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CSI for Real: How to Improve Forensics Science

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Executive Summary

American television viewers of popular programs such as *CSI* would be led to think that the forensic science lab is a bastion of white-coated scientists whose empirical and unbiased results are virtually always reliable and beyond significant dispute. A forensic scientist testifying that an accused in a criminal trial is the source of the evidence analyzed and interpreted at the scientist's lab can leave a jury strongly convinced that the scientist's conclusions are unimpeachable confirmation of the defendant's guilt. The actual quality of such testimony, unfortunately, is often quite different; in the wake of DNA exonerations, the reliability of forensic testing and testimony have come under extensive critical examination and have been found to be limited, in large part due the forensic lab's monopoly status.

Forensic error occurs at significant rates—both unconsciously and consciously (fraud)—because the current institutional structure of forensic science discourages the discovery of truth. In pure science, results are scrutinized by other scientists and subjected to criticism, review—and reproduction. The rule-governed, competitive process of pure science does not obtain, however, in most forensic labs where results are subject to little or no public or peer review.

Several factors contribute to the unreliability of forensic science labs, including:

- **Monopoly**. Most forensic labs in the United States and elsewhere hold a monopoly on the evidence that will not be reviewed or interpreted by any other. Thus, the forensic practitioner has less incentive than the pure scientist to avoid sloppy or even fraudulent work.

- **Dependence bias.** Because most forensic labs are organized within law enforcement agencies, they are dependent upon these agencies for their budgets and are in an institutional relationship that leads to a pro-prosecution bias.

- **Insufficient quality control.** U.S. forensic labs are not required to be accredited by an independent accrediting agency.

- **Information leakage.** Police investigators frequently share information about a suspect that is extraneous to the forensic scientist's testing. Such "information pollution" can easily cause both conscious and unconscious bias.

- **No division of labor between the forensic analysis and interpretation.** The scientist who undertakes an analysis on a blood or hair sample also then interprets the results. Even if the test was performed at the highest scientific standards, error can occur when the scientist interprets the results to determine whether they exclude a police suspect.

- **Lack of forensic counsel.** The indigent defendant rarely receives counsel from a forensic scientist, causing an unjust asymmetry whereby the prosecution has forensic counsel, but the defendant does not. Further, even many fine attorneys are simply unable to fully comprehend and effectively challenge the findings of the state's forensic counsel.

- **Lack of competition.** Given that very often only the state has forensic counsel, there is no competition among forensic counselors for customers.

To rectify these systemic problems and bring forensic science within a praxis that more closely resembles pure science, this paper proposes to institute the following reforms: competitive self-regulation, rivalrous redundancy (in which randomly chosen evidence is sent to multiple, competing labs within a given jurisdiction), the creation of an Evidence Control Officer (ECO), the establishment of information hiding, statistical review, the division of labor with vouchers, and the privatization of forensic labs.

For example, the ECO would be the sole point of contact with the lab receiving the evidence. He would further employ random-number generators to determine which lab will be sent a given piece of evidence and when to provide the same evidence to more than one lab.

Vouchers for retaining forensic counsel are a matter of justice analogous to the Sixth Amendment right to legal counsel. Just as indigent defendants are provided legal counsel at government expense, so, too, should they be provided forensic counsel. This would also have the effect of increasing competition for forensic services, thus establishing incentives for avoiding shoddy or fraudulent work.

These protocols would create a kind of peer review, in which any lab's results could be challenged by any other. They would also encourage high-quality forensic work by creating competition for forensic services. The proposals of others for improving the systemic issues in forensic science are considered, including regulatory schemes and blind testing; where these hold merit the author endorses them yet finds them insufficient as long as forensic work is primarily undertaken by and for the offices of police and prosecutors.

The cost of forensic science services, and the possible—but not invariable—slight increase in fiscal cost of adopting the policies described in this paper are considered, but so are the social costs of not implementing them. A failure of forensic science often results in an innocent person being sent to prison while a guilty one goes free, possibly to commit more crimes. Competitive regulation carries the promise of both greatly improving the quality of forensic science—and serving the cause of justice.

A large field of inquiry is open for considering a sound system of “forensic science administration.” The proposals in this paper will hopefully contribute to that long-overdue exploration as well as to remedying the deficiencies in the current institutional structure of forensic science.

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Part 1

Introduction

Within the current legal system, it is often difficult to challenge the analysis of a police crime lab, even for the defense. Although the word “forensic” derives from the Latin word for the forum, where citizens congregated to dispute public questions, modern forensic science is anything but public or adequately open to dispute. The forensics lab holds an effective monopoly on the analysis of the evidence presented to it. The lab’s scientist is free to infer from the evidence without being second-guessed. The forensic worker, therefore, has power.

While the vast majority of forensic scientists wield this power fairly and competently, a few do not and, as I will argue, eliminating the current monopoly would render as standard the able efforts of the majority. The proper function of forensic science is to extract the truth. According, however, to a study in 2001:

> *As it is practiced today, forensic science does not extract the truth reliably. Forensic science expert evidence that is erroneous (that is, honest mistakes) and fraudulent (deliberate misrepresentation) has been one of the major causes, and perhaps the leading cause, of erroneous convictions of innocent persons.*[1]

In the wake of DNA exonerations, an extensive literature has developed on the limited reliability of forensic testimony. The institutional structure of forensic work is an important source of error, insufficiency, and occasionally, malfeasance. Our adversarial criminal courts organize disputes between the prosecution and the defense. But the current institutional structure of forensic science places the results of forensic scientists largely beyond dispute.

Some have recommended reforms such as establishing forensic labs independent from law-enforcement agencies and improving the documentation of forensic work. Others have proposed conducting double-blind proficiency tests in which forensic scientists are made to think they are performing case analysis when actually they are being tested for the reliability of their work. Others have proposed the use of evidence line-ups in which, for example, the “questioned hair” is compared to several “known hairs” rather than to just one known hair. Such proposed reforms are well-conceived. They will have limited effect, however, without also addressing inherent flaws in the current institutional structure of forensic work that discourage high-quality performance due to a lack of competition in the supply of forensic services.

This paper proposes breaking up the forensic worker's monopoly by instituting "competitive self-regulation." Not all competition, of course, is salutary. Drug prohibition, for example, engenders competition among suppliers that often leads to violence. Competitive self-regulation, however, is designed to produce favorable results. The details are explained below, but the basic idea is to effect a world for the forensic scientist more akin to that of the pure scientist. Importantly, this reform includes the stipulation that any lab's forensic tests will sometimes be replicated by other, independent labs. This protocol creates a kind of a peer review similar to that of pure science, where the results of any one lab may be challenged by the results of any other. Such a system—in which each forensic lab becomes a check on every other—would reduce the errors committed by forensic scientists and reduce the conscious and unconscious abuses committed by some.

Part 2

Why There Is No "Science" in Forensic Science

In pure science, truth emerges from a rule-governed competitive process in which knowledge is public, the idiosyncrasies of individual researchers are checked by the results of other scientists, and results are subject to criticism, review, and reproduction. As it is practiced today, forensic science needlessly departs from this model. Forensic analysis depends too often on the personal qualities of each individual scientist; idiosyncrasies of individual forensic scientists may determine the final result—and there is limited criticism, review, and reproduction. A competitive process of self-regulation, by contrast, eliminates errors in pure science, and pure science is accepted in part because identical results can be independently duplicated. Pure science is self-regulating; forensic science is not. But it could be.

The variance between pure science and forensic science is located in differing institutional structures. Forensic science is sometimes unreliable because the larger environment of knowledge-seeking is insufficient. Most forensic scientists are skillful and diligent, but they practice their trade in an environment that does not encourage the type of institutional self-criticism characterizing pure science. Their environment can induce unconscious bias and even create, for the unscrupulous practitioner, an incentive to lie. Under competitive self-regulation, forensic science would finally become "forensic" in the truest sense: subject to public and peer review.

A. Aspects of Institutional Structure That Discourage Truth Discovery

Eight features of contemporary forensic science needlessly reduce the quality of work performed by its practitioners.

1) **Monopoly.** In most jurisdictions today, including those in the United States, each forensics lab has a monopoly on the evidence it analyzes. No other lab is likely to examine the same evidence, which allows practitioners to perform sloppy, biased, even fraudulent work, as they cannot be proven wrong. Recent history provides quite a few examples of poor work. Ralph Erdman's case is illustrative of how careless forensic work can occasionally be. Erdman not only fabricated many of

his results, but even managed to lose a human head from a body he was to examine.[2] To describe such work as "sloppy" is an understatement.

Most forensic scientists, of course, are far superior practitioners than Erdman, who was just a run-of-the-mill fraud and cheat. But the Erdmans are like canaries in the mine shaft, alerting us to more pervasive problems. The sign of trouble for forensic science is not the unfortunate fact that Erdman cheated, but that he got away with it for so long, jeopardizing many good convictions. The lack of checks and balances leaves the system susceptible to the occasional bad apple. More importantly, it permits no reliable method of ascertaining when forensic science falls below standard.

2) **Dependence bias.** Forensic labs are often organized within police departments and are thus dependent on the departments for their budgets. This institutional relationship creates a pro-prosecution bias, as the managers of forensics units answer to law enforcement agencies. For example, David Williams, an investigator in the Federal Bureau of Investigation's (FBI) Explosives Unit, was found to have "tailored" his testimony "to the most incriminating result" in two trials, namely, the prosecutions for the World Trade Center bombing of 1993 and the Oklahoma City bombing of 1995. In the Oklahoma case, "Williams repeatedly reached conclusions that incriminated the defendants without a scientific basis and that were not explained in the body of the report."[3]

Quality control measures tend to be poor, which may easily produce consistently shoddy work.

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3) **Poor quality control.** In the United States, there are no required programs of accreditation for forensic labs and the principal accrediting agency, the American Society of Crime Lab Directors, is a professional association, not an independent organization. Quality control measures tend to be poor, which may easily produce consistently shoddy work. In Scotland, for example, Detective Constable Shirley McKie was charged with murder on the basis of a fingerprint identification that was later shown to be false and mistaken. An investigation into the case by the Scottish politician and former criminal defense lawyer Winnie Ewing seems to show that "the system of gathering fingerprints in Scotland by the Scottish Criminal Records Office (SCRO) was less stringent than that used in India."[4] The SCRO did not have an effective quality control system.

4) **Information sharing.** Forensic scientists are privy to information that may be crucial to a criminal proceeding, but extraneous to the questions put to the forensic scientist. Sharing information between police investigators and forensic scientists creates the strong possibility of unconscious bias.[5] Further, dishonest scientists may then more freely act on their self-conscious biases. The inappropriate sharing of bias-inducing information might be called "information pollution." Recall the case of FBI examiner David Williams who identified the explosives used in the Oklahoma bombing of 1995 and the World Trade Center bombing of 1993. Williams's

conclusion in each case could only have been reached by the extraneous knowledge of what the suspects had previously purchased—and not by legitimate forensic means.

5) **No division of labor between forensic analysis and interpretation.** The same scientist who, say, performs a test to establish blood type also then determines whether his test results exclude the police suspect. Forensic error may result from a false interpretation of a test that was properly conducted. In Houston, for example, George Rodriquez was convicted of rape largely on forensic testimony in which a legitimate test was illegitimately interpreted. An affidavit sworn by several leading forensic scientists demonstrates that Houston pathologist Jim Bolding interpreted his serological work in a manner inconsistent with established scientific theory:

> *Jim Bolding's trial testimony . . . contains egregious misstatements of conventional serology. These statements reveal that either the witness lacked a fundamental understanding of the most basic principles of blood typing analysis or he knowingly gave false testimony to support the State's case against George Rodriguez. His testimony is completely contrary to generally accepted scientific principles.*[6]

6) **Lack of forensic counsel.** Indigent defendants rarely receive aid and counsel from forensic scientists. In common-law countries, this creates an asymmetry whereby the prosecution has forensic counsel and, indeed, sometimes great batteries of forensic specialists, whereas the defense has none and, often, an attorney unable to adequately understand and challenge forensic testimony. For example, the prosecutor may ask the forensic lab to test evidence for a link to the suspect. If the result does not implicate the suspect, the prosecutor may not ask for tests to exonerate the suspect, as would the defense were the opportunity available. The defense's lack of forensic counsel has produced many of the false convictions identified by the Innocence Project in the United States and the similar British group, Innocent.

7) **Lack of competition among forensic counselors.** From the absence of forensic counsel for the indigent it follows that there is little competition among forensic counselors for customers. Even if forensic counsel is available, it may not be vigorous or effective in a non-competitive environment.

8) **Public ownership.** Forensic laboratories are almost universally publicly owned. In the United States, they are often organized under police agencies, such as the State Police or the FBI. As noted in Part 4, after the DNA work of the Houston Crime Lab (in Texas) was shown to be unreliable, the Houston Police Department began sending all of its DNA work to private labs. This episode, while merely suggestive, nicely illustrates the claim that competitive private labs may have stronger incentives to produce reliable work than do monopoly government labs.

Part 3

How the Organizational Structure of Forensic Science Creates Bias Among Forensic Workers

Most forensic work in the United States is performed in police labs, including the FBI's. About 80 percent of all U.S. crime labs are within law enforcement agencies, and approximately 90 percent of the accredited ones are organized under police agencies. The forensic worker thus depends on the police (or other law enforcement agency) for his salary and performance evaluation. This institutional relationship frequently creates a demand for forensic workers to deliver results consistent with police theory. Frequently, forensic workers are former police officers or FBI agents. Until 1994, the FBI crime lab "generally required its examiners to also be FBI agents, except in the Latent Fingerprint section, where the examiners have always been non-agent professional staff."[7] As of September 1996, nearly 30 percent of the lab's 204 examiners were former agents.[8] So while this dynamic is beginning to change—recently there has been a move toward "civilianization" of forensics—many forensic science examiners began their careers as law enforcement officers, subject to the biases that such experience, may engender.

Some labs are not accredited; indeed, both the Houston Crime Lab and the FBI lab were accredited only recently. The American Society of Crime Lab Directors/Laboratory Accreditation Board (ASCLD/LAB) does accredit many forensic labs, but how meaningful such accreditation is less than clear. For example, their accreditation standards contain no requirements for procedures to reduce bias resulting from exposure to extraneous information or suggestive presentation of evidence.

Forensic workers tend to identify with the police and therefore to seek out evidence supporting law enforcement's theory. This flaw is illustrated by an FBI lab worker's candid admission: "People say we're tainted for the prosecution. Hell, that's what we do! We get our evidence and present it for the prosecution."[9] John McDermott, a senior FBI official, testified in 1981 before a congressional subcommittee that the ideal lab specialist "stands in the shoes of the investigator in the field, whom he is serving." According to Jack Dillon, the FBI Firearms-Toolmark Unit chief in 1998, "Sometimes they're [investigators] pretty confused about what they want, so we'll call them up to find out what they're trying to prove. Often we can suggest some better ways of doing it."[10]

A former Firearms-Toolmarks Unit chief at the FBI laboratory, Evan Hodge, wrote an article "Guarding Against Error" in which he relates a particularly revealing episode. A police inspector took

> *A 1911A1-model .45- caliber pistol to a lab for confirmation that it was a murder weapon. "We know this guy shot the victim and this is the gun he used," the examiner was told. "All we want you to do is confirm what we already know so we can get the scumbag off the street. We will wait. How quick can you do it?" The examiner gave them their instant identification. The suspect confessed and led the police to a second pistol, also a .45, also a 1911A1 model, which lab tests demonstrated was the real murder weapon. "We all do this (give in to investigative pressure) to one extent or another," Evan Hodge admits, arguing that the only solution is to remove the sources of it from the laboratory completely.*[11]

In the current institutional regime, the forensic worker is given the evidence in a suggestive manner and tries to show that the police theory is true. His analysis is not likely to be reviewed or questioned by other forensic scientists or even most legal defense teams. He therefore essentially functions in a monopoly franchise held by the police.

A. Cognitive Bias in Forensic Analysis

Social psychology literature, such as Risinger *et al.*, documents a long list of cognitive biases that may affect forensic workers. These include selective attention, anchoring effects, role effects, experimenter effects, conformity effects, confirmation bias, motivational bias, and bias by examination-irrelevant information or domain-irrelevant information. In layman's language, this means that the typical forensic worker has psychological incentives to reach findings based on his close psychological ties with the law enforcement community he serves.

Larry S. Miller demonstrates an excellent example of cognitive bias at play. He asked a group of 14 students trained in hair analysis, all of whom met the basic requirements for expert testimony on human hair identification in courts of law, to examine four cases each. For each student, two cases were presented the usual way: They were given two samples and told that one was from the crime scene and the other from the suspect. The other two cases were presented through a forensic line-up. The known sample from the imaginary crime scene was compared to five suspect-known hair samples. In all 56 cases, there were in reality no true matches. The first group of cases yielded an error rate of 30.8 percent; the second group an error rate of only 3.8 percent.[12]

Miller's study illustrates how evidence is often presented to the forensic scientist in a bias-inducing manner. The samples are labeled as coming from the defendant or from the victim and are frequently accompanied by a synopsis of the investigation indicating the reasons that the investigators believe the suspect is guilty. This protocol cues the forensic worker to the expected or correct result.

Risinger *et al*. note, “If even the mildest of expectations can affect perception, then it is not surprising to find that where an observer has strong motivation to see something, perhaps a motivation springing from hope or anger, reinforced by role-defined desires, that something has an increased likelihood of being ‘seen’.”[13] Also, social context can influence cognition. The institutional regime of police forensics influences the preferences of forensic workers and may bias their reasoning. The milieu creates a kind of “motivated reasoning” among forensic scientists. Milton Lodge and Charles Tabor present a simple model of motivated political reasoning. They list several factors that tend to produce biased judgment. Four of them apply to forensic workers in the current institutional environment. Namely, the consequences of being wrong are weak, the judgmental task is complex, evidence is ambiguous, and one is under time pressure.[14]

One forensic scientist has told me in a personal conversation that the consequences of error are very high for forensic scientists, which if true would render one of Lodge and Tabor’s factors inapplicable. An analyst, he has explained, whose work is found to be substandard acquires a damaging reputation that follows him or her. This claim seems dubious. The probability of being discovered in an error is relatively low and disciplinary measures are often weak when an error is detected. Several known cases of substandard work went undetected for years, and there exist a number of instances in which a discredited analyst has suffered little or no adverse career consequences.

In August 2005, for example, Youngstown State University, located near Cleveland, Ohio, hired Joseph Serowik to head its forensic science program. Serowik had been suspended from his job as a lab technician in the Cleveland crime lab after his work had been discredited. His erroneous analysis led to the false conviction of Michael Green for rape. Moreover, Serowik's competence had been questioned in law enforcement circles for more than a decade. Serowik was recommended for the academic post by Cuyahoga County Common Pleas Judge Timothy McGinty, the former prosecutor who sent Michael Green to prison for rape in 1988 assisted by the now-discredited testimony from Serowik.[15]

There is a further and more profound reason for motivated bias in forensics. In some cases, the police employ the forensic worker and review his job performance. This police authority creates a strong economic motive to satisfy the police by confirming the police theory. This motive competes with others, such as a desire to see justice done. It is often present, however, and provides another source of conscious and unconscious bias in forensic analysis.

Group-serving bias is another probable source of bias in forensic work. Group-serving bias is created when a person considers himself a member of a “coalitional alliance.” [16]A coalitional alliance is characterized by coordinated action toward a common goal.

An individual’s psychological identification with the group can have advantages. It discourages shirking, thereby increasing the value of the individual’s contributions to the coalition. It is not advantageous, however, for forensic scientists to psychologically identify with the police. Police and forensic workers are engaged in coordinated action toward a common goal and thus seem to be in a coalitional alliance. They are "us," and suspects are "them." This deep-seated bias in forensic analysis is inconsistent with objective scientific analysis.

Risinger *et al*. paint a vivid portrait of the daily operation of cognitive bias in forensic analysis:

> *In light of this, consider the forensic scientist who takes poor notes during an examination and prepares a skimpy report, but then goes back to "spruce them up" shortly before trial. Even assuming the most honest of intentions, that examiner is inviting errors to infiltrate his conclusions and his testimony. The error potential of the original skimpy report, which leaves much to be supplied from memory, facilitates the creation of testimony more consistent with assumptions and later acquired expectations than would be the case with a more detailed and complete contemporaneous account. Reconstructive errors are given room to manifest themselves during the "spruce-up" stage.*[17]

The OIG report on the FBI crime lab provides an example that fits this portrait perfectly. The court asked Rudolph why the diphenylamine test and other tests he described were not documented in his notes. Rudolph responded: "When I examine a case I put in my notes things that are important to me when I . . . give testimony. I don't write my notes for the United States Attorney. I don't write my notes for the defense. I write my notes for myself." Rudolph said he had done thousands of tests since 1982 and could not possibly remember them all. The court asked: "Isn't that one of the reasons you keep notes?"[18]

Risinger *et al*. observe that the cognitive biases they discuss can introduce errors at every stage of analysis. Thus, they conclude, cognitive biases may create:

- *Errors of Apprehending (errors that occur at the stage of initial perception);*
- *Errors of Recording (errors that creep in at the stage where what is observed is recorded, assuming a record beyond memory is even made);*
- *Errors of Memory (errors that are induced by both desires and the need for schematic consistency, and that escalate over time when memory is relied on);*
- *Errors of Computation (errors that occur when correct observations accurately recorded or remembered are transformed into incorrect results when calculations are performed on them); and*
- *Errors of Interpretation (errors that occur when examiners draw incorrect conclusions from the data).*[19]

Only a structural change in the organization of forensic science is likely to greatly reduce cognitive bias in forensic work.

B. Choice of Technique in Forensic Analysis

Forensic workers have a choice of techniques. They may, for example, opt from among several serological tests in matching a suspect’s blood to a sample. There are no protocols for dictating the optimal technique in any given situation. Accreditation has somewhat mitigated this problem. Accredited labs in the United States (and, again, not all are accredited) must have protocols, but they may and do vary from lab to lab. Absent universal protocols, forensic workers have considerable freedom to choose their techniques of analysis.

One author notes, “The crime laboratories' diversity of procedure reflects . . . disunity.”[20] For example, individual laboratories, and even individual technicians, frequently set their own idiosyncratic standards concerning testing protocols for the same basic serological test. Variation of protocols, or “protocol drift,” may cause inconsistent test results. Especially troublesome, the interpretation of test results may represent only one analyst's opinion.

One protocol, “selective retesting,” is equivalent to choice of technique: If you don’t like one of the results, repeat that one test, but not the others. Such a “protocol” has the same biasing effect as choosing which of several different tests to perform. Risinger *et al*. report on cases in which a forensic worker is asked to re-examine evidence after the expected result failed to appear.[21]

The honest, but unconsciously biased, forensic scientist will readily seize excuses to cast doubt on tests producing undesired results—and may dismiss doubts about techniques producing the “wrong” outcome.

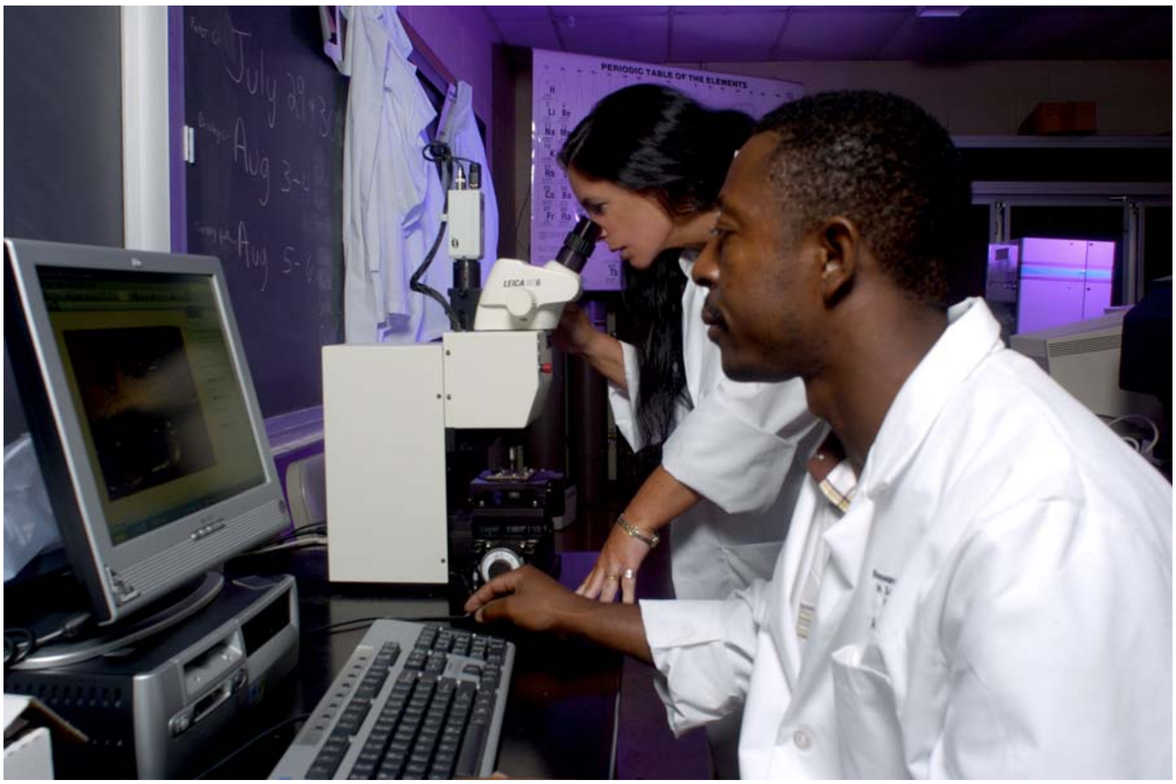
Researchers Susan Feigenbaum and David M. Levy showed in 1996 that choice of technique and selective reporting introduces bias to scientific analysis.[22] The scientist may apply several techniques to a question and publicly report only those tending to support his preferred theory. Feignbaum and Levy’s analysis applies to forensic work as well. Their paper, “The Technical Obsolescence of Scientific Fraud,” reveals the danger in leaving forensic workers free to choose. Freedom of choice increases the chances that the worker will be able to produce a predetermined result by the use of techniques that are, considered in isolation, perfectly objective and legitimate. He has no need to engage in willful fraud; fraud is obsolete. He has only to apply several tests and report on those that point in the desired direction.

Unfortunately, even honest scientists may do the same thing. Scrupulously honest scientists may systematically reject unexpected or undesired results and accept expected and desired ones. So too, the honest, but unconsciously biased, forensic scientist will readily seize excuses to cast doubt on tests producing undesired results—and may dismiss doubts about techniques producing the “wrong” outcome.

Risinger *et al*. separate fraud from bias:

> *We are not concerned here with the examiner who, in light of the other findings, deliberately alters her own opinion to achieve a false consistency. That is the perpetration of an intentional fraud on the justice system, and there are appropriate ways with which such falsification should be dealt.*[23]

But the line between "honest error" and willful fraud is fluid. On the one hand, outright fraud is technologically obsolete in some circumstances. On the other hand, there are no bright lines as we move from the psychological state of disinterested objectivity to unconscious bias to willful fraud.



Part 4

Cases of Forensic Malfeasance

A. Evidence on the Reliability of Police Forensics

Metrics for the reliability of the forensic analysis performed in government crime labs do not exist. And it is not clear how anyone, including a national government, might measure the forensic error rate. There can be no external, non-forensic test of the correctness of forensic analyses. Nor is it likely that forensic workers could be induced to fully disclose their past errors or even privately recognize them. That forensic analysis is not sufficiently reliable, however, is well-established.

The case of Josiah Sutton provides dramatic illustration of some malfeasance problems with forensics.[24] In 1999 Sutton was convicted of rape. Two men had abducted a woman at gunpoint from her Houston apartment complex, raped her, and left her in a field. While driving her car later, the victim saw Sutton with a friend, and—believing they were her attackers—she notified the police. The two men were arrested. Sutton's friend was released after preliminary tests of his body fluids failed to match samples from the victim and her car. Sutton's fluids were reported as a possible match he was tried, found guilty and at age 16 sentenced to serve 25 years.

The case against Sutton was based largely on DNA evidence. A forensic expert from the Houston Crime Lab testified in court that DNA from the semen found on the victim's clothes matched that of the defendant, Sutton. "The testimony strongly implied that this was a unique match, that Mr. Sutton was the only person in the world that would have this DNA pattern, when really thousands and thousands would," according to a DNA expert brought into the case.[25] Sutton was freed in March 2003 when the original DNA evidence was discredited. New DNA tests proved that he could not have been the source of the semen recovered from the victim and crime scene. He served 4½ years in prison.

The exoneration of Josiah Sutton occurred in the context of a general review by the FBI of the DNA/Serology section of the Houston Crime Lab. The report found serious inadequacies in area after area.

> *The laboratory is not designed to minimize contamination due to the central screening area being used by serology, trace, and arson. Better separation of these disciplines is needed. The audit team was informed that on one occasion the roof leaked such that items of evidence came in contact with the water.*[26]

Evidence in storage freezers was not properly sealed. It could not be established whether forensic workers wore gloves and lab coats. "Procedures for calibration of equipment have been written," the report indicates. "However, they are not being followed. Logs are not available documenting repair of equipment and calibration prior to being used in casework analysis."[27] Lab reports were grossly inadequate. There were no "written procedures for taking and maintaining case notes." Moreover, "screening notes are very minimal and provide little information. Screening notes do not include a description of the item, what probative stains were identified, how the stains were identified, and what stains were collected." Lab reports were sloppy. They…

> *do not consistently include: case identifier, description of evidence examined, a description of methodology, locus, results and/or conclusions, an interpretative statement, date issued, disposition of evidence (including any depleted samples), and a signature and title of the analyst.*[28]

Lab personnel did not "have the education, training and experience commensurate with the examination and testimony provided." The lab even lacked written procedures for the "cleaning of screening areas, common work areas, and equipment." Similarly, the lab was sloppy regarding the preparation of reagents. "One bottle in the lab had two dates on it and it was unclear which was the date of preparation." In June 2002, the lab's director lied about his credentials in court, falsely claiming that he had a PhD in biochemistry from the University of Texas.[29]

Researchers claim DNA tests sometimes entail surprising problems. Certain DNA tests "can present highly ambiguous results when mixed samples are involved, which require the same kinds of subjective human interpretation as, say, toolmark or bitemark identification."[30] The mixed samples issue holds even for the latest DNA technology. The *Seattle Post-Intelligencer* notes that with the latest DNA techniques, evidence can be contaminated if the technician converses while working.[31] The shoddy state of the Houston Crime Lab is only one of several similar examples in the United States and Canada today, some of which also involve DNA testing. Problems have been identified in police labs in: Baltimore, Boston, Cleveland, Indianapolis, Las Vegas, Manitoba, Missouri, Montana, Fort Worth, Virginia, and Seattle.

Proficiency tests provide another indicator of the quality of forensic work. In the United States, the Law Enforcement Assistance Administration (LEAA) gave nationwide proficiency tests for forensic labs between 1974 and 1977. Over 200 labs volunteered for a battery of 21 such tests, and the results were poor (See Table 1). "Indeed, only one quarter of the participating labs provided entirely acceptable responses in all cases."[32] The "percentage of unsuitable conclusions reached 71% in one blood test, 51% in a paint test, and 67% in a hair test."[33]

Table 1: Lab Performance Compared to Standards	
Percentage of Total Responses Considered Acceptable	Percentage of All Participating Labs With This Rating
100%	25.3%
90.0-99.9%	8.6%
80.0-89.9%	31.8%
70.0-79.9%	19.3%
60.0-69.9%	9.4%
50.0-59.9%	3.0%
Below 50%	2.6%

Source: Jonakait (1991), pp. 110-111

There are three reasons to suspect that the LEAA error rate results, however disappointing, may have produced lower error rates than those that occur in daily forensic practice. First, only volunteer labs were tested, and each participated only in the areas of its choice. Second, the labs knew they were being tested; it was not a blind examination. Third, the test samples were much simpler than those a forensic scientist faces in actual casework.[34]

Apparently, there has been only limited improvement in proficiency test results since 1977. Joseph Peterson and his colleagues published a two-part study of proficiency tests conducted by the Forensic Sciences Foundation (FSF) and Collaborative Testing Services (CTS) from 1978-1991.[35] Peterson was involved in the original LEAA tests. Like the LEAA tests, the FSF/CTS tests were voluntary, "open" rather than blind, and characterized by samples that were sometimes less challenging and complex than those from the field. (In the fingerprint test, however, the testing service "attempted to simulate actual conditions by creating smudged, elongated, compressed and other irregular latent print specimens.")

There has been only limited improvement in proficiency test results since 1977.

Peterson and his co-authors directly compare the FSF/CTS and LEAA tests and find improvement in most areas, but a decline in the testing of paint. They group forensic techniques into three categories according to the results of the FSF/CTS tests. "Fibers, paints (automotive and household), glass and body fluid mixtures all have improper comparison rates exceeding 10%" as did "animal and human hair" analysis. In over 10% of the responses on the tests for identification of these areas, a positive conclusion was drawn that was, in fact, false and mistaken. The best group includes "finger and palm prints, metals, firearms, and footwear" as well as "bloodstains and drugs."

Although Peterson *et al*. consider fingerprints a reliable area of forensic testing, the rate of false identifications for the period they cover was 2 percent. The researchers estimate that fingerprints appear in roughly 7 percent of felony case filings each year. The Bureau of Justice Statistics reports that “about 924,700 adults were convicted of a felony in State courts in 2000”[36] and another 77,000 in U.S. district courts.[37] These numbers suggest that in the United States about a million felony cases are brought to trial and concluded each year, of which 70,000 involve fingerprint evidence. It can reasonably be inferred, then, that of these 70,000 cases at least 2 percent, which is 1,400, involve a false identification. In some cases the error will create a false exoneration. It seems probable, however, that most such errors will produce a false conviction. The identification of a latent print lifted from a crime scene with an inked print from a suspect or data bank is likely to produce a conviction of the person identified.

While it cannot be precisely known how accurate the estimate of 1,400 false convictions a year might be, results of the 1995 proficiency test provide some reason to suspect it is low. The abysmal results of the 1995 test were not included in the studies of Peterson *et al*. These more recent results created shock and disbelief in the fingerprint community. Over 30 percent of answer sheets submitted included at least one false identification, and “one in five participants would have provided damning evidence against the wrong person” if the test had been “actual casework.[38] Whether the rate of false identifications for fingerprints is closer to 2 percent or 20 percent, it is significantly higher than the zero rate sometimes claimed by fingerprint examiners.

Other disappointing results show that “[t]he first and only published research evaluating the accuracy of forensic dentists revealed an average of 64% false positives and an average of 22% false negatives.”[39] Michael Saks reports, “Three similar studies by the forensic odontology community were conducted but not published (because, I am told by Dr. Michael Bowers, those results were deemed unsuitable to be made public).”[40] As with forensic odontology, hair analysis is also unreliable. The traditional technique of examining hair under a microscope yields a false positive result 35 percent of the time when checked with a subsequent mitochondrial DNA test.[41]

The conclusion drawn by Jonakiat in his 1991 *Harvard Journal of Law and Technology* article seems valid today:

> *In sum, a review of the data revealed by proficiency studies indicates that lab performance is inadequate and unreliable. The most thorough of the tests, the LEAA study, showed abysmal performances, and all subsequent testing indicates that problems persist.*[42]

In 1997 the Justice Department’s Office of the Inspector General (OIG) issued a report highly critical of the FBI crime lab. The OIG’s investigation was stimulated by the allegations of a “whistleblower,” namely, Supervisory Special Agent Frederic Whitehurst, a Ph.D. scientist employed in the FBI lab. The OIG report found significant instances of testimonial errors, substandard analytical work, and deficient practices.[43] As noted previously, David Williams, an FBI investigator in the Explosives Unit, was found to have tailored his testimony to the most incriminating result in two trials. In the World Trade Center trial, Williams’s identification of urea nitrate as the explosive used in the crime “was based not on science but on speculation based on evidence linking the defendants to that explosive.”

Much the same thing happened in the Oklahoma Bombing case.

> *His categorical identification of the main charge as ANFO [ammonium nitrate fuel oil] was inappropriate based on the scientific evidence available to him. Here, Williams did not draw a valid scientific conclusion but rather speculated from the fact that one of the defendants purchased ANFO components. His estimate of the weight of the main charge was too specific, and again was based in part on the improper, non-scientific ground of what a defendant had allegedly purchased. In other respects as well, his work was flawed and lacked a scientific foundation. The errors he made were all tilted in such a way as to incriminate the defendants.*[44]

Concerning the Trade Center trial, the OIG report says, "Ultimately, Williams conceded during our investigation that he had no basis from the crime scene for determining the type of explosive used, acknowledging that based on the crime scene the main charge could have been anything."[45]

The Williams case is only one of several in which the OIG found problems ranging from substandard work to false testimony. The report cited issues of scientifically flawed testimony, inaccurate testimony, testimony beyond the examiner's expertise, improper preparation of laboratory reports, insufficient documentation of test results, scientifically flawed reports, inadequate record management and retention, failures by management, and a flawed staffing structure of the explosives unit.[46] The Williams case is particularly troubling. And yet, the report did not substantiate allegations "that laboratory examiners had committed perjury or fabricated evidence." Indeed, the OIG report specifically cautions against drawing pessimistic conclusions from the cases it studied. The OIG investigated only limited cases involving three units within the scientific analysis section (SAS), which itself constitutes part of the lab. "Our findings and conclusions regarding certain cases in those units," says the report, "should not be imputed to other cases within those units, nor to other units in the SAS or other sections of the Laboratory that we did not investigate."[47] It may be that the FBI crime lab has behaved in an exemplary manner in all other cases. But if those examined by the Justice Department are representative, the FBI crime lab has instead undermined justice with much substandard work.

Further evidence of the inadequacy of current forensic practice exists in the long list of forensic workers whose testimony has been proven false or inadequate. For almost 15 years, beginning in 1979, one forensic scientist "testified as an expert in dozens of rape and murder cases [in West Virginia and Texas] about tests he had never done and results he had never obtained." A review of his work in Texas "found rampant fraud and falsification. In one case, he had testified about blood evidence when no blood had been found; in other cases he reported performing tests his lab was incapable of doing."[48] Another forensic scientist "faked more than 100 autopsies on unexamined bodies, and falsified dozens of toxicology and blood reports. Dozens of other autopsies were botched. In one case he lost a head."[49] A third forensic scientist "claimed the ability to match a footprint on any surface to the person who made it. [She] appeared as an expert witness for over a decade in more than 20 criminal cases throughout North America before her claims were thoroughly debunked." In the 1990s, a fourth forensic scientist employed long-wave, ultraviolet light and yellow-lensed goggles to study wound patterns on a body. Unfortunately, he was the only one who could detect such patterns.[50] A 1975 investigation revealed that one FBI Special Agent had "a staggering record of perjury, incompetence and falsification." He gave testimony about tests that were never performed. He "lied repeatedly under oath about his credentials and his reports were persistently deceptive."[51]

The formal and anecdotal evidence available points to an ongoing crisis of forensic science.

In May of 2001, the *New York Times* reported on a forensic scientist who worked on over 3,000 cases from 1980 to 1993. In 2001, the FBI issued a "report that found she had misidentified evidence or given improper courtroom testimony in at least five of eight cases the agency reviewed."[52] A report by Dr. Edward Blake and criminalist Alan Keel of Forensic Science Associates called the work of one Chicago forensic scientist into question. In one case their report found that her "representation of her data . . . can be viewed only as scientific fraud."[53] As one researcher sums up, "Some forensic science expert witnesses are in a position where they can manufacture evidence merely by wishing it into existence, and evidence suggests that some of them have done precisely that."[54]

The extent of such egregious cases of misbehavior is unknown. But, as argued above, such cases should be compared to the canary in a mine shaft. Each horror story is a sign of pervasive problems in the forensic science system.

The formal and anecdotal evidence available points to an ongoing crisis of forensic science. The Innocence Project of Yeshiva University's Benjamin N. Cardozo Law School reports that

In over half of DNA exonerations, the misapplication of forensic disciplines—such as blood type testing, hair analysis, fingerprint analysis, bite mark analysis, and more—has played a role in convicting the innocent. In these cases, forensic scientists and prosecutors presented fraudulent, exaggerated, or otherwise tainted evidence to the judge or jury which led to the wrongful conviction.[55]

This crisis is rooted in the organization of forensic science.

Part 5

Proposals to Improve Police Forensics

The police crime lab is an autonomous authority with power. Many observers have recognized that the autonomy of crime labs can lead to substandard forensics. And yet the solution of checks and balances on the power of crime labs has been overlooked.

Some may argue that good lawyering is sufficient cure for bad forensics. This position, however, fails to take into account a basic scarcity consideration: High-quality counsel is not a free good. Without constraints on their time or energy, skilled and intelligent lawyers could learn enough about the limits of forensics to persuade judges and juries in those cases in which the forensic evidence presented by the prosecution was deficient; no innocents would be jailed due to forensic error. Skillful lawyering, however, is a scarce good. Most criminal defendants are indigent and must rely on public defenders, who generally lack adequate incentives and resources to perform well.

Even a scientifically well-informed defense lawyer may be ineffective. “You can't rely on your own cross-examination of the state's witnesses,” according to Kim Campbell, an assistant state’s attorney in Illinois. Commenting on a case in which a knowledgeable lawyer failed in his challenge of an unproved forensic technique, Campbell continued, “You have to have your own expert to say why this kind of science is unreliable. And there was nobody saying that at his trial.”[56] Presumably, the difficulty is that even a skilled lawyer wears no metaphorical white lab coat creating an aura of scientific authority. Uninformed and rational jurors and judges may rely on the scientific credentials of a forensic expert witness.

A. Existing Proposals and Their Limits

There are many ideas for improving police forensics. Some researchers call for regulation, as does the Forensic Justice Project. The Clinical Laboratory Improvement Act of 1988, which may have reduced medical errors, is sometimes held up as a regulatory model. Suggested additional regulations would require inspections, personnel standards, quality control, and external proficiency testing. But a full regulatory regime of that sort might be difficult or impossible to institute given that forensic labs are not private, profit-seeking firms.[57] At a minimum, in one researcher's view, forensic labs should be subject to mandatory proficiency testing. That would be a good start, but such testing does not engender incentives for error detection.

Other researchers call for several measures, including blind testing and evidence line-ups. These, too, are worthy proposals. Still others, including The Ryan Commission Report), call for forensic labs to be independent from law enforcement agencies.[58] The likelihood of independence reducing bias, however, is questioned in the Ryan report's minority opinion. "The reality is that no matter how 'independent' this separate state agency is, the bulk of its work will still be for police agencies and prosecutors"[59] If it is to be more than nominal independence, the bias-reduction potential of independence can be realized only by addressing additional factors, such as how forensic labors are divided and whether labs are subject to competitive pressure.

Researcher Michael Saks and his colleagues proposed a state-wide "Forensic Science Service," which would provide forensic science services to police, prosecutors, defense counsel, judges, and pro se defendants in criminal cases.[60] Such a measure would make available forensic science expertise to the prosecution and the defense on equal terms. Per this scheme, a "Commission on Forensic Science Services" would supervise the "Forensic Science Service." Although they do not say who should guard this guardian, the proposals of Saks *et al*. contain many valuable suggestions. But they fall well short of competitive self-regulation. Merely proposing that a Commission on Forensic Science Services should "strive" to staff laboratories under supervision with workers who are properly trained and committed to doing good science appears to lack a check on the powers of oversight and of command and control, and any clear incentive to ensure accuracy.

As far back as 1974, a researcher called for a constellation of reforms that hold some parallels to those proposed in this paper. Some significant differences exist, however. Thomson argues for: 1) consolidating of forensic facilities, 2) placing forensic labs under the supervision of the courts, 3) accreditation, 4) instituting a mandatory regime of proficiency testing, and 5) providing for open access for all parties in a criminal action.[61] Thomson's fifth proposal is similar to my call for forensic vouchers, even demanding the use of separate facilities by the antagonists in a criminal process. He seems to place less emphasis, however, on direct competition among labs.

All of the proposals discussed thus far contain useful ideas. But none, with the partial exception of Thompson's, adequately address the fact that forensic workers operate in a virtual monopoly position with respect to the evidence given to them to analyze. Competitive self-regulation would not, of course, magically cure all forensic ills. It would, however, induce significant improvements in the quality of forensic work by dividing and contesting services, thus establishing competition.

B. Competitive Self-regulation: *Rivalrous Redundancy*

Several competing forensic labs ought to be found in any jurisdiction. Subject to the constraints of feasibility, some evidence should be chosen at random for triplicate testing at different labs. The forensic worker need not know whether the particular evidence he is analyzing is being examined by another labs; he will be aware that sometimes another lab will be doing so.

Strategic redundancy gives each lab an incentive to find the truth and apply rigorous scientific standards. Further, ***statistical review*** should accompany strategic redundancy. For example, if a given lab produces an unusually large number of inconclusive findings, its procedures and practices should be examined.

That the principle of redundancy has not been extensively applied to police forensics is surprising. Patients get a second doctor's opinion when sick. Failsafe measures are built into power plants. Drivers keep a spare tire in the trunk. But forensic science has only adopted limited forms of redundancy, such as the verifications that may go on within a crime lab.

Strategic redundancy works for two reasons. In part, it takes advantage of the fact that the probability of multiple errors is less than the probability of one error. A numerical example illustrates the principle. Earlier we saw that the error rate in fingerprint analysis is probably at least 2%. Let us imagine we have three labs, each with the 2% error rate. If fingerprint evidence is sent to only one lab, there is a 2% chance of getting the wrong answer back. But if it is provided to three independent labs, and we accept the majority opinion as true, the laws of probability dictate only a 0.12% chance of getting the wrong answer. Redundant testing in all cases involving fingerprints would reduce the number of false convictions caused by erroneous fingerprint matches from 1,400 per year to 83 per year, thus eliminating 94% of those false convictions.

Multiple testing, however, is not always feasible. In addition to cost considerations, it may be impossible in individual cases because, for example, the DNA sample is too small to be divided. Fortunately the second reason establishing strategic redundancy's efficacy applies even when triplicate tests are undertaken only in a randomly chosen minority of cases. A forensic worker must wonder who else is examining the same evidence. The worker's reputation and job prospects will suffer if he or she is found to have provided a false or sloppy analysis. The prospect of such embarrassment or worse gives the worker an incentive to provide a sound, scientific, and objective evaluation of the evidence. Strategic redundancy works best if errors and biases are not correlated across labs. Indeed, if competing labs all share the same strong bias, then strategic redundancy may n actually *increase* the seeming legitimacy of what are, in fact, bogus results. It is necessary to establish incentives for the discovery of error. Without such incentives we have ***mere redundancy***. When such incentives are in place, however, we have ***rivalrous redundancy***. An example illustrates the point.

Imagine three competing forensic labs that are biased in favor of the police theory. Assume mere redundancy among these three. If a lab performs a test, it receives a money payment. If it supports the police theory, the lab receives a psychic benefit as well. Assume, finally, that the police theory is false in the case under review. In this scenario, each lab nevertheless has an incentive to support the police theory. A given lab in this situation may find excuses to construe the evidence in ways tending to incriminate the police suspect or even simply lie for the police. If the other labs exonerate the suspect, the given lab still has its money payment. But if the other labs also support the police theory, the given lab enjoys an additional psychic benefit. In the language of game theory, supporting the police theory is a dominant strategy.

To prevent this sort of implicit collusion, labs providing inaccurate results should not be paid for those results, and fines could also be imposed. Such a scheme establishes incentives for error discovery and elimination. Mere redundancy will not produce a truth-seeking system, but rivalrous redundancy will. Such an outcome from rivalrous redundancy is a particularly likely outcome under a regime of information hiding. Withholding data that might induce bias, such as whether blood being tested came from the victim or the suspect, would reduce the chance of bias and lower the probability that results will be skewed away from the truth.

Here opens a field of research. What institutional structures induce mere redundancy and which induce rivalrous redundancy? How are conflicting claims resolved when discrepancies are found? The general principle, however, seems straightforward. It ought to be possible to create monetary penalties for deficient laboratories and to thereby create a reasonable, real-world version of rivalrous redundancy. Recent experimental work supports the hypothesis that rivalrous redundancy will lower the error rate in forensic science. (See the discussion in the boxed text.)

An Experiment in Competitive Self-regulation

Together with Robert Kurzban, I have conducted an experiment using human subjects that supports the claim that competitive self-regulation may help reduce error rates in forensic science (Koppl and Kurzban 2006). We divided experimental participants into "Senders" and "Receivers." Senders represent forensics laboratories; Receivers represent the judge or jury. We showed the Senders a proxy for evidence—one of three shapes: triangle, square, or circle—and asked them to provide a report to be given to the Receivers. The Receivers guessed what the Sender(s) saw based on the report. In the one-Sender treatment, there was one Sender per Receiver. The Sender would mark this report form by checking off one of the three shapes. The Receiver to whom the form was given would then guess what the Sender saw based on that report. Receivers were paid $5.00 for correct guesses, $2.00 for incorrect guesses. Senders were paid $3.00 for inducing correct guesses. As a proxy for laboratory bias, they got a separate payment of either $1.00 or $5.00 (depending on experimental treatment) if the Receiver guessed the "supplementary shape." Senders were informed of the "correct shape," the "supplementary shape," and the value of supplementary shape. In the one-sender condition, if the supplementary shape was worth only $1.00, Senders had an incentive to issue an accurate report. If the supplementary shape was worth $5.00, Senders had an incentive to issue an inaccurate report. The three-Sender treatment was identical except that each Receiver was matched with three Senders, not just one. Crucially, of course, incentives changed in the three-Sender case as Senders could not know what other shapes Senders were checking off.

We found that fewer incorrect reposts were made in the three-Sender treatment. In the one-Sender treatment, motivated Senders delivered inaccurate reports 86% of the time. (We consider Senders "motivated" when the supplementary shape and the correct shape differed and the supplementary shape was worth $5.00.) In the Three-Sender treatment, however, motivated Senders sent inaccurate reports only 67% of the time. This is already progress. The really significant result, however, concerned Receiver guesses. When facing motivated Senders, Receivers guessed the wrong shape 75% of the time in the one-Sender treatment. But in the three-Sender condition, when facing one or more motivated Senders, Receivers guessed the wrong shape only 25% of the time.

The study can be downloaded from http://alpha.fdu.edu/~koppl/experiment.htm.

Josiah Sutton was wrongly convicted in Texas on DNA evidence. Sutton's case shows that scientific advances such as new DNA technology will not solve all the problems besetting forensic science. New techniques will not alter the wrong set of incentives and pressures. The problem and its solution are not a matter of lab science, but of social science

Instituting competitive self-regulation for forensic science would produce conditions similar to those that obtain in pure science: Research results that are subject to the discipline of review and reproduction. Subjecting forensic scientists to the same discipline would bring forensic science results more closely within the reliability level of scientists in other fields.

1. Evidence Control Officer and Information Hiding.

Implementing competitive self-regulation would require the creation, within each jurisdiction, of an Evidence Control Officer (ECO). Such a position would not be entirely novel. Currently, an Evidence Control Center exists at the FBI for internal purposes. Indeed, in most or all jurisdictions, an evidence control office exists, sometimes under a different title. But these positions do not serve the functions that this paper proposes to be served by a jurisdiction's ECO. Other researchers—although they do not propose competitive self-regulation—also advocate creating the position of "Evidence and Quality Control Officer." Such an Officer they explain:

> *[W]ould be responsible not only for coordinating work among examiners in different specialties, but also for being the sole contact point between the entity requesting the test [prosecution or defense] and the laboratory. She would also serve as the filter between each examiner and any information about the case, whether it originated from without or from within the lab. She would decide not only generally what kinds of tests were needed, but what information about the case was needed to perform those tests, and her primary duty would be to maintain appropriate masking between the examiners and all sources of domain-irrelevant information.*[62]

These researchers rightly emphasize the duty of the ECO to engage in information hiding.

In addition to the functions identified above, the ECO should use random-number generators to decide which lab is sent a given piece of evidence and when to provide the same evidence to more than one lab.

The ECO may seem to be in a position to commit the same sorts of conscious and unconscious abuses that many forensic workers have committed. Several considerations suggest, however, that it is easy to structure the position so that it entails a low incentive to cheat, high costs for being discovered doing so, and a high probability of being caught if cheating is attempted.

First, in the system this paper proposes, many of the functions of the ECO are relatively mechanical. If these functions are witnessed or reviewed publicly, then they are more likely to be properly carried out.

Second, it may be desirable to divide the ECO's labor. For example, the ECO might randomly assign one forensic lab to prepare the evidence for a case, but evidence preparation for a second lab might be randomly assigned by volunteers and part-time workers who work as scientists outside the criminal justice system. (Even highly educated scientists in other fields would, however, have to be specially trained in the tasks of evidence preparation.)

Third, the “masking” function of an ECO (information hiding) will be easier to maintain if he is independent of the forensic labs to which he sends evidence. If there is only one lab in the jurisdiction, it becomes more likely that independence will be lost. If there is a single lab, the ECO may acquire the psychological attitude of identification with it and be subject to the feeling that he is in a coalitional alliance with the police. He may convey this feeling, consciously or unconsciously, to the monopoly lab with which he deals, a problem much less likely to occur if there are competing labs in a jurisdiction. Note that forensic work may be sent to geographically distant labs and that a lab may serve several jurisdictions. In the face of competition among labs, the ECO has an incentive to adopt an above-the-fray attitude that helps maintain objectivity and discourages cheating. Moreover, if he should exhibit bias or share inappropriate information, the fact is more likely to be revealed if there are several labs observing the problem. The ECO should be separated by one step from the tests to be performed on evidence. Thus, if he wishes to cheat, he would have to coordinate and conspire with other actors to reach biased results. Conspiracy is costly, and because the conspiracy may collapse, it is also dangerous. The risk of detection becomes an *ex ante* cost.

Fourth, the ECO could be required to occasionally send bogus, bias-inducing samples to the labs serving its jurisdiction. The lab would be under an obligation to report improper evidence preparation or information sharing. Failure to do so would meet with sanctions. In this context, the ECO’s desire to improperly influence a lab would be deterred by fear of discovery. Heavy sanctions could be imposed on ECO’s caught in acts of malfeasance.

Strategic redundancy gives each lab an incentive to find the truth and apply rigorous scientific standards.

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2. Statistical Review

Statistical review is an essential corollary to strategic redundancy. The competing forensic labs serving a given jurisdiction should be subject to periodic statistical review consisting principally in counting the number of cases falling into various categories. In how many cases were a lab’s findings deficient when compared to the contradictory results of competing labs? How many cases led to conviction? How many to exoneration? In how many cases did a lab find the evidence to be inconclusive? And so on. If a lab is found to have an unusually high or low number of cases in any category, it should be investigated to determine whether the anomalous lab is the high or low achiever.

3. Division of Labor with Vouchers

Any criminal defendant ought to have a right of forensic counsel analogous and adjunct to the Sixth Amendment right to legal counsel. Because in the United States, forensic workers typically conceive of themselves as working for the police or prosecution this introduces bias. Combined with rules of discovery, this bias makes it difficult for defense attorneys to challenge the results of forensic tests. The consequence is that the sloppiest work may easily satisfy jurors, who cannot be expected to know about the difficulties of practical forensic science today. Guaranteeing forensic counsel for the defense would mitigate this problem. The task of interpreting forensic tests should be divided from the task of performing those tests. Just as indigent persons on trial are provided an attorney at the state's expense, so too should they be provided a forensic interpreter also by government funds. Some research argues that public defenders have incentives to go along with the police and prosecutors and thus too easily give up the fight. They propose a voucher system, which would give public defenders an incentive to act in the interests of their clients. Indigent defendants ought also be provided forensic vouchers. Saks *et al*. propose something similar with their Forensic Science Service, but their model does not produce rivalrous redundancy and thus does not does not empower the indigent defendant to choose among suppliers of forensic counsel; it is therefore likely to be less effective in removing incentives to biased and sloppy work.

Forensic evidence is largely excluded from the adversarial process, a profound, needless, and inappropriate compromise of one of the most fundamental principles of the common-law system. Dividing test from interpretation and providing separate forensic interpreters for both sides would conform forensic evidence analysis with the rest of the U.S. legal system that is predicated on the understanding that truth most often emerges in an adversarial process. Separating out the task of interpretation could also be combined with the creation of standardized reports such that every expert having an ordinary knowledge in the field would know precisely what testing procedures were followed how to interpret the results. Standardized reports would tend to reduce the unfortunate element of idiosyncrasy that still characterizes much forensic work.

One objection to a forensic voucher scheme is the concern that legislators might then reduce funding of defense attorneys. This result is unlikely, and if the proposals set forth in this paper were adopted, they would reduce the costs of police forensics; as is discussed later in this section, this reduction in turn would tend to increase the spending on defense lawyers. While legislators may be prone to reducing funding of defense attorneys to "get tough on crime," the proposals offered here would reduce this incentive by increasing the ability of the system to distinguish the guilty from the innocent. Indeed, poor forensics that lead to acquittals on technicalities may induce reduced funding to indigent defense while improved forensics would increase the cases decided on the merits.

4. Privatization

Finally, competing forensic labs should be private, profit-making enterprises. Privatization would probably provide cost saving in forensics, just as it has in other areas of the criminal justice system. For example, Oro Valley, Arizona, contracted out its police services in 1975 and achieved simultaneous reductions in cost and crime.[63]

There is by now a large literature on privatization, the general thrust of which is that privatization tends to have the most positive impact when there is competition. The private forensics industry is competitive.

The current situation is almost the reverse of a natural monopoly. At present, a forensics lab's scale of operation depends upon the size of the jurisdiction it serves. Under privatization, the same lab may serve many jurisdictions and thus enjoy economies of scale.

In addition, while publicly-owned and managed forensic labs are subject to many of the institutional and psychological pressures outlined in this paper, including the ease with which police departments can intervene in the labs' operations to influence outcomes, private enterprises may be better insulated from such pressures.

However, while private labs may be immune from the influence of local police departments seeking particular results, conversely the labs may be better open to national regulation. Currently most forensic labs, owned by local governments, are resistant to national regulation and the implementation of uniform protocols and best-practices across the country.

Government labs don't face the same incentive to produce good work that their private counterparts do. Private labs are subject to civil action for false or sloppy work. They can also be regulated and subject to administrative fines for substandard work. Such fines would be felt directly by a responsible party, namely the firm owner, who has a strong incentive to correct problems and is in a position to do so.

Competitive self-regulation will produce cost savings and better results if the competing labs are private, profit-making enterprises. Privatization creates a residual claimant who gains from cost reduction. Quality improvements are likely as well if the privatized enterprise is subject to competition. Three factors encourage improved quality in privatized enterprises. First, effective employee monitoring and the development of new technology can simultaneously lower costs and enhance quality. Second, private firms have a reputation to maintain—face a dearth of customers if competitive alternatives are available. Third, in a competitive market, if customers demand a high-quality product, the market will provide just that. And, the presence of forensic counsel for *both* defense and prosecution gives the authorities an incentive to demand high-quality forensic analysis. Private labs would engender price competition. Every year a given jurisdiction might sign a contract with several competing labs. The fees for each lab would be renegotiated annually. This price competition would, of course, tend to produce cost savings for taxpayers.

Privatization has at least one more advantage. In the current system, the police in a given jurisdiction may hold undue influence over the lab or labs in their jurisdiction. Privatization would tend to reduce or eliminate this inappropriate form of power. With privatization, some labs could serve several police jurisdictions, including some at long distances. This is not an entirely new phenomenon. The FBI serves many jurisdictions. [As the experience of the FBI lab shows, the ability of a lab to serve many jurisdictions can create its own problems, including the corruption of forensic science across multiple jurisdictions. Nonetheless, competition and the other recommendations in this report would mitigate or eliminate those dangers.]

Poorly designed “privatization” may replace a government bureaucracy with a profit-seeking monopoly. If, however, privatization of police forensics is combined with rivalrous redundancy, statistical review, the creation of an ECO who insulates the labs from outside pressure, and division of labor with vouchers, then it has considerable potential to raise standards and lower costs.

5. Competitive Self-Regulation

A system of competitive self-regulation would yield unbiased and careful work even from those forensic scientists who may be disposed toward bias and negligence. Competitive self-regulation would promote high-standard work via three effects. First, it would reduce bias. For example, the position of ECO would reduce presentation bias. Second, it would mitigate the ill effects of remaining biases. For example, rivalrous redundancy increases the chances that a false and biased analysis will be scrutinized and overturned. Finally, it would create checks and balances that would use countervailing biases to neutralize one another. For example, forensic counsel for the defense would counter one bias with another, thereby increasing the chance that all relevant forensic arguments will be presented to a judge or jury.

Competitive self-regulation is a plan for the institutional restructuring of forensic science. The plan would assist forensic scientists to undertake their work properly. Strategic and rivalrous redundancy, statistical review, the creation of an ECO, division of labor with vouchers, and privatization would all induce competition promoting excellence among forensic labs.

A system of competitive self-regulation would yield unbiased and careful work even from those forensic scientists who may be disposed toward bias and negligence.

C. What about Costs?

Although at first blush it might seem that redundant testing would be costly, competitive self-regulation would actually reduce the direct and indirect costs of forensics. Competitive self-regulation requires that only a fraction of the tests be repeated in independent labs. Thus, the volume of tests performed nationally might not be much greater than current levels. Many forensic laboratories already exist in the United States. Shipping costs are low. A political jurisdiction may easily rely on geographically distant labs. Indeed, the FBI lab in Washington, D.C. performs forensic work for local jurisdictions across the nation. Thus, competitive self-regulation would require little or no additional overhead. Improved forensics would produce fewer costly appeals. The modest increases in the average cost of an individual trial would be more than compensated by a reduction in the total number of proceedings.

Even if competitive self-regulation required one new test for every investigation in which forensic evidence is tested at all, it would add less than $300.00 to the costs incurred by the criminal justice system in each such investigation. This estimate is based on annual laboratory budgets and includes, therefore, the expected value of time spent in court as an expert witness.[64]

For the average worker, $300 is the money cost of 19.5 hours in jail.[65] Thus, even setting aside the reasons competitive self-regulation would reduce the costs of forensic testing and engaging pessimistic assumptions about how much extra testing would be required, the costs of competitive self-regulation are well below the benefits. In other words, even when we stack the deck against it, the case for competitive self-regulation is still very strong indeed.

The sum of $300 is a fraction of the costs for the cases that go to trial. Even a small improvement in the quality of forensic analysis would induce compensating reductions in the social cost of the further crimes of guilty persons not convicted and of the loss of social output from innocent persons wrongly convicted. Therefore it is fair to conclude that competitive self-regulation is cost effective. Other considerations strengthen this conjecture.

The use of fees will help to reduce the costs of forensics. Researchers Saks *et al*. propose that "fees [be] charged to parties requesting tests and examinations" and that the "schedule of fees shall apply equally to all parties requesting tests and examinations." Privatization would produce this result.[66] Currently, the marginal cost of a forensic test is often zero for the party requesting the test. The government has a third-party payer, the taxpayer. Thus, it is likely that needlessly wasteful tests are being conducted today. Saks *et al*. also favor a fee system, postulating, "Because the tests are not without cost to the parties, the requesters will be more thoughtful about the knowledge expected to be obtained from the costs associated with testing."[67] Thus, the overall result of competitive self-regulation might well be a reduction in the costs of forensic testing.

Further cost savings would be realized if the price competition discussed earlier is permitted. While each lab would charge the same fees to all parties, allowable fees would be determined each year by a competitive process.

Finally, there exists no adequate measure of the costs of forensic mistakes today. A forensic error can put the wrong person in prison. When that happens, we may have one innocent person removed from a productive role in society and a guilty person left free to commit additional crimes. Each failure of forensics therefore carries a high social cost. It may be that a very small increase in the reliability of police forensics will produce a very large decrease in the social cost of forensic mistakes. Given our ignorance regarding the current costs of forensic errors, it would be negligent to dismiss competitive self-regulation as "costly."

In addition to the social costs of false convictions and false exonerations, poor forensics can be expensive for a city, county, or state that must outsource its forensics and face civil action. DNA work in Harris County, Texas is being sent to private labs in the wake of Houston's crime-lab scandal. In the somewhat similar case in Cleveland involving Joseph Serowik, the city faced a $10 million lawsuit. The plaintiff settled for $1.6 million, but only as part of an agreement that created a "special master" with extensive powers and discretion to review questionable work in Cleveland's crime lab.

Part 6

Conclusion

Our knowledge of forensic techniques is running ahead of our knowledge of how to manage and organize forensic labs and workers. This knowledge gap is contributing to sloppy and biased forensics. Yet a broad set of principles would improve forensic practice if applied skillfully.

Competitive self-regulation combines rivalrous redundancy with statistical review, information hiding, a division of labor between analysis and interpretation with forensic vouchers for the accused, and privatization of forensic laboratories to eliminate the current incentives for labs to ally with police theory. Under competitive self-regulation, each jurisdiction would employ several competing forensic labs. Evidence would be divided and sent to one, two, or three separate labs. Chance would determine which labs and how many would receive evidence to analyze. This structure would discourage sloppy work.

The strategic redundancy described in this proposal is similar to the redundancy that ensures accuracy in other industries and areas of life: computer programmers use purposeful redundancies to reduce programming errors; power plants have failsafe systems; and drivers put a spare tire in the trunk. Redundancy is common in life. But forensic science—a lynchpin of the justice system—has a curious lack of the type of redundancies that would reduce catastrophic error. It is past time to study how to apply the salutary principle of redundancy to forensic science.

A large field of inquiry opens before us, the best general term for which might be “forensic science administration.” Sound principles of forensic science administration must be determined and applied. Some principles are well-established, for example evidence lineups and proficiency testing. This paper proposes an additional, new set of principles under the label “competitive self-regulation.” The field of forensic science administration is largely unexplored; hopefully, this paper will induce others to contribute to this new field of inquiry.

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[65] The Bureau of Labor Statistics reports that the "Average hourly and weekly earnings of production or nonsupervisory workers on private nonfarm payrolls" in February 2003 was $15.34. At this value of time, $300 is the money value of 19 and a half hours in jail and $569 is the money value of 37 hours in jail. The money value of one's time, of course, understates the cost of false imprisonment.

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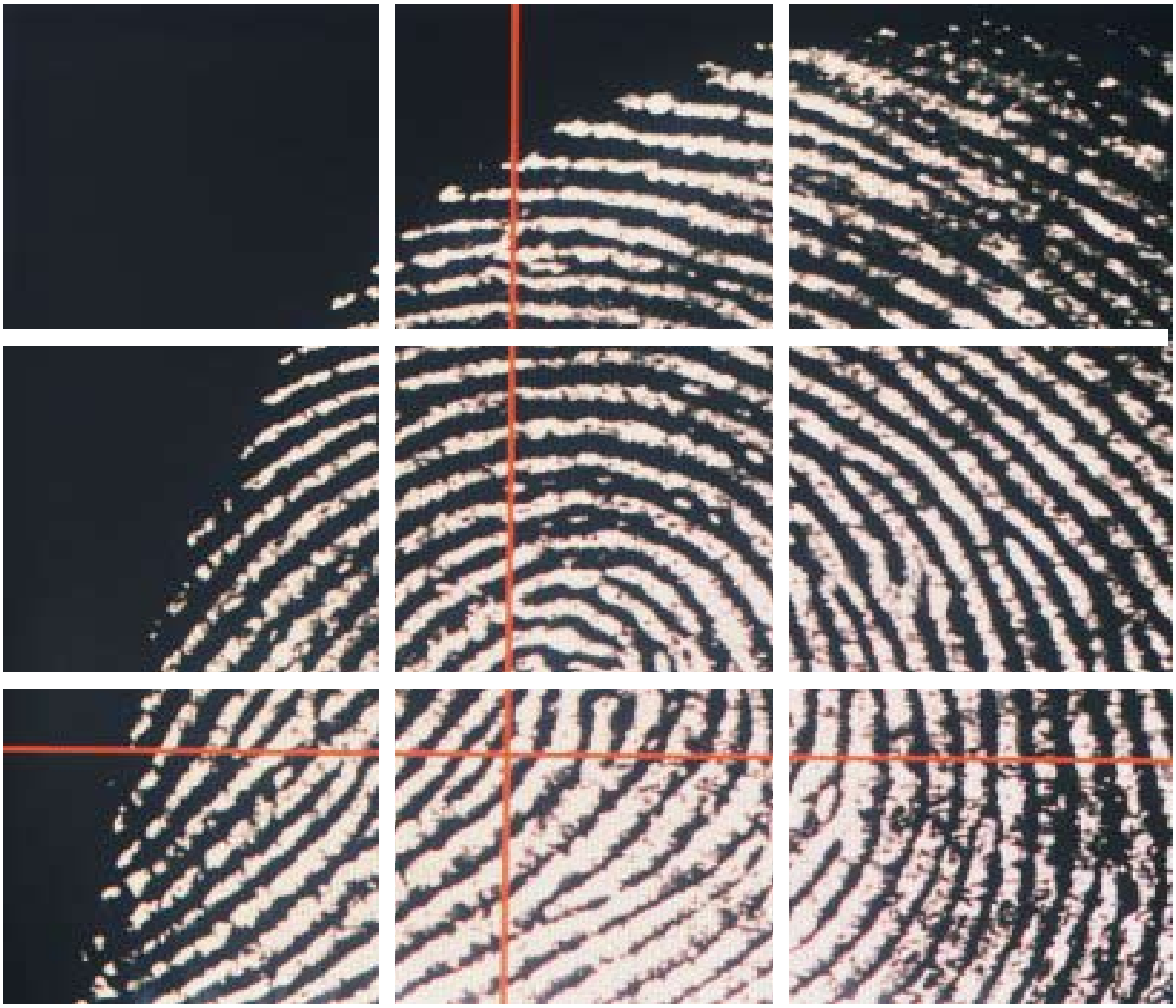

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