Speaking of Evidence:
An Empirical Study of the Reporting of Forensic Conclusions in US Criminal Trials

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I. Introduction

Over the past decade, forensic science has become an increasingly important part of the criminal justice system. New and improved technologies—most prominently, but hardly limited to, forensic DNA profiling—have increased the capability of forensic science to contribute to criminal investigations. During the same time, however, forensic science has increasingly been characterized as being in need of reform. Insiders and outsiders alike have called for urgent reforms of forensic science, so much so that some have gone so far as to suggest that forensic science is "under siege" (Pyrek, 2007).

The recently published National Academy of Science report on forensic science gives some notion of the nature and degree of the urgency for reform that has arisen around forensic science. It concluded that forensic science suffered from "serious deficiencies" (National Research Council, 2009a). It noted that "Forensic science facilities exhibit a wide variability in capacity, oversight, staffing, certification, and accreditation," that "Too often they have inadequate educational programs, and they typically lack mandatory and enforceable standards, founded on rigorous research and testing, certification requirements, and accreditation programs," and that they "lack strong ties to our research universities and national science assets" (National Research Council, 2009b: S-10)

The controversy over forensic science is wide ranging. And, "forensic science" itself is hardly a unitary concept. Rather, it encompasses a wide variety of disciplines and techniques (National Research Council, 2009b: S-5). Techniques range from the molecular biological assay of forensic DNA profiling to analysis of shoe prints. Practitioners range from Ph.D. scientists and physicians to police officers assigned to forensic duties. Disciplines range from questioned document examination to forensic entomology. This wide range of practice makes it difficult to generalize about "forensic science" or to generalize about what might be "wrong" with it (National Research Council, 2009b: S-4). However, an incomplete list of factors that have engendered the current impetus toward reform would surely include funding, scientific infrastructure, links to "mainstream" science, commitment to norms of scientific etiquette, validation, quality control and assurance, bias, institutional location, error, training, basic research, accreditation and certification, incompetent practitioners, and the influence of adversarialism.

Although generalization is difficult, it is nonetheless possible to speak in broad terms about some commonalities that persist across the nexus of practice called "forensic science." Perhaps chief among these stems from the word "forensic" itself: the notion that forensic science is science that "speaks" in court. Ultimately, all forensic practice, no matter how wide-ranging, has as its *telos* some sort of "speaking" about the results of its analysis in some sort of legal tribunal. This "speaking" may not always—and in fact usually does not—take the form of actual courtroom testimony; it may, instead, take the form of various reports, affidavits, depositions and so on. But even such "reports" carry with them they implicit "threat," as it were, of testimony: they convey the idea that the forensic practitioner would be prepared to make certain statements in courtroom testimony if litigation renders that necessary. And, indeed the recent *Melendez-Diaz* case in the United States Supreme Court has emphasized the fundamentally testimonial nature even of forensic written reports and instrumental outputs (*Melendez-diaz v. Massachusetts*, 2009).

The giving of forensic "reports"—the written documents or oral utterances in which forensic practitioners characterize the results of their analyses, usually for a lay audience of jurors or judges—was among the items singled out by the NAS report as in need of reform. The NAS noted that "Although some forensic science disciplines have proposed reporting vocabulary and scales, the use of the recommended language is not standard practice among forensic science practitioners." It noted that many forensic reports contain minimal information, "and they include no mention of methods or any discussion of measurement uncertainties." It recommended that a newly established agency "should establish standard terminology to be use in reporting on and testifying about the results of forensic science investigations . . . establish model laboratory reports for different forensic science disciplines and specify the minimum information that should be included" (National Research Council, 2009b: S--15-16).

The premise of this paper is that the NAS was correct to draw attention to forensic reporting. Moreover, it argues that scholarly debate about forensic science (including whatever modest contributions the author has made to that debate) has tended to neglect the crucial issue of reporting, focusing instead on validation, reliability, and error. Scholarly debate has focused on what we know about how often various forensic assays achieve correct results. To be sure, this is a fundamental issue, and much attention has been focused there because, in the case of many assays, we know so little (Thornton & Peterson, 2002). However, the reporting of forensic results is equally important. The reporting of forensic results *is* the contribution that the forensic analyst makes to the criminal trial. It is the moment at which the forensic analyzes characterizes the significance of the evidence for a lay fact-finder. It is, as at least two scholars have described it, "where the rubber meets the road" (Cole, 2007; Shelton, 2009).

Scholars have suggested that forensic testimony has been characterized by vagueness, lack of consistency, and what one scholar has called "overclaiming," exaggerating the probative value of the evidence (Friedman, 2003). They have emphasized the importance of controlling, not just the reliability of forensic techniques, but also the testimony that is given to the fact finder (Beecher-Monas,

1999; Berger, 2003; Black, 2003; Faigman, 2004; Gross & Mnookin, 2003; Imwinkelried, 2004; Nance, 2003).

II. Prior Studies

Despite the general lack of scholarly attention to forensic reports, two recent studies have made important contributions to this topic. These two studies also represent the two major methodological approaches to the topic, experimental psychology and archival analysis.

McQuiston-Surrett and Saks (2008, 2009) recently reported the results of a series of experiments measuring the impact on jurors of different forms of testimony concerning what they call "forensic identification science," which encompasses such techniques as latent prints, firearms and toolmarks, questioned documents, shoe and tire prints, bitemarks, and microscopic hair comparison. This study follows in a long tradition of law and psychology research measuring the impact on jurors of different modes of presentation of evidentiary information (e.g., Koehler, 2001; Nance & Morris, 2005; Schklar & Diamond, 1999; Wells, 1992).

The principal target of this study is forensic witnesses' notorious tendency to use the vague terms "match" or "consistent" to describe associations between forensic traces, rather then to convey the probative value of the evidence by either: (1) quantitatively characterizing the frequency of the associated characteristics in the relevant population (something that, for techniques other than forensic DNA profiling or serology, is typically not possible because data is lacking), or (2) subjectively estimating that frequency while candidly acknowledging the subjective nature of the estimate. Perhaps not surprisingly, they found that these vague and perhaps misleading forms of testimony proved very persuasive to mock jurors in reaching conclusions of guilt. McQuiston-Surrett and Saks suggest that forensic witnesses have, through long experience in the courtroom, settled upon rhetorically effective--though logically vague, meaningless, or exaggerated—testimonial forms, such as "match" and "similar in all characteristics."

One limitation of McQuiston-Surrett and Saks' approach is that the forms of testimony used in their experiments were contrived by the researchers, based presumably on their anecdotal impressions of how forensic identification testimony is typically given, juxtaposed with their theoretically informed notions of how it *ought* to be given. Moreover, they use a single set of testimonial forms to presumably apply to all forensic identification techniques without attempting to distinguish the different testimonial forms that might be used by different techniques.

These limitations are somewhat addressed by the second major study. Garrett and Neufeld (2009) used the data set of (relatively) undisputed wrongful convictions generated by post-conviction DNA testing to examine the nature of forensic testimony given in these cases. They performed a retrospective analyses of all cases from this data set in which forensic testimony was given and trial transcripts could be obtained. Of this set (n=120), they found that in 61% of them, what they called "improper" forensic testimony was given. "Improper" testimony

was testimony that either misstated empirical population data or exaggerated the probative value of the evidence.

An advantage of Garrett and Neufeld's approach is that it uses real testimony in real cases. One limitation, however, stems from their use of the post-conviction DNA cases data set. The unrepresentative nature of these cases is well understood.

The present study seeks to add to what we have learned from the above studies by addressing the limitations identified above. First, it seeks to empirically determine the actual state of practice of testimonial reporting of results for various forensic techniques. Second, it seeks to do so with data sets which, though not random, are not quite as selected as the post-conviction DNA exoneration cases.

III. Methods

It is somewhat astonishing to realize that, despite all the talk about forensic science, we do not have any empirical information about how forensic testimony is actually delivered in courtroom in the United States. Such information might not be necessary if standardized manuals existed which dictated how forensic conclusions should be reported, which, arguably, is what the NAS report calls for. But, such manuals do not exist. Moreover, as will be shown below, even in those cases in which centralized, standard-setting bodies have set guidelines for reporting, they are often inconsistent with actual practice as empirically measured. As we will see below, we will be able to derive some information about the reporting of results from existing procedural manuals. But, of course, it is necessary to test whether the dictates of these manuals are borne out in empirical reality.

The best way to get at the empirical reality of forensic testimony is to use trial transcripts. However, trial transcripts are not systemically, retained, archived or indexed. Appellate case reports are a far more accessible data source, but case reports only rarely offer direct quotations of the testimony of interest. Far more often, appellate case reports contain appellate judges' paraphrases of what was said at trial, if that. Moreover, as has been well documented, appellate case reports do not offer a representative sample of trials. Acquittals do not generate appellate case reports, and even those convictions that do generate reports may be selected for in various ways.

Thus, trial transcripts are a preferable data source for the questions addressed in this study, but data collection posed challenges. The first approach I used was to compile those transcripts concerning latent print evidence that I had already collected through my scholarly research and consulting work and that had been mailed to me directly by convicted prison inmates concerned about the use of latent print evidence in their trials. This yielded a total of 15 transcripts. I complemented these by directly soliciting trial transcripts involving the presentation of latent print evidence on listservs used by criminal defenders and by directly emailing attorneys of my acquaintance who I knew took an interest in forensic issues. An additional 17 transcripts were obtained in this manner. Two more transcripts publicly available through the CourtTV web site were added, yielding a total of 34 transcripts, which I will label here Data Set A. These transcripts

were produced between 1986 and 2006, with a mean year of 2000, in 12 state courts, U.S. federal court, and, in the case of one transcript, a foreign jurisdiction (Western Australia). Obviously, Data Set A is a nonrepresentative, opportunistic sample of criminal trials involving latent print evidence. However, as I argued in more detail elsewhere, there is no reason to believe that the testimony presented in these data set was in any sense substandard compared to latent print testimony routinely being given in U.S. courts during this period (Cole, 2007).

Consistent with the purpose of the study, in each transcript I sought to identify what I will call here the "conclusory moment," the moment when the expert witness tells the fact finder the meaning or probative value of the forensic evidence. Theoretically, such moments might include such things as stating that the evidence "matched" the defendant or "was consistent with the defendant" (in some cases followed by a subjectively or objectively generated estimate of the rarity of those attributes that were found consistent in some specified population); that the defendant "could not be excluded" as the source of the evidence; or (in a Bayesian framework) the relative likelihood of seeing the evidence under the competing hypotheses of guilt and innocence. Once the conclusory moments were identified, they were inductively coded. Based on an initial reading of the transcripts, I sought to derive categories that fit the testimony. These categories were then refined through repeated readings. The results of Data Set A were reported in Cole 2007. Three categories of testimony were sufficient to encompass all 34 conclusory moments.

For the present study, I applied the above methods to two additional data sets. Data Set B consisted of a collection of trial transcripts from all California capital trials between 1996 and 2000. While this data set is obviously limited in several ways—to a single jurisdiction and single category of crimes—data collection was also in some sense less haphazard in that we were able to access the complete set of capital trials during this period. These transcripts were keyword searched for the word "fingerprint," a rather imprecise method which yielded 235 cases. However, there were numerous "hits" for transcripts in which a conclusion about latent print evidence was *not* offered. Through a painstaking process, we were able to cull this set of cases down to 43 trials in which a testimonial conclusion about a latent print was offered.

While the legal reference services Westlaw and Lexis provide excellent full-text searchability for published appellate case reports, they have historically offered almost no access to trial transcripts. Slowly, this is beginning to change (Cole *et al.*, 2007). New Westlaw products like "Expert Witness Docs" and "Trial Transcripts" contain some trial transcripts. The record of transcripts contained in these databases appear to be unrepresentative and haphazardly collected. Interviews with Westlaw representatives, as part of a separate project, did not yield evidence of any sampling method behind the collection of transcripts that are added to these databases. Despite these limitations, however, these databases do offer researchers indexed searchable sets of U.S. trial transcripts that may be useful as long as the limitations associated with the haphazard, nonrandom, unrepresentative nature of their collection are kept firmly in mind.

Data Set C was generated by searching Expert Witness Docs. Westlaw offers the ability to limit searches to particular types of experts, including many of those who are the subject of the present study: such as latent print examiners, bite mark examiners, firearms and toolmark examiners, forensic documents examiners. So, for example, the latent prints subset of Data Set C was generated by searching the Expert Witness Docs database, specifying "criminal cases," "forensics," "finger prints," and "latent examiner" on July 9, 2008. This yielded a total of 127 documents. Of these, only 18 yielded testimonial conclusions about the source of a latent print. Some of the excluded documents contained testimony in which "fingerprints" were mentioned in comparison to some other forensic technique (e.g., "a bite mark is like a fingerprint"); some used "fingerprint" as a metaphor (e.g., a "chemical fingerprint" in a petroleum sample); and some involved the identification of inked "ten-prints," rather than latent prints.

The methods used for latent prints were used to generate samples of trial transcripts for bite marks, firearms and toolmarks, forensic DNA profiling, and forensic document examination. Because the author does not have a special interest in techniques other than latent prints and therefore a personal collection of transcripts and contacts with attorneys interested in that type of evidence for those areas, only data sets B and C were utilized for techniques other than latent prints.

IV. Results

A. Latent Prints

There is no single body that has authority over the reporting of conclusion for latent print analysis. The body that has probably made the clearest effort to regulate conclusions in the Scientific Working Group for Friction Ridge Analysis Study & Technology (SWGFAST), which has produced a document entitled "Standards for Conclusions" (SWGFAST, 2003). SWGFAST is a group convened by the Federal Bureau of Investigation and composed of a membership of prominent latent print examiners. It has no formal authority over any laboratory or law enforcement agency, but it does seek to set standards for best practices in the industry. The Standards for Conclusions limits latent print examiners to only three conclusions: individualization, inconclusive, and exclusion. For purposes of this study, the only relevant conclusion is the first. "Individualization" is defined as "The determination of an examiner that there is sufficient quality and quantity of detail in agreement to conclude that two friction ridge impressions originated from the same source" (SWGFAST, 2009). The term is also widely discussed as an appropriate conclusion in the latent print literature (e.g., Ashbaugh, 1999; but see Champod *et al.*, 2004)

The leading professional organization for latent print examiners, the International Association for Identification (IAI), does not have any articulation of how latent print examiners should report their conclusions. However, in 1979 the IAI passed a resolution banning what it called "probable identifications"—that is, any report that included an individual as the potential source of a latent mark with a degree of probability smaller than 1 (International Association for Identification,

1979, 1980). Later, an international symposium on latent print analysis issued an expression of support, known as the Neu'rim Declaration, for this policy (Israel National Police, 1995). As many have now noted, this approach to reporting conclusions defies probabilistic reasoning (e.g., Champod & Evett, 2001; Cole, 2006; Mnookin, 2008; National Research Council, 2009b; Saks & Faigman, 2008; Saks & Koehler, 2008), but it should be noted that the apparent noble intent of the policy was to compel analysts to be conservative about reporting conclusion of "individualization" (Champod, 1995; Cole, 1999).

Another potential source of information about the reporting of conclusions may be found in the Standard Operating Procedures (SOPs) of various laboratories that perform latent print analysis. Although many of these are silent on the issue of reporting of conclusions—again illustrating the general neglect of this crucial issue—some do address it. For example, the New Hampshire manual specifies that inculpatory conclusions be reported as follows: "The latent impression developed on exhibit ____ has been identified as the fingerprint impression of _____" (New Hampshire State Police Forensic Laboratory, 2005). Likewise, circa 1990 the Los Angeles Police Department's Latent Print Section used a preprinted "Forensic Print Comparison Report" that was worded as follows: "After examination of this evidence the latent prints obtained from _____ and the _____ of _____ were made by one and the same person."

In sum, it would be fair to say that, according to the literature and standards promulgated by the latent print profession, inculpatory results are supposed to be reported as "individualizations" and that "individualizations" may be understood as definite or absolute conclusions about the origin of a particular mark that stand outside any notion of probability (however odd that may seem to those with scientific training).

As previously reported (Cole, 2007), the conclusory moments in Data Set A could most parsimoniously be accounted for by using three categories of testimony, which I labeled (1) "process statements," (2) "attribution statements," and (3) "identity statements." Of these, (1) and (2) were almost equally prevalent, being present in around half the cases, while (3) was rather rare. (Since it was not unusual for more than one of these types of statements to be made by a single witness in a single case, totals in these analyses sum to more than 100%). And yet, 10% of the cases could only be accounted for with this third category.

The analysis of Data Sets B and C presented here shows a similar pattern (Table 1). Again, the three originally identified categories are sufficient to account for all observations. Although there are fairly wide fluctuations between the data sets, perhaps due to relatively small sample sizes or substantive differences between the samples, the relative proportions of each type are relatively consistent, with types (1) and (2) each accounting for around half the cases and type (3) accounting for only around 10-20%.

Process statements were those in which the witness merely states the outcome of some process, rather than, say, stating the likelihood that the defendant is the source of the evidentiary sample. Typically, the witness might state that the

latent print "was identified to" the defendant or "matched" the defendant. An example of a statement that I coded as a process statement[1] is:

Q. And did you have a chance on that day to compare the latent print, which is exhibit 310, which is Merced PD sixteen of twenty, and the in[ked] card of Albert Ruiz which has been marked as 192?
A. Yes.
Q. And what does your comparison show?
A. My comparison showed one latent impression of the two appearing on the item, which is People's exhibit 310 was positively identified as being made by the left ring finger of People's exhibit number 192 bearing the name Albert Ruiz.

The key here is that the witness does not actually make any statement about the origin of the latent print but merely describes the outcome of a process: the latent "was positively identified" as that of the defendant.

Attribution statements were those in which the witness flatly stated that the defendant was the source of the evidence. Typically, the witness would say that the defendant "made" the print. An example of a statement I coded as an attribution statement is:

Q Did you make a comparison from people's 16, the prints of Dewayne Carey, to people's 18?
A Yes, I did.
Q And what were your results?
A The comparison of people's 16 to people's 18 is my opinion that they were made by one and the same person, and it is in fact Dewayne Carey's left thumb.

Identity statements were those in which the witness made an assertion of identicality between the latent print and the known print. Typically, the witness stated that the latent print and the known print were "one and the same" or "identical." An example of a statement that I coded as an identity statement is:

Q. Okay. And did you come to any conclusion about them?
A. Yes.
Q. And what was that conclusion?
A. I identified one latent impression on People's Exhibit 88H, as being the same as the right thumb of David Zaragoza.

1. Analysis

What might we conclude from this empirical analysis of the reporting of conclusions that is actually occurring "on the ground" in U.S. courtroom? Perhaps our first conclusion should be that the NAS's sentiments about the need for

[1] Because (Cole, 2007) used examples from Data Set A, in this paper I use examples from Data Set B.

standardized reporting are justified. Although reports seem to be limited to three basic types, the wording is quite inconsistent across this sample of trials. Moreover, the crucial assertations of the reports are inconsistent, falling into three distinct categories that are largely, though not entirely, mutually exclusive. It would appear that jurors charged with determining the guilt or innocence of a criminal defendant partially incriminated by latent print evidence might hear any of three quite different statements from the government's expert witness. Which of these statements the jurors hear does not appear to have anything to with the nature of the evidence but merely with the local practices and predilections of either the laboratory or the individual practitioner. This is somewhat analogous to the now well known findings of stark regional variations in medical treatments for identical symptoms (Timmermans & Kolker, 2004: 188).

Next we should perhaps observe the curious fact that the closet thing to an officially sanctioned reporting terminology—"individualization"—is conspicuously absent from the empirically observed reality. Although the term "individualization" was used once in Data Set B in the witness's background discussion of latent print analysis (*People v. Daveggio and Michaud* 2002), it was not used in any of the conclusory moments in *any* of the three data sets. To be sure, "individualization" has been extensively discussed by latent print examiners in pretrial admissibility hearings about the reliability of latent print evidence in general (e.g., *State v. Columbus*, 2006). But what are we to make of the fact that what SWGFAST lists as the *only* permissible is not used at all in actual practice?

One possible explanation is that "individualization," as discussed by groups like SWGFAST and by the textbooks and treatises in the field is an "inward facing" concept meant for discussion with the profession but is considered too technical for consumption by a lay audience. In this view, perhaps the latent print examiner harbors a notion of "individualization," but testifies in vernacular terms to process, attribution, or identity statements. But this interpretation seems quite inconsistent with the spirit of, say for example, the SWGFAST Standards for Conclusions document which makes no mention of such a distinction between inward and outward facing statements. The other possible explanation, of course, is that local practice appears to be largely immune to attempts to regulate and control the reporting of conclusions by national bodies like SWGFAST.

Finally, it is necessary to comment on the three statement types themselves. None of them could be said to fulfill the ostensible purpose of forensic expert testimony, to transparently convey the probative value of the evidence to the fact finder. Process statements merely tell the jury the outcome of a process, but the jury is given no information about the reliability of that process itself. What does it mean to "match" or "identify" a latent print to individual? How likely is such an outcome given the competing hypotheses of innocence and guilt? This information is not provided to the jury.

Attribution statements, meanwhile, may be viewed as exercises in overclaiming. A latent print analyst confining their conclusions to their analytic observations has no business rendering conclusions about whether or not the defendant "made" the latent print; the proper domain of their testimony is limited to their observations about consistencies between the prints in evidence (Biedermann

et al., 2008). To put it in Bayesian terms, such statements make unwarranted assumptions about the prior odds. As I have noted elsewhere (Cole, 2007), such statements appear responsive to Wells' (1992) observation that jurors appear to desire "bidirectionality" in expert witnesses' statements—that is, they feel more comfortable when witnesses offer a conclusion about the ultimate issue, rather than merely express the probative value of the evidence.

Identity statements, meanwhile, are on their face false. It is a tenet of forensic science that different impressions, even of the same object, are, in fact, never "identical" (or "one and the same"). Of course, what the witnesses presumably mean to convey when they make such utterances are attribution statements—that the defendant is the source of the evidence—but, even so, identity statements exhibit a surprisingly lack of care about the words that are used in reporting forensic conclusions.

In sum, these results suggest that the empirical reality of the reporting of latent print conclusions "on the ground" is (1) inconsistent; (2) inconsistent with the expressed preferences of national and international standard-setting bodies; and (3) such statements either exaggerate or do not clearly state the probative value of the evidence.

. . . [Results for other forensic techniques (bitemarks, toolmarks, handwriting, DNA, comparative bullet lead analysis) to follow]

Table 1. Latent Prints.

Data Set	**N**	**Conclusion types**						**Addenda**			
		Process	%	Attribution	%	Identity	%	Bolstering	%	Quantification	%
A	31	17	0.55	13	0.42	3	0.10	7	0.23	4	0.13
B	43	20	0.47	26	0.60	7	0.16	8	0.19	2	0.05
C	18	13	0.72	6	0.33	4	0.22	2	0.11	0	0.00
Total	92	50	0.54	45	0.49	14	0.15	17	0.18	6	0.07

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