. Science takes great pains to avoid biases by using strict protocols to minimize their effects.

Fn9: See, e.g., M.J. Saks, D.M. Risinger, R. Rosenthal, and W.C. Thompson. 2003. Context effects in forensic science: A review and application of the science of science to crime laboratory practice in the United States. *Science and Justice* 43(2):77-90.

This is an important discussion to have on record, as many in the forensic community believe and argue one or more of the following regarding examiner bias and observer effects: they don’t exist; they can be willed away; they are dealt with by peer review and publication; and/ or they have never heard of them. Of course, none of these are true.

In failing with these arguments, the next line of attack from vested forensic practitioners and their employers has been to suggest that if these concerns were real, it wouldn’t just be the defense bar discussing them in law review articles. This is why a chapter on this subject was included in Chisum and Turvey’s *Crime Reconstruction* (see Chapter 3: “Observer Effects and Examiner Bias: Psychological Influences on the Forensic Examiner”). No other forensic science text had tackled the issue before in such a broad and direct manner, at least not one written by those currently working in the forensic sciences. Like the NAS Report, we found that (Cooley and Turvey, 2007; pp.52-53):

Although the forensic community is attenuated to the potential for extreme forms of outright fraud and overt bias, it tends to be wholly unaware when it comes to understanding and accepting that well-documented forms of covert bias can taint even the most impartial scientific examinations. This is disheartening for the simple reason that covert and subconscious biases represent a far greater threat to the forensic community than do the small percentage of overtly biased, dishonest, or fraudulent forensic examiners.

And further, we found that (p.55):

Because the forensic community has generally ignored this basic principle of cognitive psychology and good research methodology, by failing to account for subconscious examiner influences on research and casework, the following tends to be true:

- Forensic examiners are unaware that observer effects do exist and can impact their examinations, or
- Forensic examiners naively profess to be aware of subconscious observer effects yet, at the same time, refuse to admit that anything could possibly impact their conclusions; they claim that they have been trained to be objective and can, by exercising a unique will power, purge their minds of any impurities (conscious and subconscious alike) that may taint their analyses.

With respect to the latter situation (i.e., “these effects cannot distort my analysis”), what forensic examiners are in fact claiming is that their training montage consists of learning a special ability that is denied all other scientific disciplines, which makes them invulnerable to subconscious influences. This position is not defensible, although many upper tier forensic scientists continue to profess otherwise.

Given these previously published findings, and their agreement with the NAS Report, I concur with its assessment that (Edwards and Gotsonis, 2009; p.4-11) “Research has been sparse on the important topic of cognitive bias in forensic science—both regarding their effects and methods for minimizing them.” Further, I agree with the inference that more study of these subjects is necessary – not less.

Technicians v. Scientists

The NAS Report makes a clear distinction between forensic scientists and forensic technicians. It provides, among other things, that (Edwards and Gotsonis, 2009; p.S-5):

There are also sharp distinctions between forensic practitioners who have been trained in chemistry, biochemistry, biology, and medicine (and who bring these disciplines to bear in their work) and technicians who lend support to forensic science enterprises. Many of these differences are discussed in the body of this report.

And (p.1-2):

[government forensic science] laboratories are staffed by individuals with a wide range of training and expertise, from scientists with Ph.D.s to technicians who have been trained largely on the job.

With the greatest distinction being that of testing vs. interpretation (p.2-4):

Because of the distinctly different professional tracks within larger laboratories, for example, technicians perform tests with defined protocols, and credentialed scientists conduct

specialized testing and interpretation.

The distinction between technician and scientist is both subtle and tremendous. Currently, the trend is to populate crime labs with technicians who do little more than inject a sample and push a button without knowing the science beneath their analysis. This allows them to testify about results, but prevents them from being able to explain their meaning with competence. Such a circumstance provides an interpretative windfall for the police and prosecution – who are left to provide interpretations to the trier of fact with scientists carefully in their pocket or moved entirely to the side. As explain in Chisum and Turvey (2007; pp.xvi-xvii):

A technician is one who is trained in specific procedures, learned by routine or repetition. A forensic technician is trained in the specific procedures related to collecting and even testing evidence found at crime scenes. This is without any need for employing or even understanding the scientific method and the principles of forensic science. This describes the police technicians documenting crime scenes and collecting evidence, and more than a few of the forensic personnel working in government crime labs.

A scientist is someone who possesses an academic and clinical understanding of the scientific method and the analytical dexterity to construct experiments that will generate the empirical reality that science mandates. *A forensic scientist* is one who is educated and trained to examine and determine the meaning of physical evidence in accordance with the established principles of forensic science, with the expectation of presenting her findings in court. This describes fewer and fewer of those practicing forensic science in government crime labs.

As the authors have experienced on countless cases, it is technicians, investigators, and ultimately attorneys who are actually providing a majority of crime reconstructions in court, often with little understanding of forensic science or the scientific method, to say nothing of the natural limits of physical evidence. Crime lab personnel are performing any necessary laboratory analysis, but police and prosecutors are taking the final step to explain events and their relationships in court. This has the net effect of elevating the lay testimony of investigators and forensic technicians to that of the forensic scientist and of reducing the expert findings of the forensic scientist to the level of the technician.

The position taken by the NAS, which is in fact the correct one, is that science must be part of both our methods and in our interpretations. A technician can collect a sample, extract DNA, or test for the presence or absence of substances. But it takes a scientist to interpret the results of that test in the context in was run, with respect to the limits of good science. If others are interpreting evidentiary findings on our behalf, or without a scientific background, then there is increased room for misrepresentation and error.

Education

The imposition of basic educational standards is one of the greatest challenges confronting the forensic science community. A major contributing factor to our problem is, again, the alignment of forensic science with the law enforcement community. Many forensic examiners work for or within law enforcement agencies that have very low educational requirements. As do, subsequently, their in-house forensic positions. This is not something that the law enforcement community prefers to acknowledge or be reminded of. Therefore, to remain in the good graces of the many uneducated forensic examiners employed by law enforcement, most professional organizations either do not impose degree requirements, or provide exceptions for law enforcement experience. This has created the very problem that the

NAS Report has identified: an overall lack of scientific education and training, let alone a culture of science, in the forensic sciences.

The NAS Report makes clear in its discussion of education reform that at the very least an undergraduate degree in the forensic sciences, or some other related science, is necessary, and that a graduate degree is preferable. It also provides that mere on the job training is an inadequate substitute for a scientific education (Edwards and Gotsonis, 2009; p.8-1):

Forensic examiners must understand the principles, practices, and contexts of science, including the scientific method. Training should move away from reliance on the apprentice-like transmittal of practices to education at the college level and beyond that is based on scientifically valid principles, as discussed in Chapter 4. For example, in addition to learning a particular methodology through a lengthy apprenticeship or workshop during which a trainee discerns and learns to copy the skills of an experienced examiner, the junior person should learn what to measure, the associated population statistics (if appropriate), biases and errors to avoid, other threats to the validity of the evidence, how to calculate the probability that a conclusion is valid, and how to document and report the analysis. Among many skills, forensic science education and training must provide the tools needed to understand the probabilities and the limits of decisionmaking under conditions of uncertainty.

To correct some of the existing deficiencies, the starting place must be better undergraduate and graduate programs, as well as increased opportunities for continuing education. Legitimizing practices in the forensic science disciplines must be based on established scientific knowledge, principles, and practices, which are best learned through formal education and training and the proper conduct of research.

This runs contrary to the views of many law enforcement forensic examiners who have been bullying the forensic community for years – arguing that experience trumps education and that science can be learned on the job. It also helps with task of preventing law enforcement examiners and prosecutors from arguing or suggesting that one must be in law enforcement, or work for law enforcement, in order to be a forensic scientist.

Additionally, the NAS Report notes that (Edwards and Gotsonis, 2009; p.8-11):

Many forensic degree programs are found at small colleges or universities with few graduate programs in science and where research resources are limited. The lack of research funding has discouraged universities in the United States from developing research-based forensic degree programs, which leads to limited opportunities to attract graduate students into such programs. Only a few universities offer Ph.D.-level education and research opportunities in forensic science, and these are chemistry or biology programs with a forensic science focus.

Most graduate programs in forensic science are master's programs, where financial support for graduate study is limited. In addition, the lack of research funds means that universities are unlikely to develop research programs in forensic science. This lack of funding discourages top scientists from exploring the many scientific issues in the forensic science disciplines. This has become a vicious cycle during which the lack of funding keeps top scientists away and their unavailability discourages funding agencies from investing in forensic science research. Traditional funding agencies have never had a mission to support forensic science research.

This indicates the need for establishing PhD forensic science programs to provide for much needed research in the forensic sciences. This is something that just about every other scientific discipline enjoys and benefits from. These need to be developed and federally funded.

My response to the NAS Report on these issues is simply this: it's about time.

There are other areas that the NAS Report covered which are important to the development of forensic science, but those I've mentioned are the ones that I see as being the most crucial for the future at this time. No doubt there will also be unforeseen benefits of certain findings that will bear out in the years to come as the report is more widely read, and the admissibility of its findings are litigated.

CRITICISMS

While there are many areas here the NAS Committee is to be commended, there are also some very important criticisms of the report that demand a response. These comments are prepared with full knowledge that not everything discussed in the inquiry could be covered in the report, and that some things were simply beyond the scope of the inquiry.

DNA

Many of those responding to the NAS Report are of the opinion that it is not relevant to DNA, or to DNA analysts. This is because DNA analysis is singled out in the report as having a more solid scientific foundation than any other forensic discipline. Also, this is because statements such as this throughout the report (Edwards and Gotsonis, 2009; p. S-5): "With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source." These statements are of course true.

However, there is an absence of direct criticism from the NAS regarding how DNA is databased, and how DNA results are searched for, obtained, calculated, reported, and interpreted by forensic scientists – criticisms that are widely known and understood even by the general public. This includes the FBI's pathological secrecy regarding its DNA databases. It also includes the unbelievable coordinated threat from the FBI's [CODIS](#) director to cut off access to any state that allows database searches it does not approve – which it turns out was a ruse designed to manipulate the court into denying motions from the defense (Dolan and Felch, 2008). For discussion, see:

- Moxley, S. "[CSI Games: If DNA Evidence Doesn't Fit in Orange County, Alter It?](#)" *Orange County Register*, March 12, 2008.
- Dolan, M. and Felch, J. "[When a match is far from a lock; Genetic evidence is widely viewed as ironclad. In 'cold hit' cases, however, the truth is often elusive.](#)" *Los Angeles Times*, May 4, 2008.
- Dolan, M. and Felch, J. "[Crime labs finding questionable DNA matches; FBI tries to keep national database away from lawyers.](#)" *Los Angeles Times*, August 3, 2008.
- Bykowicz, J. and Fenton, J. "[City crime lab director fired; Database update reveals employees' DNA tainted evidence, throwing lab's reliability into question.](#)" *Sun reporters*, August 20, 2008.

- Dolan, M. and Felch, J. “[Showdown over DNA lab reflects national debate](#),” *Los Angeles Times*, December 14, 2008.
- Dolan, M. and Felch, J. “[The danger of DNA: It isn't perfect](#),” *Los Angeles Times*, December 26, 2008.
- Mills, S. “[Judge orders FBI to search database for DNA from slain girl](#),” *Chicago Tribune*, February 3, 2009.

To be fair, DNA cannot escape criticism from the NAS Report because of the many other general areas covered, including problems with education, reporting, bias, error rates, and inappropriate alignment with law enforcement culture. DNA suffers from problems with each of these and more – as do all of the forensic sciences. But the absence of didactic criticism on known issues of great concern, in contrast with holding DNA analysis out as the best among the forensic sciences, can be confusing to some. And it can be used as a form of cover for the inept or ignorant.

Crime Reconstruction

The NAS Report specifically addresses the requirements and limits of bloodstain pattern analysis, which is good because it is an area where there has been a great deal of demonstrable ignorance and even false testimony over the years. As accurately explained in the report “[b]loodstain pattern analysis is employed in crime reconstruction or event reconstruction when a part of the crime scene requires interpretation of these patterns,” (Edwards and Gotsonis, 2009; p.5-38). However, while focusing solely this specialty area of reconstruction, the report fails to discuss the practice of crime reconstruction in general. Certainly by inference the general mandates provided for bloodstain pattern analysis would apply⁸. But this omission of its parent discipline is important; there is more to crime reconstruction than looking for and interpreting bloodstains and bloody transfer. In fact, without a great deal of information and reconstruction effort external to bloodstain evidence, it is by itself just about meaningless. Or at the very least misleading.

Though, importantly, the NAS Report does delineate between the function of crime scene investigation and the function of forensic scientists, consistent with Chisum and Turvey (2007) (Edwards and Gotsonis, 2009; p.1-1):

Crime scene investigators, with varying levels of training and experience, search for and collect evidence at the scene, preserve and secure it in tamper-evident packaging, label it, and send it to an appropriate agency—normally a crime laboratory, where it may be analyzed by forensic examiners.

It is subsequent to the analysis of evidence, and the results of forensic testing, that crime reconstruction efforts are properly performed – making it a function of forensic

⁸ The NAS Report determined that the bloodstain SWGs and related professional organizations such as the IAI and the IABPA mandate “no educational requirements for certification in bloodstain pattern analysis. This emphasis on experience over scientific foundations seems misguided, given the importance of rigorous and objective hypothesis testing and the complex nature of fluid dynamics. In general, the opinions of bloodstain pattern analysts are more subjective than scientific,” (Edwards and Gotsonis, 2009; p.5-39).

examiners with, at the minimum “an appropriate scientific education,” (Edwards and Gotsonis, 2009; p.5-38).

In short, it would have preferable to focus on the general area of crime reconstruction and then focus on the bloodstain subspecialty, but it is still very useful.

Forensic Fraud

The NAS Report recognizes the occurrence of fraud with statements such as “[a]lthough cases of fraud appear to be rare, perhaps of more concern is the lack of good data on the accuracy of the analyses conducted in forensic science disciplines and the significant potential for bias that is present in some cases,” (Edwards and Gotsonis, 2009; p.1-8), and does mention some high profile cases.

This could be because the NAS committee did not have a presenter on that specific issue. Or it could be because there is only one published descriptive study in the area of forensic fraud accompanying the research that has been published in law review journals (see: Turvey, 2003; Cooley, 2007). Or it could be that when the aforementioned Dr. Budowle provided in his presentation to the Committee that there were only a few cases of forensic fraud, and the Committee therefore need not concern itself terribly, they actually believed him – though this seems doubtful (see Budowle, 2007). Whichever the case, this is an area where further scientific inquiry is desperately needed, and in the absence of major research we are precluded from any suggestion of actual frequency. We simply do not know how common or uncommon forensic fraud is at this time – we just know that there are a lot of cases and the more we look the more we find. That we are not studying it, just as we have not been studying error rates at the request of those like Dr. Budowle from the FBI, is just as significant.

CONCLUSION

As it stands, the NAS Committee has determined that the forensic community has given up any authority to govern itself, let alone consider itself scientific. Existing professional organizations have failed to develop practice standards, failed to develop and enforce meaningful codes of ethics, and have failed to recognize the shortcomings of their methods by promoting an environment where research and peer review are welcome (Edwards and Gotsonis, 2009). Additionally, the NAS Report provides that (p. S-13):

...there is little doubt that some existing federal entities are too wedded to the current “fragmented” forensic science community, which is deficient in too many respects. Most notably, these existing agencies have failed to pursue a rigorous research agenda to confirm the evidentiary reliability of methodologies used in a number of forensic science disciplines. These agencies are not good candidates to oversee the overhaul of the forensic science community in the United States.

Finally, some existing federal agencies with other missions occasionally have undertaken projects affecting the forensic science community. These entities are better left to continue the good work that defines their principal missions. More responsibility is not better for these existing entities, nor would it be better for the forensic science community or the Nation.

The committee thus concluded that the problems at issue are too serious and important to be subsumed by an existing federal agency. It also concluded that no existing federal agency has

the capacity or appropriate mission to take on the roles and responsibilities needed to govern and improve the forensic science enterprise.

This section is directed towards a number of agencies, but specifically at the FBI and the NIJ. Only by severing ties with the past, including the failed models, cultures, and political agendas that have been selectively funded and supported by such federal agencies, can we move into a future partnered with actual science.

Subsequently, the report's recommendations for the development of a National Institute of Forensic Science (NIFS), an "independent federal agency" that is not "in any way committed to the existing system" and not "part of a law enforcement agency", with "a culture that is strongly rooted in science", must be wholly endorsed (Edwards and Gotsonis, 2009; p. S-13).

Despite to the remarks of some and the fears of others, the NAS Report is not an attack on the forensic community. On the contrary, it is clearly a call to salvage it, both on a level of scientific credibility and one of dignity. For all its imperfections, I for one regard the NAS Report as an excellent blueprint to begin the process of forensic reform.

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