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MEETING THE CHALLENGES OF THE *DAUBERT* TRILOGY: REFINING AND REDEFINING THE RELIABILITY OF FORENSIC EVIDENCE

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I. INTRODUCTION

Daubert[1] and its progeny, *General Electric Co. v. Joiner*[2] and *Kumho Tire Co. v. Carmichael*,[3] established new guidelines and procedures for determining the evidentiary reliability of expert testimony. Following the *Daubert* trilogy, the admissibility of expert testimony is presumably based not only on an analysis of the evidence's legal merits and *Frye*'s general acceptance standard,[4] but also on the judicial analysis of the qualifications of the expert, the methods by which the expert arrives at his or her conclusions, and even the conclusions themselves.[5]

Judges' interpretations of their gatekeeping responsibilities under the *Daubert* trilogy have imposed more objective, stringent requirements (relevancy, legal sufficiency, and reliability) for the admissibility of some kinds of evidence which for

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1. *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 580 (1992).
2. 522 U.S. 136 (1997).
3. 526 U.S. 137 (1999).
4. *Frye v. U.S.*, 293 F. 1013 (D.C. Cir. 1923).
5. *See* Margaret Berger, *The Supreme Court's Trilogy on the Admissibility of Expert Testimony*, in *Reference Manual on Scientific Evidence* 11 (2d ed., Fed. Jud. Ctr. 2000); Michael H. Gottesman, *From* Barefoot *to* Daubert *to* Joiner*: Triple Play or Double Error?* 40 Ariz. L. Rev. 753 (1998); Joseph Sanders et al., *Legal Perceptions of Science and Expert Knowledge*, 8 Psychol. Pub. Policy & L. 139 (2002).

seventy years had been considered admissible under the *Frye* decision's general acceptance standard, while other kinds of evidence have remained relatively unaffected by the *Daubert* trilogy.[6] Confronted with challenges to the admissibility of evidence from their various fields, forensic practitioners have responded to the questions about the reliability of their testimony by seeking ways to both improve their disciplines and demonstrate to judges, attorneys, academicians, and fellow experts that their underlying assumptions, methods, and conclusions meet the requirements of the *Daubert* trilogy.

This discourse among practitioners, judges, attorneys, law professors, and evidence scholars about how the admissibility of expert testimony from the forensic fields should be determined illustrates an issue relevant to all expert testimony. Gary Edmond wrote

> [b]ecause the various sciences maintain different approaches, theories, criteria, canons of practice, metaphysics, status, levels of relevance, levels of abstraction and so on, it would be highly naive to suggest that we could expect some basic or universal criteria which could be applied consistently to determine "reliability."[7]

Experts, attorneys, and judges use normative images of science to explain and legitimate decisions about relevance, sufficiency, and admissibility, although "science" itself may be discredited as just another social activity.[8] Thus, information heard by triers of fact does not directly represent nature. It contains a social component consisting of human agency, institutions and their norms and values, and the processes of science. Debates about the admissibility of many forms of expert testimony following *Daubert* and its progeny illustrate this social component of scientific knowledge. The movement of expert testimony from the status of "proffer" to that of "admissible evidence" is a social process in which experts, attorneys, and judges all participate. It is a negotiated movement from "science," which is itself a social construction,[9] to "legal science,"[10] which is mediated by the rhetoric and discourse of attorneys, judges, and academicians.

This paper presents a view of changes in the production and presentation of expert testimony in forensic document examination and latent fingerprint examination, two major areas of forensic practice. Part II presents a brief summary of findings from an empirical content analysis of published judicial decisions concerning cases in which forensic document and latent fingerprint expert testimony were challenged following the 1993 *Daubert* decision. The purpose of this study of case law was to provide a context for the subsequent sections by empirically examining patterns of cases and the variety of factors that judges discuss when describing the reasons for their admissibility decisions. Part III presents a discussion of the impact of *Daubert* on the field of forensic document examination from the point of view of two experts, and the steps taken by forensic document examiners to meet the requirements of the *Daubert* trilogy. Part IV presents a discussion of the impact of *Daubert* on the field of latent fingerprint examination and the

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6. Mara L. Merlino et al., *Judicial Gatekeeping and the Social Construction of the Admissibility of Expert Testimony*, ___ Behavioral Sci. & L. ___ (forthcoming 2008).

7. Gary Edmond, *Judicial Representations of Scientific Evidence*, 63 Modern L. Rev. 216, 251 (2000).

8. *See generally* David S. Caudill, *Law and Science: An Essay on Links and Socio-Natural Hybrids*, 51 Syracuse L. Rev. 841 (2001).

9. *See generally* Sheila Jasanoff, *What Judges Should Know about the Sociology of Science*, 77 Judicature 77 (1993).

10. *See* Caudill, *supra* n. 8, at 842.

steps taken by latent fingerprint examiners in response to the *Daubert* trilogy, again from the perspective of two experts. Part V examines the empirical data and the discussion by forensic professionals in the context of the sociology of science, and discusses how the tenets of this sociological perspective are demonstrated in the discourse surrounding the social construction of evidentiary reliability and the admissibility of forensic expert testimony.

II. CONTENT ANALYSIS OF CASE LAW

We identified a total of 65 cases with 76 codeable proffers in which the admissibility of forensic document examination (30 cases with 37 codeable proffers) or latent print examination (35 cases with 39 codeable proffers) was challenged.[11] Eight of these cases (5 forensic document and 3 latent print) are civil, and 68 (32 questioned document and 36 latent print) are criminal.

Of the 37 challenges to proffers of forensic document examination expert testimony in this sample, the greatest number (n = 10) have been in the Sixth Circuit. Seven have occurred in the Ninth Circuit, five have occurred in the Eleventh Circuit, three have occurred in both the Second and Fourth Circuits, two have occurred in both the First and Third Circuits, and one challenge each has occurred in the Fifth, Seventh, and Tenth Circuits.

Of the 39 challenges to proffers of latent print examination testimony in this sample, eight have been made in both the Third and the Seventh Circuit. Five challenges have occurred in both the Fourth and Fifth Circuit, four have occurred in the Sixth Circuit, two have occurred in the First, Second, Ninth, and Eleventh Circuits, and one has occurred in the Tenth Circuit. Neither forensic document examination evidence nor latent print evidence have been challenged in the Eighth Circuit.

Twenty-five of the 37 proffers of forensic document examiner testimony in this sample (67.6%) were held to be admissible by the judges. Of these 25 proffers, three were admissible with restrictions. Of the 11 excluded proffers of forensic document examiner testimony, five were excluded in states which currently have adopted either the *Daubert* trilogy in its entirety, or *Daubert* alone. The remaining six proffers were excluded in *Frye* states.

Thirty-four of the 39 proffers of latent print examiner testimony (87.2%) were held to be admissible. Of these 34 proffers, two were admissible with restrictions. Of the five proffers of latent print examiner testimony that were excluded, two were excluded in states which currently have adopted either the *Daubert* trilogy in its entirety, or *Daubert* alone. One was excluded in a non-*Frye* state that rejects *Daubert,* and two were excluded in *Frye* states.

Of the 37 instances of forensic document examination testimony, 27 proffers were

11. The cases used in these analyses are a subset of the total number of cases published on Lexis in which the admissibility of expert testimony about forensic document examination or latent print examination was challenged. Not all cases published on Lexis were considered codeable. We also recognize these cases do not represent the entire population of codeable published cases, as neither Lexis nor Westlaw publishes all cases in these areas. A full statistical appendix is available by request from Dr. Merlino, which details selection criteria for codeable cases, key measures, and research methodology.

made by the prosecution and ten were made by the defense. Six of the 27 proffers by the prosecution were excluded, and six of the ten proffers made by the defense were excluded. Of the 39 instances of latent print examination testimony, 34 proffers were made by the prosecution and five were made by the defense. Three of the prosecution proffers were excluded and two of the defense proffers were excluded.

In the four-year period between the *Daubert* and *Joiner* decisions, seven proffers of forensic document examination testimony and one proffer of latent print examination testimony were challenged. Of these eight challenges, two resulted in the exclusion of forensic document examination testimony. In the two-year period between *Joiner* and *Kumho,* six more proffers of forensic document examination testimony were challenged, two of which were successful. The majority of challenges to proffers of both forensic document examination (n = 24) and latent print examination testimony (n = 38) have come following the *Kumho* decision. Of these proffers, nine of the 24 challenges to the admissibility of forensic document examination testimony and four of the challenges to latent print examination testimony were successful.

We divided forensic document examination proffers into two groups according to whether the case was decided before or after the *Kumho* decision, and conducted a series of analyses to determine whether there were any differences in judges' discussions of admissibility in terms of various rules of evidence. No significant differences were found in this sample in the number of mentions pre- and post-*Kumho* of the evidence's relevance, whether the evidence was more probative than prejudicial, whether the evidence was repetitive or a waste of time, whether the method or principle upon which the evidence was based was reliably applied to the facts of the case, the qualifications of the witness, or general acceptance. However, significant differences were found pre- and post-*Kumho* in the number of mentions of the reliability of the basis of the testimony, the reliability of the principle or method upon which the evidence was based, falsifiability, error rate, and peer review and publication.[12] No pre and post-*Kumho* comparisons of latent print evidence could be performed because only one latent print proffer was challenged pre-*Kumho.*

Judges in this sample mentioned expert qualifications unfavorably in nine of the twelve proffers in which the testimony of forensic document examiners was excluded. In three of the nine proffers judges negatively evaluated the expert's training outside academia. In two proffers, the expert's education was negatively evaluated, and in two the expert's skill or subject matter knowledge was negatively evaluated. Other negatively evaluated factors were the expert's experience (n = 1), publication record (n = 1), and reputation (n = 1).

Eighteen unfavorable mentions of forensic document examination evidence characteristics were made by judges. Most frequently mentioned were the lack of general acceptance (n = 3) and peer review and publication (n = 3). Judges made two

12. These analyses were conducted using independent-group *t*-tests with alpha = .05. Corrections for unequal variance were used. Statistically significant results were as follows: Reliability of the basis of the testimony, t (23) = -2.145, p = .043; Reliability of method or principle upon which evidence is based, t (23) = -3.715, p = .001; Falsifiability, t (23) = -2.769, p = .011; Error rate, t (23) = -2.460, p = .022; Peer review and publication, t (23) = -3.077, p = .005.

unfavorable mentions each of the known or potential rate of error, the existence of maintenance of standards controlling the technique's operation, and the facts/data/studies underlying the testimony. Other factors unfavorably mentioned were falsifiability (n = 1), control or consideration of possible confounds or alternative explanations (n = 1), the use of findings or theories consistent with others (n = 1), the use of facts or data reasonably relied on by others (n = 1), the statistical significance of the finding (n = 1), and the purpose for which the research was conducted (n = 1).

The only unfavorable mention of expert qualifications in the five excluded latent print proffers was one mention of the expert's skill or subject matter knowledge. Judges in this sample mentioned only eight unfavorable characteristics of latent print examination evidence. Most frequently mentioned were falsifiability (n = 2) and general acceptance (n = 2). Also mentioned were the existence of maintenance of standards controlling the technique's operation (n = 1), peer review and publication (n = 1), reliance on verifiable facts or data (n = 1), and the clarity and coherence of the expert's explanation (n = 1).

Bivariate correlational analyses revealed significant relationships between the number of evidence characteristics mentioned by judges and the length of time post-*Daubert* that the decision was handed down. The number of evidence characteristics judges discussed in forensic document examination proffers increased as the length of time post-*Daubert* increased (a significant positive correlation). Conversely, as the length of time post-*Daubert* increased, the number of evidence characteristics discussed in latent print examination proffers actually decreased (a significant negative correlation).[13] No statistically significant relationships were found in either type of evidence between the number of expert characteristics discussed and the length of time post-*Daubert.*

The data available in this sample suggest that judges differentially focus on characteristics of the experts and the evidence depending on the type of case. Judges in civil cases who discussed forensic document evidence discussed a greater number of both expert characteristics and evidence characteristics than judges in criminal cases. Judges in criminal cases who discussed latent print evidence discussed a greater number of evidence characteristics than judges in civil cases, but there was no difference between civil and criminal cases in the number of expert characteristics discussed.[14]

The descriptive information provided in the sections below by forensic document and latent print examiners provides a richly detailed account of the activities of these two

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13. These analyses were conducted using the total number of mentions of different evidence characteristics in both the admissible and inadmissible proffers. The length of time post-*Daubert* was measured by entering the decision date in an YYYY/MM format, e.g., 200712 is a higher value than 199307. The bivariate correlation for the forensic document examination proffers was $r^2 = .333$, $p = .044$; for latent print proffers, the correlation was $r^2 = -.321$, $p = .046$. Alpha was set at .05 for both analyses. Examination of scatterplots revealed that difference in the direction of the correlations can be accounted for by the number of challenges to forensic document examination evidence immediately following *Daubert.* The number of challenges to latent print evidence was initially high post-*Kumho,* but has since decreased, while the number of challenges to forensic document examination evidence has tended to increase. If the single case decided pre-*Kumho* is removed from the analysis, this relationship becomes even more pronounced ($r^2 = -.449$, $p = .005$).

14. Although the data suggest that these differences might be statistically significant, too few civil cases are included in this sample to perform reliable statistical tests.

professional groups which lie beneath the quantitative and qualitative information revealed by our empirical examination of the case law.

III. FORENSIC DOCUMENT EXAMINATION

Forensic document examiners (FDE) are often referred to as handwriting experts.[15] The examination and comparison of known and disputed (i.e. questioned) handwriting specimens for the purpose of determining authorship is the most common task affiliated with forensic document examination. This includes examination of writing, marks, symbols, or signs that are used as a means of written communication, produced by any method on any media. Forensic document examination also includes the examination of machine-generated documents, mechanical impressions, the detection of text or page insertions, alterations, obliterations, and indented writings, as well as non-destructive ink comparisons and determination of the date of document origin. Performing each of these tasks requires formally trained examiners who have established their expertise through training, testing, knowledge, skill, and experience implementing established methodologies that have evolved over the past century. The central task of forensic document examiners remains the examination of handwritten entries (e.g., cursive, hand printing, and signatures). This area has been the task most frequently challenged under *Daubert*, and will be the main focus of this discussion.

A. *The Impact of* Daubert

Following the 1995 decision *United States v. Starzecpyzel*,[16] in which the judge defined forensic document examination testimony as "technical" rather than "scientific" knowledge, forensic document examiners began a process of demonstrating to the courts the reliability of forensic document examination under *Daubert*. The *Daubert* decision articulated a set of guidelines judges might consider as they determined the admissibility of expert testimony. Subsequently, many judges expected attorneys and experts to provide information regarding the proficiency of forensic document examiners and the reliability of their methods. In some instances, how well this information was communicated to the courts through independent documentation and direct testimony determined whether the expert would be allowed to testify before the jury.[17]

Challenges to the admissibility of forensic document expert testimony were raised in *Daubert*-type language, creating a new format for testimony that required experts to describe the reliability of their methodology in *Daubert* terms (e.g., falsifiability, error rate, peer review and publication, general acceptance). Gathering and organizing the research and other information which has accumulated over the past 100 years of this

15. Forensic document examination is sometimes mistakenly considered to be synonymous with Graphology. While each field involves the study of handwriting, the focus of that study is distinctly different. Analysis of handwriting using forensic document examination methods is based on establishing the authorship of a given specimen of writing. In contrast, graphology is concerned with attempts to establish personality or character traits though the analysis of an individual's handwriting.

16. 880 F. Supp. 1027 (S.D.N.Y. 1995).

17. *U.S. v. Saelee*, 162 F. Supp. 2d 1097 (D. Alaska 2001) is an excellent example of an exclusion resulting from the prosecution's failure to elicit testimony of how this profession meets *Daubert*. Conversely, *U.S. v. Prime*, 363 F.3d 1028, 1033 (9th Cir. 2004) highlights the importance of entering such testimony.

discipline's existence, generating new studies, and presenting this information effectively to the courts is an ongoing process which continues to present challenges to the profession. The learning curve involved in successfully incorporating all of this information into the testimony of experts is evident when comparing the initial exclusions or limitations of forensic document examiner testimony to the level of admissibility post-2002.

Challenges to the qualifications of forensic document examiners have demonstrated to many members of the profession the desirability of increasing the standardization of training, testing, and certification requirements. Document examiners have addressed these issues in a variety of ways.

B. Education

A college education is required for membership in many of the mainstream forensic organizations and for certification.[18] Most forensic document examiners possess at least a baccalaureate or graduate degree from fields such as chemistry, criminal justice, computer science, psychology, sociology, or law. Many have earned a masters degree in forensic science from universities in the United States, Scotland, or Australia. Although there are currently no academic degree programs specifically in forensic document examination offered through colleges or universities, numerous universities and colleges offer classes in forensic document examination as part of forensic science degree programs. The popularity of forensic science education is growing internationally, creating a demand for the development of additional academic based programs.

C. Training

A formal two-year, apprenticeship-style training program under the guidance of a qualified forensic document examiner is currently the approved method of training.[19] The structured program includes a comprehensive study of all of the tasks that fall within the purview of forensic document examination. Applicants are often required to successfully pass examinations for color blindness and form perception before initiating training. The trainees receive a historical grounding in the discipline's tenets and methods, and progressive study of the development and improvement of methodologies as a result of cultural acceptance and implementation of new technology.[20] Throughout the training process trainees are required to demonstrate that they have obtained an

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18. Examples of these organizations include: Questioned Document Section of the American Academy of Forensic Sciences (AAFS); American Society of Questioned Document Examiners (ASQDE); American Board of Forensic Document Examiners (ABFDE).

19. ASTM Intl., *ASTM E 2388 Standard Guide for Minimum Training Requirements for Forensic Document Examiners* (2005) (available at www.astm.org).

20. One example is the introduction of hand printing, also called manuscript writing, into a few private schools in the United States in the early 1920s. Hand printing, which was not formally introduced to the general school population until the mid-1940s, was initially characterized by Albert Osborn as a "strange educational fad" of the 1920s. The awkward characteristics observed in this "new" writing style of hand printing by adults between 1925 and 1950 are not present in modern writers because hand printing is now an established part of the penmanship courses now taught, beginning with young children.

acceptable level of knowledge or proficiency associated with each forensic document examination task or topic by successfully passing written, practical, and/or oral examinations.

D. *Skill/Subject Matter Knowledge*

Numerous crime laboratories require their examiners to annually participate in external proficiency testing programs. For those laboratories that are accredited by the American Society of Crime Laboratory Directors Laboratory Accreditation Board (ASCLD/LAB) participation must involve the use of samples obtained from an ASCLD/LAB approved test provider when an approved provider is available.[21] A key element of the Proficiency Review Program is "compliance monitoring."[22]

Skill-Task Training Assessment and Research, Inc. (ST^2AR) was formally established in mid-2007 as a nonprofit organization dedicated to "[f]urthering [f]orensic [s]cience."[23] One of the primary goals of this organization is to design, develop, and administer skill-based tests in collaboration with the Forensic Expertise Profiling Laboratory (FEPL) at LaTrobe University in Australia. The success of this program is yet to be determined as the first skill-task assessment package, which will involve the FDE task of examining naturally written, disguised and simulated signatures, will not become available until early 2008.

E. *Certification*

Certification testing for FDEs is available through the American Board of Forensic Document Examiners (ABFDE).[24] Applicants must successfully pass three different testing phases in order to obtain certification. These include a written examination, a series of practical examinations, and an oral examination. The written examination assesses the candidate's knowledge of forensic document examination. The practical examinations require the candidate to successfully apply accepted examination methodologies and techniques on problems covering a wide range of relevant tasks. The testing concludes with an oral board examination in which the candidate must orally defend the examination procedures and methods utilized and the bases of their findings (from three of the practical problems) before a panel of ABFDE Directors. In 2007, ABFDE's certification program was accredited by the Forensic Specialties Accreditation Board, becoming just the sixth forensic science certification body to achieve this level of recognition.

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21. ASCLD/LAB, *Proficiency Review Program*, http://www.ascld-lab.org/legacy/pdf/aslabintern proficiencyreviewprogram.pdf (Apr. 2003).

22. *Id.* at A-2.

> Proficiency testing is an integral part of an effective quality assurance program. It is one of many measures used by laboratories to monitor performance and to identify areas where improvements may be needed. A proficiency testing program is a reliable method of verifying that the laboratory's technical procedures are valid and that the quality of work is being maintained.

Id.

23. Skill-Task Training Assessment & Research, Inc., http://www.st2ar.org (accessed Mar. 16, 2008).

24. Am. Bd. Forensic Doc. Examrs., http://www.abfde.org (accessed Mar. 16, 2008).

F. Current Research on Expertise

Issues have been raised both in court and in a number of law review articles and treatises concerning the relatively small body of research supporting claims that forensic document examiners outperform laypersons in successfully identifying the source of questioned handwriting samples.[25] *Daubert* acted as a catalyst that brought this issue into sharp focus and motivated forensic document examiners to seek opportunities to participate in empirical research to investigate the extent of the validity of the field. Although additional research is needed, the growing body of extant studies tends to support the validity of forensic document examination as a field of expertise.[26]

Challenges to the theory, methods, and conclusions of forensic document examination have also generated significant activity among members of the field. To understand the impact of *Daubert* in this area it is important to first understand the tenets

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25. A detailed discussion of this extensive literature and the arguments of forensic document examination critics are largely beyond the scope of this article, and will no doubt be addressed by other contributors to this journal. Our discussion of the issues they raise will be limited to the general themes of their discourse. Some examples of their arguments can be obtained from the following sources: *State v. Rose*, No. K06-545 (Balt. Co. Cir. 2007) (mem.); David L. Faigman et al., *Modern Scientific Evidence: The Law and Science of Expert Testimony* 325 (West 2006); David L. Faigman et al., *Modern Scientific Evidence: The Law and Science of Expert Testimony* vol. 3 (2d. ed., West Supp. 2003); Mark P. Denbeaux & D. Michael Risinger, Kumho Tire *and Expert Reliability: How the Question You Ask Gives the Answer You Get*, 34 Seton Hall L. Rev 15 (2003); D. Michael Risinger et al., *Exorcism of Ignorance as a Proxy for Rational Knowledge: The Lessons of Handwriting Identification "Expertise"*, U. Pa. L. Rev. 731, 739 (1989); Michael J. Saks & Jonathan J. Koehler, *The Coming Paradigm Shift in Forensic Identification Science*, 309 Sci. 892 (2005); Michael J. Saks & Holly Vander Haar, *On the "General Acceptance" of Handwriting Identification Principles*, 50 J. Forensic Sci. 119 (2005); Michael J. Saks, *The Legal and Scientific Evaluation of Forensic Science (Especially Fingerprint Expert Testimony)*, 33 Seton Hall L. Rev 1167 (2003); Michael J. Saks, *Prevalence and Impact of Ethical Problems in Forensic Science*, 34 J. Forensic Sci. 772 (1989).

26. *See e.g.* Adrian G. Dyer et al., *Visual Attention and Expertise for Forensic Signature Analysis*, 51 J. Forensic Sci. 1397 (2006); B. Found & DK Rogers, *Investigating Forensic Document Examiners' Skill Relating to Opinions on Photocopied Signatures*, 45 Sci. & Just. 199 (2005); Bryan Found et al., *The Development of a Program for Characterizing Forensic Handwriting Examiners' Expertise: Signature Examination Pilot Study*, 12 J. Forensic Doc. Exam. 69 (1999); Bryan Found & Doug Rogers, *Contemporary Issues in Forensic Handwriting Examination: A Discussion of Key Issues in the Wake of the* Starzecpyzel *Decision*, 8 J. Forensic Doc. Exam. (1995); Moshe Kam & Erwei Lin, *Writer Identification Using Handprinted and Nonhandprinted Questioned Documents*, 48 J. Forensic Sci. 1391 (2003); Moshe Kam et al., *The Effect of Monetary Incentives on Document Examination by Nonprofessionals*, 43 J. Forensic Sci 1000 (1998); Moshe Kam et al., *Writer Identification by Professional Document Examiners*, 42 J. Forensic Sci. 778 (1997); Moshe Kam et al., *Proficiency of Professional Document Examiners in Writer Identification*, 39 J. Forensic Sci. 5 (1994); Jodi Sita et al., *Forensic Handwriting Examiners' Expertise for Signature Comparison*, 47 J. Forensic Sci. 1117 (2002); Carolyne Bird, Bryan Found & Doug Rogers, Address, *Forensic Document Examiners' Opinions on the Process of Production of Disguised and Simulated Signatures* (13th Conf. Intl. Graphonomics Socy., Melbourne, Austrl., Nov. 11–14, 2007); Tanhee Dewhurst, Bryan Found & Doug Rogers, Address, *Can Expert Penmen Produce Better Simulations Capable of Avoiding Detection by Forensic Document Examiners?* (13th Conf. Intl. Graphonomics Socy., Melbourne, Austrl., Nov. 11–14, 2007); Bryan Found & Doug Rogers, Address, *The Probative Character of Forensic Document Examiners' Identification and Elimination Opinions on Questioned Signatures* (13th Conf. Intl. Graphonomics Socy., Melbourne, Austrl., Nov. 11–14, 2007); Bryan Found & Doug Rogers, Address, *Problem Types of Questioned Handwritten Text for Forensic Document Examiners* (12th Conf. Intl. Graphonomics Socy., Salerno, Italy, June 26–29, 2005); Moshe Kam, Test, *Proficiency Testing* (Am. Socy. Questioned Doc. Examrs., San Diego, Cal., 2006) (Extended writing tests were given at the 2002 ASQDE meeting by Moshe Kam. The test was given to individual participants on Day 1. On Day 2, individuals worked in pairs to peer review each other's answers. The error rate from Day 1 tests decreased to zero with peer review. This study has yet to be published. However, the results of this study were presented at the American Board of Forensic Document Examiners (ABFDE) *Daubert* Symposium, Las Vegas, NV (June 21–23, 2004)); Sch. Human Biosciences Handwriting Analysis & Research Laboratory (unpublished study, La Trobe U., Victoria, Austrl.); Victoria Police Forensic Servs. Ctr. Doc. Exam. Unit (unpublished study, Macleod, Victoria, Austrl.).

of handwriting analysis.

Handwriting is based on physiological and neurological foundations. Consequently, handwriting is a behavioral artifact that is identifiable due to the presence of features and characteristics within the writing (e.g., signatures, hand printing, numerals). These features, when considered in combination, individualize the habit pattern of the writer. The handwriting analysis aspect of forensic document examination is based on two primary tenets regarding handwriting tasks: (1) No two people write exactly alike in all features and characteristics when considered cumulatively and in combination (i.e. *inter*-writer variation); and (2) a person does not write exactly the same way twice (*intra*-writer variation). The quantity and quality of the features observed to be present or absent when comparing the known and questioned specimen sets form the basis of the examiner's opinion.

G. *Falsifiability*

Over the years the tenets of forensic document examination have been subjected to empirical research. This research addresses a variety of questions including, among other topics, the effects of genetic similarity on handwriting similarity,[27] and the characteristics of adolescent handwriting and hand printing.[28]

The individuality and uniqueness of handwriting have also been demonstrated within large collections of handwriting samples. One such collection is the Forensic Information System for Handwriting (FISH), a database maintained by the U.S. Secret Service since 1991.[29] Another is maintained by the Center of Excellence for Document

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27. Mary S. Beacom, *A Study of Handwritings by Twins and Other Persons of Multiple Births*, 5 J. Forensic Sci. 121 (1960); David Boot, *An Investigation into the Degree of Similarity in the Handwriting of Identical and Fraternal Twins in New Zealand*, 1 J. Am. Socy. Questioned Doc. Examrs. 70 (1998); D.J. Gamble, *The Handwriting of Identical Twins*, 13 Can. Socy. Forensic Sci. J. 11 (1980). Handwriting samples from a total of 203 twin pairs were examined in these three studies. The 1958 and 1998 studies included fraternal as well as identical twins. All of the studies concluded that with a sufficient amount of known handwriting exemplars, the set of twins writings were distinguishable.

28. J.F. Masson, *A Study of the Handwriting of Adolescents*, 33 J Forensic Sci. 167 (1988); C.T. Cusack, Study, *A Comparison Study of the Handwriting of Adolescents* (Am. Acad. Forensic Sci., Phila., Pa., 1998); S.E. MacInnis, Study, *Adolescent Handwriting-Native Versus Non-native* (Am. Socy. Questioned Doc. Examrs. Conf., Montreal, Que., Aug. 1993). The studies on adolescent handwriting/hand printing include an analysis of 633 adolescent writers from three distinct geographical areas. Seven features occurred in the writing samples obtained from the three locations. These two studies stress the importance of understanding the limitations inherent in this type of writing and the necessity of obtaining an abundance of handwriting exemplars. MacInnis' research reached the same conclusion as Masson's and Cusack/Hargett's studies, noting there are some general characteristics observed in adolescent writing. She also stressed the examiner should be cautious in examining this type of writing. The studies support the caution issued by Osborn, Conway, and Harris: Albert S. Osborn, *Questioned Documents* (2d ed., Rowan & Littlefield 1974); James V. P. Conway, *The Identification of Handprinting*, 45 J. Crim. L., Criminology & Police Sci. 605 (1955); John J. Harris, *How Much Do People Write Alike: A Study of Signatures*, 46 J. Crim. L., Criminology & Police Sci. 647 (1958).

29. The FISH system was developed by the German federal police and contains handwriting samples obtained from more than 10,000 individual writers. The German database contains handwriting obtained from more than 100,000 individual writers. Neither database has revealed the existence of two or more writers having the same combination of handwriting characteristics. The Center of Excellence for Document Analysis and Recognition (CEDAR), University at Buffalo, State University of New York, used computer software to measure the handwriting features of 1,500 writers. Using a writer's combination of characteristics in his or her writing, the computer was able to identify the writer with a 95% confidence level. *See* Sargur N. Srihari et al., *Individuality of Handwriting: A Validation Study*, 47 J. Forensic Sci. 106 (2002).

Analysis and Recognition (CEDAR) at the State University of New York, Buffalo.[30]

The reliability of the methodology used in forensic document examination has also been questioned due to its subjectivity. It is indisputable that forensic document examiners subjectively apply the knowledge they obtain from education, training, and experience when comparing handwriting samples. However, this methodology is consistent with a long-accepted research methodology known as content analysis.[31] Forensic document examiners are taught and trained to evaluate samples of handwriting as a gestalt (e.g., the overall examination of the signature or sample is greater than the sum of its parts), taking into consideration both quantitative and qualitative aspects of the sample. Recognizing the presence or absence in both samples of specific handwriting characteristics is analogous to the coding process of content analysis, in which specific features of the message or image are identified and converted to data by the coder (e.g., assigned numerical values that are later used in data analysis). The reliability of content analysis is increased by having additional coders review the work of the first.[32]

Similarly, the reliability of forensic document examination is increased by internal technical review. Many, if not most, forensic laboratories have Quality Management Programs that include requirements for technical reviews. Several studies have been conducted to assess whether the process of internal laboratory peer review of case work has any impact on potential FDE rates of error.[33]

H. Error Rate

Proficiency tests are "designed, prepared and distributed . . . to evaluate the proficiency and capability of analysts, technical support personnel and the quality

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30. See the CEDAR web site for a selection of post-*Kumho* publications and presentations about forensic/questioned document examination produced by CEDAR researchers. CEDAR, *Forensic/Questioned Document Examination: Selected Research Publications*, http://www.cedar.buffalo.edu/NIJ/publications.html (accessed Mar. 15, 2008).

31. Content analysis has historically been used to analyze recorded textual communications (e.g., newspaper articles, books, court documents), but can be used to analyze any recorded medium (e.g., photographs, audio recordings, video recordings). *See* Earl Babbie, *The Basics of Social Research* (4th ed., Wadsworth 2007). Among other purposes, content analysis has been used to establish authorship for purposes of securing political and military intelligence, to provide legal and evaluative evidence, and to relate known characteristics of sources to the messages they produce. *See also* Ole R. Holsti, *Content Analysis*, in *The Handbook of Social Psychology* 596 (Gardner Lindzey & Elliot Aronson eds., 2d ed., Addison-Wesley 1968).

32. This process is referred to as check-coding, and is commonly used to ensure the accuracy of data gathered in by a variety of modalities. Whether every case in the data set or a sample of cases is check-coded depends on the size of the data set, the size of the research project's budget and staff, the complexity of the source materials, and other factors. Discrepancies between the coder and check-coder are resolved by a third individual, or "verifier," who is considered the ultimate authority in the application of the coding scheme. High consistency between the coder and check-coder (inter-rater reliability) demonstrates clarity and consistent application of the coding scheme. Forensic experts often refer to the internal review of casework as "technical reviews" or "peer reviews." Discrepancies between the initial examiner and the reviewer are typically resolved by a senior examiner or bench supervisor. The extent of technical review within a laboratory depends on the workload, lab budget and personnel, and other factors.

33. *See* M. Kam, Address, *Proficiency Testing and Procedure Validation for Forensic Document Examiners* (*Daubert* Seminar Am. Bd. Forensic Doc. Examrs., Oct. 29–30, 2004); M. Kam, A. Gorski & C. Gaughan, Address, *A Decade of Writer Identification Proficiency Tests for Forensic Document Examiners* (61st Annual Meeting Am. Socy. Questioned Doc. Examrs., Aug. 2003). Preliminary data demonstrated that consultation between two FDEs tended to reduce error rates to zero, although sample sizes for preliminary data were small.

performance of the laboratory."[34] Prior to *Daubert* the existence of empirical data relating to the known or potential error rates for forensic document examiners was admittedly limited. Indeed, some critics opined prior to *Daubert* that "[f]rom the perspective of published empirical verification, handwriting identification expertise is almost nonexistent."[35] Lack of reliable research in this area negatively impacted the field as individuals seeking to exclude forensic document examination evidence inappropriately relied on early proficiency testing data generated by Collaborative Testing Services (CTS).[36] Some individuals continue to cite these data despite the existence of more recent and reliable research that contradicts these early findings.[37]

As an American Society of Laboratory Directors-Laboratory Accreditation Board approved proficiency test provider, CTS is a primary vendor of proficiency tests for forensic laboratories. ASCLD-LAB accredited laboratories require annual proficiency testing of all analysts. Satisfactorily passing proficiency tests is mandatory for those who are employed in ASCLD/LAB accredited laboratories. Forensic examiners in multiple disciplines must pass a proficiency test in each practiced discipline.

The experts who are required to participate realize the potential negative consequences that can result from unsatisfactory performance. For these examiners, failing a mandatory proficiency test can necessitate removal from the bench, with remedial training followed by a requirement to successfully complete another test focused on the same task. Depending on the circumstances of a failure, examiners may be subjected to outright dismissal. Thus, examiners are highly motivated to maintain

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34. ASCLD/LAB, *Proficiency Test Provider Program*, http://www.ascld-lab.org/legacy/word/alpd1010.doc (2007).

35. Risinger et al., *supra* n. 25, at 739.

36. The CTS Advisory Council informed some individuals that the CTS proficiency tests may not be suitable for gathering data on a forensic discipline. According to the advisory council the test may not be treated equally among all participating laboratories because some labs use the tests for training purposes, some for proficiency purposes, and some for screening purposes. Additionally, use of the test is not restricted to qualified forensic document examiners. Consequently, data generated from the test results are confounded by the inclusion of scores for untrained and unqualified subjects. Another inappropriate use of CTS scores involves the attempt to generalize the aggregate test scores for a single group administration to the entire body of non-test taking forensic document examiners as an indicator of the reliability of the field. The applicability of CTS with respect to known or potential error rates lies not with an analysis of the group of participants, but rather with a case by case assessment and evaluation of the individual participants. An overall assessment and analysis of the performance of the individual test taker will provide data that can be used to either support or refute claims of expertise for that specific examiner regarding the task(s) tested. This information can be brought before the court via rules of discovery; deposition testimony, direct, cross-examination, and re-direct testimony.

37. Contemporary test results indicate that proficiency has improved, even with the inclusion of scores for untrained or unqualified subjects. Some critics have declined to acknowledge these improved scores, or have interpreted them to mean that the difficulty level of the tests has decreased. *See* Transcr. Dr. Michael Saks Test. at 105, *Nev. v. Warren*, No. C187202 (Dist. Clark Co. 2004), where Michael Saks responded to the prosecuting attorney's question about whether 100% and 80% ratings were better than previous scores:

> Q: So it has gotten better?
>
> Saks: Well, document examiners will tell you that—
>
> Q: I'm just asking percentage rate. The 100 percent and the 80-some percent is better—
>
> Saks: [If] all you are asking me is did the number go up and then down a little, it started out low and then it went up, and then came down a little, yes, the numbers did do that.

Id.

proficiency, not only because of the severe consequences for others resulting from an erroneous conclusion in live casework (e.g., denying someone their life, liberty, or property), but also by the significant personal and professional consequences involved.

I. The Existence and Maintenance of Standards Controlling the Operation of the Techniques

An objective review of the standards controlling the methods and techniques used by forensic document examiners in the pre-*Daubert* era could easily leave one wanting, as this information was scattered throughout literature existing in different forms and sources. *Daubert*'s most significant impact on the field of forensic document examination may be the significant strides made toward developing, consolidating, and publishing information about the methods, techniques, and standards used by document examiners.

Following *Daubert*, and especially after *Starzecpyzel*, the profession began to realize that it had failed to adequately consolidate, standardize, and maintain its established methods and techniques. The American Society for Testing and Materials International (ASTM) has become the primary source of published guidelines on the various tasks in forensic document examination. ASTM serves a wide array of professions and requires extensive peer review throughout the standards development process. Prior to gaining approval and eventual publication, all proposed standards must be balloted and pass review not only at a sub-committee level (e.g., Sub-Committee E30.02 on Questioned Documents), but also at a main committee level (e.g., Forensic Science—Committee E30).[38]

In the decade and a half since *Daubert*, fifteen new standards pertaining to forensic document examination have been balloted, accepted and published through ASTM International standards development process.[39] The number of forensic document examiners and other forensic scientists participating in the standards developing process have also seen tremendous growth in the post-*Daubert* era. Currently, the E30 Committee on Forensic Science has 792 members and the E30.02 Sub-Committee on Questioned Documents has a membership of 221. To put this in perspective, the 1990 meeting Minutes of the Sub-Committee E30.02 on Questioned Documents reflect that

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38. According to ASTM:

> Standards development work begins when members of an ASTM Technical Committee identify a need or other interested parties approach the committee. Task group members prepare a draft standard, which is reviewed by its parent subcommittee through a draft ballot. After the subcommittee approves the document, it is submitted concurrently to the main committee and the entire membership of ASTM. All negative votes cast during the balloting process, which must include a written explanation of the voters' objections, must be fully considered before the document can be submitted to the next level in the process. Final approval of a standard depends on concurrence by the ASTM Standing Committee on Standards that proper procedures were followed and due process was achieved.

ASTM Intl., *What is ASTM International?* http://www.astm.org/IMAGES03/whatisastm_englishpdf.pdf (2003).

39. Forensic Document Examination standards provide guidelines for a number of tasks, including but not limited to the following: Scope, Training, Standard Terminology, and Examination of handwriting, rubber stamps, and physical match. *See generally* ASTM Intl., *Standards Worldwide*, http://www.astm.org (accessed Mar. 16, 2008).

only five individuals were present.

Daubert and *Starzecpyzel* also played a pivotal role in the creation of the Technical Working Group for Documents (TWGDOC) in 1997, which became the Scientific Working Group for Documents (SWGDOC) in 1999. The National Institute of Justice provided funding for this group following the challenges to forensic document examination which began to appear following *Daubert* and *Kumho*. SWGDOC has in essence served as a task group for ASTM Sub-Committee E30.02, and has been responsible for drafting and submitting the majority of the ASTM standards under the purview of E30.02. Currently there are seventeen FDE related standards, and SWGDOC has developed and drafted an additional four guides[40] which should be balloted within ASTM in the near future. SWGDOC is currently developing an additional seven draft guides.[41]

J. Peer Review and Publication

Various forms of peer review and sources of publication continue to be utilized in forensic document examination. Published material regarding new, traditional, or experimental methods utilized by forensic document examiners can be located in a variety of peer reviewed journals. Some journals are specifically focused on the profession of forensic document examination. Others are broader in scope, publishing articles that are relevant to the broader scientific, forensic science, legal, and law enforcement communities.[42] Forensic document examiners also routinely present their research at professional conferences worldwide.

Accreditation programs for individual laboratories and certification bodies also provide a measure of peer review. The American Society of Laboratory Directors-Laboratory Accreditation Board evaluates forensic laboratories, to include those with Forensic Document Branches, to determine whether each discipline meets specific standards. Accredited laboratories have the additional responsibility of providing objective documentation as evidence of their compliance with ASCLD-LAB standards. The Forensic Specialties Accreditation Board (FSAB) offers accreditation to forensic certification bodies. As previously mentioned, the American Board of Forensic Document Examiners certification program is accredited by FSAB.

K. General Acceptance

Justice Blackmun wrote in *Daubert* that "general acceptance" refers to the acceptance of a technique by the relevant scientific community. The courts have upheld the reliability of forensic document examination in many pre-trial hearings in which

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40. The draft guides currently balloted pertain to the examination of charred paper, liquid-soaked paper, simulations and tracings, and the examination and classification of facsimile transmit terminal identifiers.

41. The unballotted draft guides pertain to the determination of sequence of strokes, writing instruments, document authentication, document imaging, document dating, printing processes, and folds and creases.

42. These journals include the *Journal of Forensic Science*; *Science and Justice*; *Journal of the American Society of Questioned Document Examiners*; *Canadian Society of Forensic Science Journal*; *Forensic Science International*; *Journal of Police Science and Administration*; *International Journal of Forensic Document Examiner*; *Journal of Forensic Identification*; *Journal of Forensic Document Examination*; and *Journal of Criminal Law and Criminology*.

individuals from outside the discipline have tried to refute its reliability. Just as electrical engineers are the relevant community for critiquing the work of other electrical engineers or marketing experts are the relevant community for critiquing the work of other marketing experts, the members and practitioners within forensic sciences are the relevant scientific community for forensic sciences.

Membership in this community should be based on inclusion in multi-discipline forensic organizations such as the American Academy of Forensic Sciences, the International Association of Identification, and the Canadian Society of Forensic Sciences.[43] Expert qualifications should include coursework and training as described above. College and graduate-level courses in Questioned Documents are part of the college/university curriculum in the following forensic programs: George Washington University, Michigan State University, John Jay College, National University in San Diego, University of Alabama at Birmingham, University of New Haven, University of Central Oklahoma, University of Illinois in Chicago, and Oklahoma State University. Forensic document examiner involvement and participation in ASTM International, ASCLD-LAB, and FSAB have already been discussed. These organizations recognize the forensic document examination profession as a member of the larger forensic science community.

We believe that the changes and developments that have occurred within the discipline of forensic document examination during the last fifteen years demonstrate that *Daubert* has in fact provided an impetus for change within the field. As a result of these changes we must concur with Saks' and Koehler's view that "[c]onverging legal and scientific forces are pushing the traditional forensic identification sciences toward fundamental change" and that a "paradigm shift" is, and has been underway for several years.[44] If anything, this period has illustrated that the field of forensic document examination, like the other forensic specialties, is not infallible. Nor should it claim to be. Claims of this nature are not only insupportable, but also are likely to serve as a basis for exclusions.[45] Nor is the field without limitations. Events in the aftermath of *Daubert* reinforce the idea that we must continue to ask questions and pursue new knowledge. Slowly, and over time as we answer these questions we inevitably uncover new questions which in turn must be explored thereby leaving us to continuously repeat a never ending process known as discovery.

IV. LATENT PRINT EXAMINATION

Latent print examination is the task of comparing a questioned friction ridge skin impression (fingerprint) with a friction ridge skin impression of known origin to

43. The American Academy of Forensic Sciences (AAFS) is the only national forensic science organization. Questioned Documents was one of the first disciplines in the establishment of this organization in 1948. The International Association of Identification (IAI) is a multi-discipline, international organization which has a forensic document examination section. Questioned Document sections are in the following multi-discipline organizations: Mid-Atlantic Association of Forensic Sciences (MAAFS), Mid-Western Association of Forensic Scientists (MAFS), Northeastern Association of Forensic Sciences (NEAFS), and the British and Canadian Forensic Science Societies.

44. Saks & Koehler, *supra* n. 25, at 892.

45. *Rose*, No. K06-545 (mem.).

determine whether both impressions came from the same source.[46] The use of fingerprints as a means of identification is becoming ubiquitous in many industries. Various laptop computers are manufactured with fingerprint readers, and fingerprint scanners have been incorporated into high tech security systems. Some vendors are even offering time clocks that use fingerprints instead of punch cards. Inked and latent prints are also utilized to make non-criminal identifications such as identifying disaster victims. In the aftermath of the tragic shootings at Virginia Tech University, the Virginia Department of Forensic Science used latent prints to verify the identity of victims when other means such as DNA analysis were unavailable.

The earliest use of fingerprint identification can be traced back to ancient China, where archaeological evidence suggests that fingerprints were embossed in clay as a means of authenticating documents as early as 250-200 B.C.[47] The use of finger and handprints in various forms as a means of authenticating documents spread to neighboring nations such as India and Japan. Sir William Herschel, an administrator in the Indian civil service from 1858 to 1879, reported that fingerprints were used in both civil contract disputes and criminal cases to establish personal identity.[48] The use of fingerprints and latent print examination as proof of identity has been a mainstay of the criminal justice system and forensic science since it was first used in the 1910 trial of Thomas Jennings for the murder of Clarence Hiller.[49]

A. The Impact of Daubert

It was not until 1999 in the case of *United States v. Mitchell*[50] that latent print examination fell under the scrutiny of the *Daubert* guidelines. Latent prints came under fire again in 2002 in the case of *United States v. Llera Plaza*.[51] These cases required the latent print profession to articulate the scientific basis for the use of latent fingerprints as a unique form of identification and the methodology (ACE-V) used to perform the examination. These court cases started a trend of knowledge consolidation.

The process of knowledge consolidation was more formal than novel. Latent print examination did not and does not exist in a vacuum absent of basic science and institutional experience. Rather, *Daubert* introduced guidelines for the admission of expert evidence. The challenge to latent print examiners and the forensic science community was to re-articulate the existing body of knowledge, research, and experience in terms that are meaningful to a trial judge in a *Daubert* hearing. Those terms collectively refer to the methodology of latent print examination (i.e. ACE-V), its reliability, the methods used to test its reliability, how well the principles and methods are accepted by the professional community, published professional standards, and

46. A latent print is deposited in sweat or a similar medium that requires physical or chemical development for visualization. Patent prints are deposited in blood, paint, or some other medium visible to the naked eye without development.

47. David R. Ashbaugh, *Quantitative-Qualitative Friction Ridge Analysis: An Introduction to Basic and Advanced Ridgeology* 15 (CRC Press 1999).

48. *Id.* at 21–24.

49. *People v. Jennings*, 96 N.E. 1077 (Ill. 1911).

50. 190 F.3d 543 (11th Cir. 1999) (table).

51. 179 F. Supp. 2d 492 (E.D. Pa. 2002), *vacated*, 188 F. Supp. 2d 549 (E.D. Pa. 2002).

publication and peer review. The multitude of *Daubert* requirements imposed in one Supreme Court decision required some time for adjustment by forensic professionals.

The latent print comparison process is undertaken by a formally trained latent print examiner (LPE) who employs an established methodology.[52] Prior to performing this comparison, the LPE must demonstrate expertise in the area of latent print comparison. This expertise is developed through extensive training and experience and is demonstrated through frequent competency testing and quality control measures.

B. Education

To date, there are no accredited colleges or universities in the United States that offer a degree in latent print examination. In part, this absence may be accounted for by the interdisciplinary nature of latent print comparison as an applied science. Nonetheless, crime labs recognize the need for personnel with formal training in the sciences. As such, latent print examiners as well as other forensic scientists typically possess at a minimum a bachelor's degree in forensics or one of the natural sciences. In fact, most crime labs will not hire and train a new examiner without a four-year science degree. In addition, the International Association for Identification (IAI), which certifies latent print examiners, favors college graduates by requiring additional bench experience for examiners without degrees.[53] SWGFAST, the Scientific Working Group on Friction Ridge Analysis, Study, and Technology, sets the toughest standard requiring latent print trainees hired on or after 2005 to possess at minimum a bachelor's degree.[54] These factors when coupled with the broad availability of forensic science programs at domestic universities will soon make a bachelor's degree the de facto standard for all forensic sciences.

C. Training

In the absence of a formal college degree program, latent print examiners participate in agency-specific training programs under the supervision of senior-level examiners. SWGFAST, a government sponsored committee of latent print experts tasked with formulating national standards, outlines the critical objectives for a complete training program and requires trainees to demonstrate their knowledge through written and practical tests.[55] A comprehensive program includes but is not limited to the biological basis for the uniqueness and permanence of friction ridge skin, scientific methods as they apply to latent print examination, pattern recognition, the chemistry of latent print detection, and the basis for scientific conclusions. Attorneys have the right to

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52. This methodology is formally referred to as "ACE-V," which stands for Analysis, Comparison, Evaluation, and Verification.

53. Intl. Assn. Identification, *Latent Print Examiner Certification Requirements*, http://www.theiai.org/certifications/fingerprint/requirements.php (accessed Mar. 16, 2008).

54. SWGFAST, *Minimum Qualifications for Latent Print Examiner Trainees*, http://www.swgfast.org/Minimum_Qualifications_for_Latent_Print_Examiner_Trainees_2.1.pdf (Aug. 22, 2002).

55. Critics have argued that SWGFAST standards are really guidelines or suggestions since forensic labs are not mandated to adhere to their policies. It is meaningful to note that the federal government traditionally encourages compliance by tying the availability of federal funds to compliance with established standards. For example, some federal funding is restricted to crime labs that attain and maintain ASCLD-LAB accreditation.

question the qualifications of an expert witness in open court or during a *Daubert*-type hearing through the *voir dire* process. This is the court's opportunity to discover the nature and extent of a latent print examiner's training and how the examiner's training meets established standards.

D. Skill/Subject Matter Knowledge

Competency testing is required for practicing forensic scientists. SWGFAST advocates proficiency testing.[56] CTS provides exams for latent print examiners in part to fulfill the need for proficiency testing required by ASCLD and SWGFAST. ASCLD-LAB requires proficiency testing prior to beginning case work and annually thereafter.

E. Certification

In order to become certified, a latent print examiner must successfully complete a multi-step testing process. Applicants must first document their education, training, and professional experience, and must then pass a detailed written examination comprised of latent print comparison exercises, pattern interpretation of inked prints, and a series of questions regarding the history of latent print examination, chemical development techniques, and other related topics. Certification through the IAI is available to latent print examiners with a minimum of two years experience in the field.

F. Current Research on Expertise

Latent print examination draws on the fields of biology, physics, mathematics, cognitive science, and others, in addition to over one-hundred years of empirical data collected by practitioners. The biological origin of the uniqueness of individual fingerprints forms the theoretical foundation for the field of latent print examination. The main tenets of this theoretical perspective are: (1) friction ridges develop when humans are embryos and remain unchanged throughout life; (2) friction ridges are persistent throughout life and can only be altered by permanent scarring; and (3) friction ridge patterns and the ridge flow in small areas of friction ridge skin are unique and never repeated.[57] Information used to make comparisons is both qualitative and quantitative in nature. Both the quality and the amount of information in a fingerprint impression must be evaluated in conjunction prior to making a comparison. An impression with too little information due to lack of quality, quantity, or a combination of the two, is of no value.

Latent print examiners require some means of assessing and correlating data in a latent print and a known print. As practiced today, this process may be modeled as a pattern recognition or pattern matching task. Pattern recognition has been extensively studied in the fields of cognitive and vision science, and the consensus is that the human brain is a powerful pattern matching tool. Thomas Busey and John Vanderkolk have undertaken research designed to assess visual and cognitive processing in latent print

56. SWGFAST, *Guidelines for Latent Print Proficiency Testing Programs*, http://www.swgfast.org/Guidelines_for_Proficiency_Testing_1_0.pdf (Sept. 11, 2003).

57. Ashbaugh, *supra* n. 47, at 89–92.

examiners. Their research encompasses both fingerprint and non-fingerprint matching exercises and compares the data to the results of the same exercises from subjects untrained in latent print examination.[58] Experiments are ongoing, but the preliminary results suggest that expert latent print examiners exhibit discrete adaptive changes in cognitive processing related to the pattern recognition of finger prints.

G. *Falsifiability*

Many studies, both descriptive and experimental, exist concerning the theories and methods of latent print examination. Written records suggest an interest in the study of fingerprints predating Herschel, and these studies encompass a body of knowledge collected by numerous scientists and researchers in the effort to provide a detailed characterization of finger, palm, and footprints.[59]

These descriptive studies provided a wealth of data for classifying fingerprints and facilitating the practical analysis and comparison of fingerprint impressions. However, it is the contemporary work of investigators such as William Babler and others that provide the scientific mechanism for the uniqueness and permanence of friction ridge skin. Babler's research characterizes the development of friction ridge skin *in utero* and attributes the variability found in fingerprints to random, non-reproducible events caused by growth stresses in the hands and fingers.[60] Wertheim and Maceo later drew on this body of research to reaffirm the biological uniqueness of fingerprints and articulate the permanence of fingerprint patterns based on the highly structured arrangement of cells in the dermal and epidermal layers of skin.[61]

Research by Babler and others describes the biological formation of friction ridges and ultimately the source of latent print impressions. The development of the skin, however, is only part of the physical process involved in latent print deposition. Latent prints are the result of the interaction of friction ridge skin with another object, and the evaluation of latent prints is based on both qualitative and quantitative information.[62]

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58. Thomas A. Busey & John R. Vanderkolk, *Behavioral and Electrophysiological Evidence for Configural Processing in Fingerprint Experts*, 45 Vision Research 431 (2005).

59. Published descriptive studies include: H. Cummins & C. Midlo, *Fingerprints, Palms and Soles* (Blakiston 1943); Henry Faulds, *Dactylography or the Study of Finger-Prints* (Halifax 1912); Francis Galton, *Finger Prints* (MacMillan & Co. 1892); Edward Henry, *Classification and Uses of Fingerprints* (Routledge 1900); Harris Hawthorne Wentworth & Brent Wilder, *Personal Identification* (Gorham Press 1918); Inez Whipple, *The Ventral Surface of the Mammalian Chiridium* (unpublished M.A. thesis, Smith College, June 1904) (copy available at Smith College).

60. *E.g.* William J. Babler, *Embryonic Development of Epidermal Ridges and Their Configurations*, 27 Birth Defects Original Art. Ser. 95 (1991); William J. Babler, *Prenatal Development of Dermatoglyphic Digital Patterns*, 11 Collegium Antropologicum 297 (1987) [hereinafter Babler, *Prenatal Development*]; William J. Babler, *Prenatal Selection and Dermatoglyphic Patterns*, 48 Am. J. Physical Anthropology 21 (1978). There are also other similar articles which have been written on this issue.

61. Kasey Wertheim & Alice V. Maceo, *The Critical Stage of Friction Ridge and Pattern Formation*, 52 J. Forensic Identification 35 (2002).

62. Ashbaugh, *supra* n. 47. Ashbaugh delineates latent print data into three categories: Level One Detail encompasses the overall shape of a latent print and classifies prints into the categories of Arch, Loop, and Whorl (circular or spiral). Level Two Detail refers to ridge path. Individual friction ridges run along the surface of the skin like a road or highway. These ridges may terminate as in a ridge ending or split apart as in a bifurcation. They may appear as short segments or as dots nestled between adjacent ridges. They might also split apart and rejoin forming a circular or oval enclosure. These changes in ridge path are commonly referred to as minutiae points and compromise only a subset of level two data. Ridges without minutiae have a

This analysis is conducted according to a standard procedure referred to as ACE-V,[63] which conforms to SWGFAST standards.[64]

This confluence of quantitative and qualitative data in a latent print creates a sliding scale for determining a threshold of identification.[65] In cases where the latent print has high clarity and exhibits little if any signs of distortion, the latent print should predict with greater precision the data found in the known print.[66] As such, a smaller data set is sufficient to reach a conclusion of identification (conversely a smaller set of unexplained discrepancies is also sufficient for exclusion). In cases where the latent print shows irregularities in development and significant distortion, the latent print may have less predictive power when compared to the known print, but this difference is offset by requiring a proportionally larger data set to establish identity. Using these measures, the forensic scientist comes to one of three conclusions: (1) identification, or the determination that the latent print is from the same person who made the known print; (2) inconclusive, or the determination the forensic scientist can neither identify nor exclude the source of the known print that based on the data present in the latent and known print;[67] or (3) exclusion, the available data eliminates the source of the known

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characteristic flow and a spatial orientation with respect to the entire latent print that contributes to its individuality. Level Three Detail concerns the variability inherent in friction ridge development, which causes irregularities along the length of a friction ridge. These irregularities give rise to "edge shapes" as described by Salil Chaterjee and others. Ridges are also populated with sweat glands which emerge on the surface of the skin as pores which occupy fixed positions along friction ridges and offer additional information when analyzed within that context.

63. Analysis, Comparison, Evaluation, and Verification (peer review) are the procedural steps of latent print analysis.

64. SWGFAST, *Standards for Conclusions*, http://www.swgfast.org/Standards_for_Conclusions_ver_1_0.pdf (Sept. 11, 2003).

65. The quantitative aspect of a latent print refers to how much data is present. The quantitative element of a latent print is sometimes defined by the number of minutiae present, and early comparisons of fingerprints formulated conclusions of identity solely on minutiae. Assessments of this nature disregard valuable information that may be present in the latent print. The IAI established a standardization committee in 1970 to research and evaluate the use of a purely quantitative threshold for identification based on minutiae. In the 1973 report of the committee's findings, it was found that no scientific basis existed at the time for a strictly quantitative standard. An investigation was commissioned by the British Home Office in 1988 and resulted in a similar conclusion. *See Llera Plaza*, 188 F. Supp. 2d at 567–68. In addition to minutiae, the forensic scientist assesses the presence of skin creases, scars, and third level detail. All of these features add to the quantitative data set of evidence available in formulating conclusions.

The qualitative assessment of latent prints covers a range of issues including clarity, distortion, and the rarity of features. A latent print practically speaking is the two dimensional representation of a three dimensional formation of friction ridge skin. Clarity refers to how well the three levels of detail found in the skin reproduce in the latent impression. Taken in combination with an analysis of distortion, clarity is the guide an examiner uses to measure the significance of the quantitative data found in agreement between a latent and a known print. The total weight of evidence also rests on the rarity of features within the data set. For example, there may be a cluster of ridge endings below the delta of the latent print. Based on training and experience, the examiner considers that ridge endings are more common directly below deltas and in the absence of third level detail or other discriminating evidence adjusts the value of that finding accordingly.

66. Since the skin is not rigid like a rubber stamp, it deforms or changes shape under pressure and is the major source of latent print distortion. Distortion has the potential to induce conformational changes in the friction ridge pattern, leading to dissimilarities between a latent print and a known print. Hitherto, distortion was addressed at the level of the individual scientist through logic, experience, and consultation with other latent print examiners. Now, forensic scientists have at their disposal the results of a comprehensive study in fingerprint distortion provided by Alice Maceo. This research data establishes important measures of tolerance for latent print distortion and has tremendous predictive value when properly applied to casework. *See* Wertheim & Maceo, *supra* n. 61.

67. An inconclusive finding may be the result of several factors, including but not limited to, poor or

print as the source of the latent print.

The reliability of latent print examination methods is supported by the use of the Automated Fingerprint Identification Systems (AFIS), which gives forensic scientists the ability to select known prints from large databases that will be most similar to the latent print undergoing analysis. AFIS uses computer algorithms to assess the spatial relationship of minutiae points in the latent print. Even though minutiae represent only a small subset of the data available to fingerprint examiners, it is not uncommon for AFIS to generate candidate prints that are very similar to the latent print of interest.[68]

Similarity, however, is not identity. Utilizing the full scope of quantitative-qualitative analysis, forensic scientists are able to discriminate between the chance correspondence of limited data sets and proper conclusions of identification based on a complete analysis.[69]

H. Error Rate

The *Daubert* opinion devotes considerable space to defining scientific knowledge and validity. However, the decision offers little guidance concerning the prodigious challenge of how to define "error rate." Unlike instrumental methods that employ gas chromatographs or UV spectrometers, the method of latent print examination only exists in union with the mind of the latent print examiner. Consequently, it is difficult to distinguish between methodological and human error. Even if a test was devised to measure the combined error of the method and examiner, there is serious debate concerning the validity of the results of such a test.[70]

The same questions that arise in forensic document examination apply to the field of latent print examination. What is a valid and reasonable measure of the actual or potential rate of error in latent print examination, and what is a reasonable and reliable method for obtaining valid information on such error rates? Should error rate be calculated on the basis of individual performance, performance in comparison with other examiners, or on the performance of latent print examiners as a whole?

This raises the issue of what information may be relevant to the courts. Haber and Haber[71] insist that all forms of error should be included in the determination of a known

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incomplete known prints.

68. These occurrences are sometimes referred to as "near hits" and remain a topic of interest and discussion among forensic scientists as part of the peer review process. Near hits may be found on the internet. Captain Close, *Close Calls*, http://clpex.com/CloseCalls/CloseCalls.htm (accessed Mar. 16, 2008).

69. At least part of this discriminating power stems from the rarity of features found in the friction ridge skin impression. Rarity of features refers to the frequency of a specific type or grouping of fingerprint characteristics. Practitioners measure this frequency based on their training, on their experience observing fingerprint images, and in consultation with their peers. In addition, there is quantitative data available with respect to minutiae points. *See* Christophe Champod et al., *Fingerprints and Other Ridge Skin Impressions* 211–16 (CRC Press 2004). Champod provides probabilities of various minutiae by type and relative orientation in the fingerprint. Srihari takes a more holistic approach and uses generative computer models to gauge the overall similarity found between various fingerprints including a subset on the similarity of fingerprints in twins. *See* Sargur N. Srihari et al., *Discriminability of Fingerprints in Twins*, 58 J. Forensic Identification 109 (2008).

70. Champod notes that if a forensic scientist demonstrates zero errors based on repeated testing we cannot conclude that the individual has an error rate of zero. Champod et al., *supra* n. 69.

71. Lynn Haber & Ralph N. Haber, *Scientific Validation of Fingerprint Evidence under* Daubert, L., Probability & Risk (2007), http://lpr.oxfordjournals.org/cgi/reprint/mgm020v1.

or potential rate of error, but in practice only issues of possible false identification (Type I error) are challenged in evidentiary hearings.[72] Thus, it seems quite reasonable to argue that error rates in latent print examination are primarily (but not exclusively) concerned with the rate of false identifications. However, an individual examiner's error rate (number of false identifications/total number of identifications) cannot be reasonably generalized to the entire field of examiners.

Some individuals argue that data from proficiency tests offered by organizations such as Collaborative Testing Services (CTS) may be a valid source of information for calculating error rates.[73] While proficiency tests are valuable for purposes of certification or establishing minimum standards of performance for acceptance into professional organizations, they are less valid measures of actual examiner performance on the bench.[74] Laboratories vary with respect to the number of personnel, the method of submission of samples, operating budget, case load, and many other factors that may contribute to the processing of latent prints. Given this variability, conducting the experimental validation studies discussed by Haber and Haber[75] seems quite problematic.

With respect to fingerprint identification, it may be more appropriate to judge the known or potential error rate based on the ability of peer review (internal verification) and quality controls to prevent false identifications, which is explicitly included in the verification component of the ACE-V process. Harmon and Budowle, citing the National Research Council for DNA analyses, state that error rates are not a direct measure of reliability and that the most direct measure of reliability is the analysis of

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72. Defense attorneys gladly accept negative testimony from latent print examiners for its potential exculpatory value. In cases where an identification is made, however, error rates suddenly become an issue. It is curious that evidence derived from the same method is valid and reliable when it supports one's case, and is of questionable validity and reliability when it does not.

73. Some individuals who are critical of latent print examination have cited the twelve year old results of the 1995 proficiency exam which show that 22% of participants made one or more erroneous identifications (the CTS report attributes majority of the errors to one questioned print, which was incorrectly identified by ten respondents). Collaborative Testing Servs., *Forensic Laboratory Testing Program Report Number 9508: Latent Print Examination* (CTS 1995). Indeed the CTS Proficiency Advisory Committee (PAC) takes note of these errors and urges "immediate action to address this problem." *Id.* However, as noted by the forensic document examiners, CTS tests are available to experts and non-experts, and CTS does not distinguish results between the two groups in their report, so there is no way to determine how many of the false identifications were attributable to practicing forensic scientists.

Data from the 2007 CTS report uses latent prints and a larger sample size (351 as opposed to 156 in 1995). CTS reported an aggregate error rate of 3.4% with twelve respondents reporting false identifications. This result is in sharp contrast to the 22% error rate reported in 1995 and suggests that CTS data should be considered cumulatively when assessing its power to predict practitioner error. Two respondents incorrectly identified two latent prints. Since CTS does not distinguish between experts and nonexperts, these errors cannot be attributed to practicing examiners with any certainty. *See* Collaborative Testing Servs., *Latent Prints Summary Report Test No. 07-516*, http://www.collaborativetesting.com/reports/2716_web.pdf (2007).

A second problem with the validity of the results of the 1995 CTS exam is that the fingerprints compared in the 1995 test were not latent prints, but patent prints in blood. *See* Collaborative Testing Servs., *Forensic Laboratory Testing Program Report Number 9508: Latent Print Examination* (CTS 1995). Bloody prints are a special class of friction ridge impressions subject to distortions atypical of latent prints, and are a subject of continued research and study.

74. The same arguments against using CTS proficiency tests to determine error rates in forensic document examination apply to the use of such tests to determine error rates in latent print examination. *See supra* n. 46.

75. Haber & Haber, *supra* n. 71.

another expert.[76] In addition, Langenburg has conducted a pilot study to examine the resolving power of peer review.[77] The study participants deliberately reported findings of false identification and false exclusion and submitted these conclusions for peer review. The resulting data shows that all false positives were eliminated following review by another expert.

Some individuals argue that current verification procedures are unreliable due to confirmation bias. Recent research by Dror demonstrated that when a small sample of examiners were given information about previous examiner conclusions that were presumably erroneous identifications and asked to conduct a second evaluation, examiners moved toward more conservative conclusions.[78] Langenburg also found that a larger sample of examiners who were given a case of presumably erroneous identification changed to more conservative conclusions of "inconclusive."[79] These data do provide some evidence of confirmation bias, as the examiners in the two studies did change to more conservative conclusions (i.e., their conclusions shifted in the direction of the biased information, and confirmed the results of the previous examination when given no biasing information). The conflicting findings of these studies demonstrate that more research is needed to provide a clear picture of the possible effects of confirmation bias. Such studies may or may not indicate that blind verification is more desirable that current practice. However, blind confirmation may not be feasible, given the characteristics of laboratories discussed above. Research demonstrates that education about the possible effects of bias effectively eliminates bias-related errors in perception.[80] Including such education in examiner training may be a more feasible method of controlling for unconscious bias.

I. The Existence and Maintenance of Standards Controlling the Operation of the Techniques

The field of latent print examination includes practitioners in local, state, and government jurisdictions as well as private agencies. In a rapidly changing field of study with such a wide variety of interested parties it was apparent that a means of

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76. Rochne Harmon & Bruce Budowle, *Questions about Forensic Science*, 311 Sci. 607, 607 (2006).

77. Glenn Langenburg, Presentation, *Pilot Performance Study of Latent Print Examiners* (Intl. Assn. Identification 92nd Intl. Educ. Conf., San Diego, Cal., July 2007).

78. Itiel Dror et al., *Contextual Information Renders Experts Vulnerable to Making Erroneous Identifications*, 156 Forensic Sci. Intl. 74 (2005). Dror conducted a study in which latent print examiners were presented with cases in which the examiners previously came to conclusions of identification. *Id.* at 75. They were told that the evidence was from a case in which an erroneous identification was made and asked to conduct their own analysis. *Id.* at 76. All but one examiner changed their finding to inconclusive or exclusion. *Id.* Even if one disregards the small sample size used for the study (only five examiners were surveyed), the results show that examiners moved toward more conservative conclusions when supplied with conflicting information. No erroneous identifications were made.

79. Langenburg used a larger sample size, included a control group where no contextual bias was introduced, and presented examiners with a case of false identification. The results showed that the participants reported a more conservative finding in cases of contextual bias with most examiners reporting inconclusive results in comparison with the control group. The study data (Dror and Langenburg) suggests that when contextual bias affects latent print comparison, examiners are more likely to report false exclusions than erroneous identifications. *See* Langenburg, *supra* n. 77.

80. Judith H. Langlois & Perry H. Prestholdt, *Information: A Control for Observer Bias*, 102 J. Soc. Psychol. 133 (1977).

standardization was necessary. In 1995, the National Institute of Justice in conjunction with the FBI created SWGFAST, the Scientific Working Group on Friction Ridge Skin Analysis, Study and Technology. SWGFAST is a group of forty members representing both law enforcement and the forensic community in general. Among SWGFAST's published objectives are the establishment and dissemination of guidelines and standards for the development of friction ridge examiners' knowledge, skills, and abilities. This work is done in conjunction with other relevant national and international organizations.[81] SWGFAST has put forth a set of documents that represent a consensus of the latent print examination community with respect to a variety of topics including training, proficiency testing, and methodology.[82]

In addition to SWGFAST, both the International Association of Identification (IAI) and the American Society of Crime Laboratory Directors—Laboratory Accreditation Board (ASCLD-LAB) are organizations that influence the standards used in the field of latent print examination.

Forensic labs accredited by ASCLD must provide evidence that they are in compliance with the objectives established by this agency. Latent print examiners employed by ASCLD certified labs must meet this set of standards as a requisite of employment. In addition to ASCLD requirements, crime laboratories operate under a set of quality control standards established by their agency. These "in house" standards are implemented to ensure quality results are provided to commissioned officers and the courts served by the given agency.

J. Peer Review and Publication

Peer review and publications in the area of fingerprint formation and identification began more than one hundred years ago. Early studies arose out of scientific curiosity with regard to the variability and individuality of fingerprint patterns. These studies were descriptive in nature and constitute a rich and diverse collection of empirical scientific data rooted in careful observation.[83] Likewise, at the turn of the twentieth century, scientists and investigators, using data from descriptive studies, formulated the first methods to use friction ridge skin impressions for personal identification.[84] Furthermore fingerprint research did not end with descriptive studies. As the body of descriptive studies grew, researchers began to question and investigate the biological processes responsible for these observations.[85] This body of research has been published

81. SWGFAST, *Bylaws*, http://www.swgfast.org/bylaws_3.0.pdf (Sept. 20, 2007).

82. *Id.* at http://www.swgfast.org.

83. *Supra* n. 59.

84. Judge Souder in her decision to exclude latent print evidence in *Rose*, No. K06-545 (mem.) discusses the one hundred year history of fingerprint identification and dismisses it as reliable evidence citing the long held belief that the earth is flat. This conclusion does not account for the differences in empirical observation between professionally trained, competent scientists and non-experts. Good scientists are keen and cautious observers driven by their training and curiosity, and good scientists are particularly responsive to those observations. It may be that most people in the ancient world were not concerned with the shape of the earth and that treating it as flat was the most expedient option. Yet there is evidence that as early as 330 BC, Aristotle and others used *observational* data regarding the position of constellations and other astronomical data to infer that the earth *must* be spherical.

85. Note that the study of the variability of friction ridge skin can be traced back as early as 1977 to

in a variety of peer-reviewed journals with readership from among the natural, social, and forensic sciences.[86]

Researchers in the latent print field also present their studies directly to peers at seminars and educational conferences sponsored by forensic science organizations such as the International Association for Identification, The Fingerprint Society, the Canadian Identification Society, and the American Academy of Forensic Sciences.

K. General Acceptance

The *Daubert* decision states that the general acceptance standard, established in the U.S. Court of Appeals decision *Frye v. United States*, is still a factor judges may consider when determining the admissibility of expert testimony. *Frye* states that "the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs."[87] The relevant scientific community for latent print examiners includes members of forensic science organizations such as the International Association of Identification and the American Academy of Forensic Sciences, which encompass many forensic disciplines.

As with forensic document examination, membership in this community should be based on affiliation with multi-discipline forensic organizations, coursework in the appropriate academic disciplines, and training and experience in the field.

V. REFINING AND REDEFINING THE RELIABILITY OF FORENSIC SCIENCE

In her 2001 article *Fingerprint Evidence in an Age of DNA Profiling*, Jennifer Mnookin wrote:

> The overall story this Article will tell is that scrutiny of expert evidence does not take place in a cultural vacuum. What seems obvious, what needs to be proven, what can be taken for granted, and what is viewed as problematic all depend on cultural assumptions and shared beliefs, and these can change over time in noticeable and dramatic ways. Whatever the ostensible legal standard used, it is filtered through these shared beliefs and common practices.[88]

This view is similar to one expressed by Sheila Jasanoff, who in 1993 wrote perhaps "[t]he most significant insight that has emerged from sociological studies of science in the past 15 years is the view that science is socially constructed."[89] In her article titled *What Judges Should Know about the Sociology of Science*, Jasanoff argued that scientific facts are socially derived by consensus among relevant bodies of scientists.

The idea that scientific knowledge, and subsequently legal scientific knowledge, is socially constructed is highly relevant to discussions about the admissibility of any kind

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William Babler's Doctoral Thesis at the University of Michigan, about fifteen years prior to *Daubert*. Babler, *Prenatal Development*, *supra* n. 60.

86. These journals include such publications as: *Journal of Forensic Identification*, *Fingerprint World*, *Forensic Science International*, *Journal of Forensic Sciences*, *Vision Research*, *American Journal of Physical Anthropology*, and *Collegium Anthropologicum*.

87. 293 F. at 1014.

88. Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 Brook. L. Rev. 13, 15 (2001).

89. Jasanoff, *supra* n. 9, at 77.

of expert testimony. Truly understanding the development of any field of expertise requires at the very least some recognition of the reciprocal influences of historical and social context and human agency on the development of such knowledge.

Jasanoff points out that during a controversy, that which is constructed can be "deconstructed," or pulled apart to reveal its constituent elements. With respect to current controversies about forensic document examination and latent print examination, these elements include the theoretical foundation upon which the fact is based, the methodology used to create the fact, the conventions (both scientific and legal) upon which decisions about the importance or relevance of the fact are established, and who is qualified to produce, evaluate, or speak for the fact. Jasanoff refers to the deconstruction of the facts as "experimenters' regress." Deconstruction of the qualifications of the experts is called "boundary work."[90] Boundary work is a form of legitimization by which members of a scientific community defend their right to be the spokesperson for the fact. Scientific communities resist criticism from outsiders, rejecting or dismissing the claims of those outside their discipline, whom they sometimes label misfits, charlatans, deviants, quacks, or non-scientists. Boundary work is often tied to credentialing. According to Jasanoff, boundary work helps scientific communities maintain the stability of their findings by resisting criticisms from those outside the community. She notes that the boundaries around fields change over time, becoming moving targets that are defined in relation to changing cultural, political, scientific, and historical circumstances.[91]

The means and incentives for engaging in boundary work and experimenters' regress are inherent in the adversary system, where the development of expert testimony is initiated by a crime or dispute outside the lab. The importance of the various physical artifacts recovered from crime scenes is determined by the extent to which they can be used to convict or clear possible suspects. Many such artifacts are collected by investigators, but for a variety of reasons are never processed by crime labs. For example, a handwriting sample or latent print may be recovered from a crime scene, but a suspect's confession may make it unnecessary to submit these artifacts to the crime lab for development into evidence. Thus, the movement toward the production of a legal scientific fact (e.g., the conclusion of a forensic examiner) is generally initiated by prosecuting or defense attorneys who place strategic value on the outcome of the examination.

After recognizing the strategic significance of the development of evidence and initiating its production, proffering attorneys are then required to advocate for the admissibility of such evidence, while opposing attorneys must advocate for its exclusion if the evidence is to be challenged. The importance of the historical role of attorneys in the construction of the reliability of expert testimony cannot be overlooked. Mnookin wrote when discussing the history of the admissibility of handwriting identification evidence:

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90. Jasanoff, *supra* n. 9, at 78; *see also supra* n. 12.

91. *See* Shiela Jasanoff, *Science at the Bar: Law, Science, and Technology in America* (Harvard U. Press 1995).

> In the case of handwriting experts, judicial determinations about admissibility were the driving force in generating beliefs in the reliability of the evidence itself. Handwriting experts shaped the form of their expertise with judicial conceptions of science in mind; they designed their methods of analysis and presentation with one eye clearly focused on how to persuade judges that they should be heard. The reliability of expert evidence in handwriting was co-produced by judges and experts in tandem. Judges did not simply certify a reliable technique; their beliefs helped shape the form taken by the technique, and their decisions and their dicta helped create its authority.[92]

Research demonstrates that admissibility is indeed shaped in part by judicial decision-making, but the bases underlying such decisions vary according to the judge and the type of evidence.[93] However, research and case law also clearly demonstrate that judges place the responsibility for providing them with adequate information on which to base their decisions squarely on the shoulders of attorneys.[94] Thus, the motives that Mnookin seems to impute to handwriting and latent print experts seem slightly misplaced, as this particular statement completely overlooks the contribution of attorneys who first recognized the strategic possibilities of observational techniques that were already in use by areas outside law, brought the experts before the judges, and argued compellingly before the courts for the reliability and admissibility of such expertise.

Having successfully established the reliability of handwriting analysis and latent print examination well before *Frye*, it is not really surprising that attorneys and critics who are now attempting to challenge the admissibility of such expert testimony following the *Daubert* trilogy have been met with relatively little success. The content analysis presented in Part I demonstrates that although the falsifiability, error rate, existence or maintenance of standards controlling the technique's operation, peer review and publication, and general acceptance of forensic expert testimony have been successfully challenged on some occasions, the majority of challenges to this type of evidence have been unsuccessful. Critical examination of published decisions and transcripts of these cases offers some insights into why this is the case. A comprehensive discussion of case law is beyond the scope of this paper, but we offer as one example the exclusion of the defense's proffer of the testimony of Dr. Simon Cole in *People v. Hyatt*.[95]

Both boundary work and experimenters' regress are clearly evident in the transcript of this pre-trial hearing.[96] The defense proposed to have Cole, who described

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92. Jennifer L. Mnookin, *Scripting Expertise: The History of Handwriting Identification and the Judicial Construction of Reliability*, 87 Va. L. Rev 1723, 1742 (2001).

93. *See* Sophia I. Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post-Daubert World,* 25 Law & Human Behavior 433 (2001). The authors found considerable inconsistency among judges in the kinds of evidence they considered "scientific," "technical," or "other specialized knowledge." Two-hundred forty-three of the 400 participants in their study "believed that 'scientific knowledge' could be distinguished from 'technical or otherwise specialized knowledge.'" *Id.* at 448. Of these 243 judges, 203 (85%) indicated that this distinction should be made "on a case-by-case basis, depending on the nature of the evidence proffered, the purpose for which the evidence is proffered, the qualifications of the expert offering the evidence, and existing precedents." *Id.* at 448–49.

94. *Supra* n. 12.

95. No. 8852/2000 (N.Y. Sup. Ct. Oct. 10, 2001).

96. Frye Hrg., *Hyatt*, No. 8852/2000 (available at http://onin.com/fp/ny_v_hyatt_simon_cole_testimony_4oct01.pdf).

himself as a sociologist and historian of science and technology, testify that latent print evidence was not scientific according to the *Daubert* guidelines. Cole was described by the prosecuting attorney as "simply a historian" who was not a qualified latent print examiner, whose working knowledge of latent prints was minimal, and who had never consulted with the examiner who actually conducted the investigation to learn what methods and techniques were used.

Judge Michael Brennan wrote in his decision:

> It is incumbent upon the proponent of expert scientific testimony to lay a proper foundation establishing that the processes and methods employed by the expert in formulating his or her opinions adhere to the accepted standards of reliability within the field.... [T]he methodology... from which Dr. Cole's deductions are made are anecdotal and second hand rather then [sic] scientific.... His approach to this issue is historical in nature and can hardly be viewed as generally accepted as reliable in the relevant scientific community.... Dr. Cole's proposed attack on the scientific underpinning of fingerprint identification is more in the nature of the roll [sic] of an advocate or historian and not as an expert. His testimony would neither be relevant to the issues in this case nor assist the jurors who as triers of fact might be in need of specialized information.
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> . . .
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> What Dr. Cole has offered here is interesting but too lacking in scientific method to even bloody the field of fingerprint analysis as a generally accepted scientific discipline.[97]

In this case the prosecution effectively turned Cole's own argument against him, which is reflected in the Judge's decision. Cole sought to convince the court that latent print examination evidence should be excluded because it could not satisfy the requirements of *Daubert* (although New York was, and is, a *Frye* state). However, Cole's own testimony did not meet these requirements. It is not enough to assert that the identification sciences are unreliable, biased, or invalid without any properly conducted research as a foundation for such assertions, and it is to Judge Hynes's credit that he held Cole's testimony to Cole's own high standards.

Indeed, it is our belief that all expert testimony should be held to high standards of reliability, and challenges to the admissibility of forensic document and latent print examination after *Daubert* and *Kumho* have brought into focus some important issues for all areas of forensic science. For example, it is not enough to assert that current practice is the best practice without empirical support. Many latent print examiners and forensic document examiners have taken seriously the need for standardized training and proficiency testing, as discussed above, and are working to define and establish valid and reliable measures of proficiency and error. Empirical research investigating the visual processing of latent print and handwriting specimens has begun to illuminate the nature of expertise in these areas. Research into possible sources of bias such as expectancy effects has also begun. Critical thinking is a hallmark of science, and ongoing research is needed if the forensic fields are to recognize their strengths and weaknesses and continue to grow as disciplines.

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97. *Hyatt*, No. 8852/2000, slip op. at *1.

Forensic experts are also striving to ensure that their methods are transparent to the courts, and that judges are given the information they need to make their decisions. Efforts to organize and present information effectively have been an important consequence of the *Daubert* trilogy. Forensic scientists are seeking opportunities to collaborate with judges, attorneys, and scientists from other fields on research and education projects.

Daubert, *Joiner*, and *Kumho*, agents of change in a time of rapid advances in science and technology, have given forensic document and latent print examiners much to consider as they rise to the challenges created by changing definitions of reliability. Refining and redefining the reliability of forensic science evidence is a process that proceeds much as science itself proceeds. It is an ongoing process based on effort, critical thinking, collaboration, cooperation, communication, evaluation, discovery, and self-examination. We welcome these challenges as scientists and look ahead in anticipation to the advances that new knowledge will bring.