

MODERN SCIENTIFIC EVIDENCE

Volume 1

PART 1 LEGAL STANDARDS

CHAPTER 1

THE LEGAL STANDARDS FOR THE ADMISSIBILITY OF SCIENTIFIC EVIDENCE

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WESTLAW Electronic Research

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§ 1-1.0 INTRODUCTION

Courts continue to struggle to define a standard for evaluating the admissibility of expert testimony based on scientific knowledge. This is a problem with a venerable history¹ and, in all likelihood, an enduring future. Although modern science's roots lie in the eighteenth century,² only in the twentieth did it spread and bloom across virtually the entire human landscape. The courtroom, never an isolated corner of the societal landscape, has similarly felt science's impact.³ Over the years, courts have tried various methods to respond to the increasing influx of science. This Chapter examines the two principal approaches courts use, with special attention given to the most recent variation announced by the United States Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*⁴

The two principal lenses through which courts view scientific evidence are the general acceptance standard of *Frye v. United States*⁵ and the validity standard of *Daubert*.⁶ Although these perspectives represent the two basic alternatives in current practice, they share many common requirements. For instance, both tests similarly require that the evidence be "relevant" and that the expert be "qualified."⁷ Moreover, in practice, courts adhering to one regularly borrow from the other;⁸ indeed, *Daubert* incorporates the very core

§ 1-1.0

1. For a general historical overview of the use of expert testimony see Stephan Landsman, *Of Witches, Madmen, and Products Liability: An Historical Survey of the Use of Expert Testimony*, 13 BEHAV. SCI. & THE LAW 131 (1995); see also David L. Faigman, Elise Porter & Michael J. Saks, *Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying About the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799, 1803-1809. (1994) (examining the modern rule in light of the standards that prevailed in the nineteenth and early twentieth centuries). The classic exploration of this historical question is Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 40 (1901).

2. See generally TOBY E. HUFF, *THE RISE OF EARLY MODERN SCIENCE* (1995).

3. See generally SHEILA JASANOFF, *SCIENCE AT THE BAR: LAW, SCIENCE AND TECHNOLOGY IN AMERICA* (1995).

4. 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993).

5. 293 F. 1013 (D.C.Cir.1923).

6. See generally *Recent Developments in the Law: Confronting the New Challenges of Scientific Evidence*, 108 HARV. L. REV. 1481, 1481-88 (1995) [hereinafter cited as *Developments—Scientific Evidence*].

7. See Margaret A. Berger, *Evidentiary Framework*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 37, 47, 55-67 (Federal Judicial Ctr. ed., 1994).

8. In fact, as some courts grew increasingly disillusioned with *Frye*, they began to define general acceptance in terms of scientific validity. See e.g., *United States v. Franks*, 511 F.2d 25, 33 n. 12 (6th Cir.1975) ("We deem general acceptance as being nearly synonymous with reliability. If a scientific process is reliable, or sufficiently accurate, courts may also deem it 'generally accepted.'"), cert. denied 422 U.S. 1042, 95 S.Ct. 2654, 45 L.Ed.2d 693 (1975).

of *Frye* as one factor among several courts should consider in the evaluation of expert testimony.⁹ In addition, over time courts have added to and subtracted from these two principal alternatives. Therefore, while organized around these perspectives, this Chapter examines in some detail their variations across jurisdictions.

§ 1-2.0 THE GENERAL ACCEPTANCE STANDARD OF *FRYE*

§ 1-2.1 Before *Frye*

Courts in the nineteenth and early twentieth centuries queried only whether the expert was “qualified” before the expert’s testimony could be admitted.¹ If the expert was an expert, then opinion testimony was “entitled” to be admitted as evidence (given, of course, its apparent relevance to the issues to be determined at trial).² A more sophisticated version of this pre-*Frye* test focused, first, on the nature of the subject matter in issue and whether that subject matter was beyond the range of knowledge of the average juror. If so, a qualified expert’s opinion was considered to be helpful,³ if not essential, to the jury’s determination of facts at issue.⁴

The assurance of expertise was implied by the expert’s success in an occupation or profession that embraced that knowledge. If a person could make a living selling his knowledge in the marketplace, then presumably expertise existed.⁵ Although courts sometimes spoke of an expert’s “greater study respecting certain subjects” or having “made the subject upon which he gives his opinion a matter of particular study,”⁶ it seems clear that a modicum of prosperity in the practice of the occupation or profession possessing that knowledge almost always accompanied the expertise. In effect, the marketplace determined whether valid knowledge existed by endowing it with

9. *Daubert’s* inclusion of “general acceptance” does not, by itself, make the new rule more or less liberal than the old one. The question whether *Daubert* is a more liberal test than *Frye* has been the subject of intense scholarly debate. This matter is considered infra § 1-3.3.4.

§ 1-2.0

1. For an examination of the modern application of the qualifications requirement, see infra § 1-3.2.

2. Albert S. Osborn, *Reasons and Reasoning in Expert Testimony*, 2 LAW & CONTEMP. PROBS., Oct. 1935, at 488, 489. Conditioning the admission of expert testimony on nothing more than the expert’s “qualifications” went on before *Frye*, after *Frye*, after the Federal Rules, and perhaps will after *Daubert*. See generally, Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half Century Later*, 80 COLUM. L. REV. 1197, 1210 (1980).

3. The “helpfulness” element of admissibility is still present today in the Federal Rules of

Evidence. See e.g., FED. R. EVID. 702 (expert can testify if it “will assist the trier of fact”)(emphasis added). Today, this helpfulness element is also referred to as a “relevancy” requirement. See infra § 1-3.1.

4. As stated by one commentator in 1880:

The practice of the courts is to admit the testimony of a class of witnesses who are not supposed to have personal knowledge of any facts or circumstances bearing upon a pending case, but on the assumption that they are able from their special training and experience to apply scientific tests and present to the court and jury the import and value of such evidence as may appear, which laymen could not be expected to comprehend and properly estimate.

John B. Chapin, *Experts and Expert Testimony*, 22 ALB. L. J. 365, 365 (1880).

5. We, therefore, refer to this as the “commercial marketplace test.”

6. *Jones v. Tucker*, 41 N.H. 546, 548 (1860).

commercial value. This is not a point that courts made explicitly, but it seems to be implicit in the courts' determinations of who was "qualified."⁷

On the one hand, this seems practical enough. What better crucible for testing expertise than the everyday world of life's activities, with stakes as great or greater than those at issue in trials, and decisions reflected in consumers' hard earned dollars? Knowledge that proved valuable in the marketplace could hardly be without worth in a courtroom. But though it might be a practical and easily administered test, the test of commercial value is a poor one. Its major weaknesses are perhaps more obvious today than they were a century or two ago. The market not only selects for validity, it selects also for entertainment, desire, wishful thinking, hope, sometimes even desperation. These are not without their value, but they are not good proxies for what courts are looking for in expert testimony. If the marketplace approves, as it does, of astrologers, sellers of phony cancer cures, and guides to new age vortices, are those therefore good enough to provide guidance in a courtroom? The marketplace test is incapable of distinguishing astrology from astronomy.⁸

A second problem is that some fields exist that have little or no life in any commercial marketplace. Indeed, some fields have come into being in the past century that have no function outside of their possible courtroom utility.⁹ The courtroom *is* their marketplace.

7. Consider three examples from the middle of the 19th century. Chief Justice Lemuel Shaw, writing in *New England Glass Co. v. Lovell*, 61 Mass. (7 Cush.) 319 (1851):

It is not because a man has a reputation for superior sagacity, and judgment, and power of reasoning, that his opinion is admissible; if so, such men might be called in all cases, to advise the jury, and it would change the mode of trial. But it is because a man's professional pursuits, his peculiar skill and knowledge in some department of science, not common to men in general, enable him to draw an inference, where men of common experience, after all the facts proved, would be left in doubt.

Id. at 321.

Chief Justice Ames writing in *Buffum v. Harris*, 5 R.I. 243 (1858), affirming a lower court decision to admit the opinions of two civil engineers, a well-digger, a farmer, and a gardener in an action on the case to recover damages for interference with the flow of water from a natural spring on plaintiff's property:

Indeed, knowledge of any kind, gained for and in the course of one's business as pertaining thereto, is precisely that which enti-

ties one to be considered an expert, so as to render his opinion, founded on such knowledge, admissible in evidence.

Id. at 251.

Or the Supreme Court of Maine in *Clark v. Rockland Water Power Company*, 52 Me. 68 (1860):

The foundation on which expert testimony rests, is the supposed superior knowledge or experience of the expert in relation to the subject matter upon which he is permitted to give an opinion as evidence. This knowledge must be such as is peculiar to persons of skill and experience in some particular branch of business, or department of science, which is the subject of investigation, and not of such a character as to be open and common to all persons.

Id. at 77.

8. The *Frye* test also cannot distinguish between science and pseudoscience; after all, astrological forecasts are "generally accepted" in the "pertinent field" of astrology. See *infra* notes 35-42 and accompanying text.

9. Some of these have been appropriately gathered under the heading of forensic sciences, and they include the identification of

Finally, the marketplace test conflates the expert and the expertise. Before the twentieth century courts apparently never considered the question of expertise disentangled from the professionals and tradespeople who carried the knowledge at issue. That is, they never asked whether a body of asserted knowledge existed, and could be validated, separate from the "qualified expert" who "possessed" it. The people and the knowledge were treated as one. If experts were "qualified," then expertise existed.¹¹ But being a "qualified expert" presupposes that an expertise exists in which someone may become an expert.

§ 1-2.2 The Frye Extension

The defendant in *Frye* proffered an early form of polygraph testing, the "systolic blood pressure deception test," the results of which supported James Alphonso Frye's plea of innocence to a charge of murder.¹² This was an unfamiliar problem for a court. There were as yet no polygraphers and no developed market for their services. There might never be, if the only place that had any use for them was the courtroom, and if the only way to get in the courtroom was to gain prior marketplace acceptance.¹³ A novel scientific question presented itself and the conventional test offered no ready solution. The asserted expertise offered in *Frye* demanded a different test than the one that had served the law for so long.

Judge Van Orsdel found a solution that departed as little as possible from prior law. The entire *Frye* opinion took up only two pages. The critical words are these:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing

firearms, handwriting, tiremarks, fibers, toolmarks, and so on.

10. So have many courts right up to the present time. See, e.g., Giannelli, *supra* note 2.

11. Osborn, *supra* note 2, at 489.

12. See generally James E. Starrs, *A Still Life Watercolor: Frye v. United States*, 27 J. FORENSIC SCI. 684 (1982)(discussing the facts presented in the case and refuting the assertion that *Frye* might have been innocent).

13. See *infra* Chapter 14 for a review of the admissibility of polygraph tests today.

Today, the polygraph has a very developed market outside the courtroom. This market, however, as the chapter from Professors Iacono and Lykken argues, *infra*, is not necessarily based on the same utility as the courtroom use of the technique. Polygraphs might serve a useful practical function—such as promoting confessions—that is substantially unrelated to their validity.

14. The court in *Frye* may have had a second problem. Suppose it wanted to exclude the lie detection results, then and thereafter, even if some day such examiners did attain a commercial market and qualified polygraphers were plentiful. The most obvious reason a court might feel this way is that polygraph testing could become a major vehicle by which at least some defendants could make a jury find there is reasonable doubt about guilt. That would not be easy in a legal world where, despite "constant complaining and mistrust" of experts, routinely admitted them—so long as they were "qualified." And William Marston, *Frye's* expert witness, was well qualified by conventional standards (if he actually had expertise in the subject at issue). Marston was an attorney and research psychologist who had done a considerable amount of empirical research on the physiological correlates of lying. See William M. Marston, *Systolic Blood Pressure Symptoms of Description*, 2 J. Ex. Psy. 117 (1917).

from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.¹⁵

In one sense, this is nothing more than the familiar market test relocated into a different marketplace. Where there is no commercial market, and may never be one, the evaluation of the asserted expertise can be performed in the “field’s” marketplace by those who trade there.¹⁶ The intellectual or professional marketplace was simply a proxy for the commercial marketplace. The test is still a marketplace test; the real evaluation still is conducted outside of the court or the law; and it still is incapable of distinguishing astrology from astronomy.

Yet the *Frye* extrapolation did some new things. First, it separated the expertise from the expert, thereby creating legal accommodation to the notion that a body of asserted knowledge has an existence separate from any individual, no matter how brilliant, well-educated, or experienced that person might be, and that the body of asserted knowledge had to be evaluated apart from the individual who brings it to court. Second, of course, the alternative marketplace, the intellectual marketplace, allows more knowledge to be assessed, even if the knowledge is too new to be marketed commercially or if there is no hope of ever marketing it commercially.

Third—and most remarkable—as assessors of the value of what was being offered, *Frye* replaced buyers with sellers.¹⁷ The commercial marketplace test, even with its serious weaknesses, had the virtue of allowing buyers in the marketplace to be the authority on whether something was valuable and therefore “valid.” Under the *Frye* variation, that control was passed to the people who produced the knowledge and offered it, and themselves, to the courts.¹⁸

Primarily, the “*Frye* test” was a minor adaptation of a major theme. For most kinds of expertise in most circumstances, the larger doctrine and the special situation would lead to the same result. So unimportant was the *Frye* extrapolation that it went unnoticed for decades. No contemporaneous law

15. *Frye*, 293 F. at 1014.

16. See e.g., *People v. Barbara*, 400 Mich. 352, 255 N.W.2d 171, 194 (1977) (“It therefore is best to adhere to [the *Frye*] standard which in effect permits the experts who know most about a procedure to experiment and to study it. In effect, they form a kind of technical jury, which must first pass on the scientific status of a procedure before the lay jury utilizes it in making its findings of fact.”).

17. The practical result of this shift is that courts adopt the same standards of the respective field that is the subject of the admissibility decision. Rigorous scientific fields result in rigorous admissibility standards, whereas fields lacking a rigorous tradition result in low admissibility standards. Even tea leaf reading is generally accepted if the field surveyed is practicing tea-leaf readers.

18. While this might strike some readers as an odd or even dangerous relocation of the power to make important judgments, it was entirely consistent with one of the defining notions of professionalism that was alive in that period and for some time thereafter: to be a profession is to hold a monopoly of judgment over what constitutes your field’s expertise, and in many respects the courts have been deferential to the claims of other professions. The latter part of the twentieth century has seen a weakening of the status of professions, and the most recent shifts in the rules of evidence may be seen to parallel the loss of autonomy of professions. See generally SAMUEL HABER, *THE QUEST FOR AUTHORITY AND HONOR IN THE AMERICAN PROFESSIONS 1750-1900* (1991); RONALD M. PAVALKO, *SOCIOLOGY OF OCCUPATIONS AND PROFESSIONS* (2d ed. 1988).

review articles were written about it and other courts did not cite it.¹⁹ In fact, *Frye* only became fashionable in the 1970's as an argument arose over the admissibility of scientific evidence, perhaps in anticipation of the new Federal Rules.²⁰

§ 1-2.3 *Frye's* Ascendance

Although barely noticed for decades, the "*Frye* Test" eventually became the icon for one of the dominant notions of the proper criterion for the admissibility of scientific evidence—general acceptance within its field.²¹ *Frye* may have become the standard of choice for several reasons. Foremost, perhaps, it was easy to apply and required little scientific sophistication on the part of judges. Moreover, the controversial cases were of the subset of scientific evidence cases that *Frye* was designed to deal with: asserted new knowledge that lacked an established clientele. To established fields of endeavor, to old "knowledge," the courts implicitly applied the old marketplace notions: if one were a card carrying member of a recognized occupation or profession, one's proffered expert testimony was admitted and the validity of the underlying knowledge was assumed.²² Finally, by the middle of the twentieth century, the distinction between experts and expertise had grown more apparent. Not only did new fields or new specializations arise, but old fields acquired and offered distinct new knowledge. New knowledge was sometimes put before courts in a form more abstracted and isolated from the people who presented it. *Frye* had been designed to fit just these kinds of situations.²³

§ 1-2.4 The Decline of *Frye*

Over time, courts and commentators found the general acceptance test to

19. *Frye* was not cited by a single court for a decade. During the first quarter century after its publication, *Frye* was cited in eight federal cases and five state cases. During its second quarter century, it was cited fifty-four times in federal cases and twenty-nine times in state cases. By the 1980's, it was being cited as much each year as it had been in its first fifty years. These numbers suggest that judicial interest in the *Frye* test did not pick up until a few years before the promulgation of the Federal Rules of Evidence and thereafter, no doubt stimulated by the drafting and adoption of the Federal Rules themselves.

20. See Paul C. Giannelli, *Frye v. United States—Background Paper Prepared for the National Conference of Lawyers and Scientists*, 99 F.R.D. 188, 191 (1983); J.E. Starrs, "A Still-Life Watercolor": *Frye v. United States*, 27 FORENSIC SCI. 684, 685 (1982).

21. See e.g., *United States v. Skeens*, 494 F.2d 1050, 1053 (D.C.Cir.1974) (*Frye* "has been followed uniformly in this and other circuits."); *Reed v. State*, 283 Md. 374, 391 A.2d 364, 368 (1978) ("This criterion of 'general acceptance' in the scientific community has come to be the

standard in almost all the courts in the country which have considered the question of the admissibility of scientific evidence."). See generally Steven M. Egesdel, Note, *The Frye Doctrine and Relevancy Approach Controversy: An Empirical Evaluation*, 74 GEO. L.J. 1769, 1769-70 (1986).

22. Yet, some portion of the "knowledge" of established fields is invalid. For example, many accepted medical techniques have been found after finally being subjected to rigorous empirical testing to be no better or worse than less well accepted treatments or no treatment at all. See John P. Gilbert et al., *Progress in Surgery and Anesthesia: Benefits and Risks of Innovative Therapy*, in COSTS, RISKS, AND BENEFITS OF SURGERY 124 (John P. Bunker et al. eds, 1977).

23. For further discussion of the strengths and weaknesses of the *Frye* Test, see infra § 1-3.3.4 and accompanying text (discussing the general acceptance standard as a factor in the *Daubert* validity test).

have significant limitations.²⁴ In particular, the vagueness of the general acceptance test renders it susceptible to manipulation and tends to obscure the relevant inquiry.²⁵ Indeed, virtually every component of the test has sustained severe criticism.

Frye is often criticized as overly conservative, for it imposes a protracted waiting period that valid scientific evidence and techniques must endure before gaining legal acceptance.²⁶ This criticism highlights the fact that all significant scientific findings gestate before they are accepted by the general scientific community.²⁷ During this time period courts and the parties before them are deprived of this work. Moreover, many critics also note the “nature” of the scientific enterprise which sometimes responds negatively to revolutionary findings, because they might threaten entrenched “paradigms” and thus entrenched scientists.²⁸ Proponents of this view observe that the views of a scientist heralded today as brilliant, but dismissed in his day as misguided or worse, would be excluded under a general acceptance test. Galileo, for example, or Einstein early in his physics career, would not have been allowed to testify because of the radical nature of their views.²⁹

Commentators responding to this criticism of *Frye* argue that for every Galileo or Einstein there are hundreds of Lysenkos with “revolutionary” theories that are eventually proven false by empirical research. They maintain further that judges (and jurors) should not be expected to distinguish “true” scientific revolutions from “false” ones. If scientists are unable to recognize an Einstein when they see one, laypersons are unlikely to have this ability.

Another asserted weakness of the *Frye* approach concerns the difficulty of ascertaining when a scientific proposition has been generally accepted.³⁰ The test does not specify what proportion of experts constitute general acceptance.³¹ Courts have never required unanimity, and anything less than full

24. See MCCORMICK ON EVIDENCE, § 203, at 871-77 (4th ed. 1992); JAMES R. RICHARDSON, MODERN SCIENTIFIC EVIDENCE: CIVIL AND CRIMINAL § 9.2, at 290 n.8 (2d ed. 1974); see generally *United States v. Downing*, 753 F.2d 1224, 1235-37 (3d Cir.1985).

25. *Downing*, at 1236.

26. See 1 DAVID LOUISELL & CHRISTOPHER B. MUELLER, FEDERAL EVIDENCE § 703.2 at 821-22 (3d ed. 1991); Giannelli (1980), *supra* note 2, at 1223; see also *United States v. Addison*, 498 F.2d 741, 743 (D.C.Cir.1974).

27. Constantine J. Maletskos & Stephen J. Spielman, *Introduction of New Scientific Methods in Court*, in LAW ENFORCEMENT, SCIENCE & TECHNOLOGY, 957, 958 (S.A. Yefsky ed. 1967) (“A literal reading of *Frye v. United States* would require that the court always await the passing of a ‘cultural lag’ during which period the new method will have had sufficient time to diffuse through scientific discipline and create the requisite body of scientific opinion needed for acceptability.”).

28. See David F. Horrobin, *The Philosophical Basis of Peer Review and the Suppression of Innovation*, 263 J. AM. MED. ASSN. 1438 (1990). The classic treatment of “paradigms” in science is THOMAS KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* (1970).

29. See e.g., Brief Amici of Physicians, Scientists, and Historians of Science in Support of Petitioners, at 14, submitted in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993)(No. 92-102)(The Brief noted Galileo’s persecution by the inquisition and quoted Thomas Huxley’s remark that “[e]xtinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules.”)(citing and quoting Darwiniana, *THE ORIGIN OF SPECIES* (1860)).

30. See generally Bert Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595, 627-28 & n.156 (1988).

31. See e.g., *United States v. Williams*, 583 F.2d 1194, 1198 (2d Cir.1978), cert. denied, 439 U.S. 1117, 99 S.Ct. 1025, 59 L.Ed.2d 77 (1979).

consensus in science can quickly resemble substantial disagreement.³² In fact, the most rigorous fields with the healthiest scientific discourse might fail the *Frye* test with the greatest frequency. In light of the skeptical perspective of good scientific investigation, judges should be cautious when they approach a field in which there is too much agreement.³³

Moreover, the *Frye* test requires general acceptance in the *pertinent field*. But there are no standards defining which field to consult. Courts have had considerable difficulty assessing scientific information under this standard because it often extends into more than one academic or professional discipline.³⁴ Furthermore, each field may contain subspecialties.³⁵ This difficulty leads to paradoxical results. General acceptance, often criticized for being the most conservative test of admissibility, in practice can produce the most liberal standards of admission.³⁶ The more narrowly a court defines the pertinent field, the more agreement it is likely to find.³⁷ The general acceptance test thus degenerates into a process of deciding whose noses to count.³⁸ The definition of the pertinent field can be over-inclusive or under-inclusive.³⁹ Because the pertinent field can be so readily manipulated,⁴⁰ the test by itself provides courts with little protection against shoddy science.

Even more critically, the pertinent field inquiry leaves the law at the mercy of the practitioners of the respective fields. Different fields have widely

32. John W. Strong, *Questions Affecting the Admissibility of Scientific Evidence*, 1970 U.ILL. L.F. 1, 10-11.

33. To be sure, although science does not prove things "true," the scientific library is filled with volumes that are not seriously disputed. But even though this library contains some legally relevant knowledge that is located in the dusty rooms of near-certain science (so that judicial notice can be taken of it), most legal questions raise matters in the uncertain corridors of science. See *United States v. Jakobetz*, 955 F.2d 786 (2d Cir. 1992), cert. denied, 506 U.S. 834, 113 S.Ct. 104, 121 L.Ed.2d 63 (1992) (The court took judicial notice of the general theory and application of DNA profiling technology, but held that particular applications of that technology were a matter for the trier of fact to assess.). For example, few seriously dispute the carcinogenic properties of cigarettes; but science remains some distance from permitting doctors to conclude that particular lung cancers are attributable to smoking. See Chapter 32.

34. See e.g., *Cornett v. State*, 450 N.E.2d 498 (Ind.1983) (The court defined the relevant scientific fields for spectrographic voice identification as linguistics, psychology, engineering and voice spectography.). See generally Giannelli, *supra* note 2, at 1208.

35. *Id.* at 1209.

36. In addition to what follows, see the discussion at *infra* § 1-3.3.4.

37. See *Williams*, 583 F.2d at 1198 (noting that "[s]election of the 'relevant scientific community,' appears to influence the result"); see also National Academy of Sciences, *On the Theory and Practice of Voice Identification* (1979) (in which a group composed of acoustical engineers, physiologists, statisticians, and others gave a less favorable assessment of the technique than the narrower range of developers of the technique).

38. *DeLuca v. Merrell Dow Pharmaceuticals, Inc.*, 911 F.2d 941, 955 (3d Cir.1990) cert. denied, 510 U.S. 1044, 114 S.Ct. 691, 126 L.Ed.2d 658 (1994).

39. See *Reed v. State*, 283 Md. 374, 391 A.2d 364, 377 (1978) ("The purpose of the *Frye* test is defeated by an approach which allows a court to ignore the informed opinions of a substantial segment of the scientific community which stands in opposition to the process in question."); see also Giannelli, *supra* note 2, at 1210.

40. See e.g., *Commonwealth v. Lykus*, 367 Mass. 191, 327 N.E.2d 671, 678 (1975) (*Frye* test is met when the technique is "generally accepted by those who would be expected to be familiar with its use."); *People v. Williams*, 164 Cal.App.2d Supp. 858, 331 P.2d 251, 253-54 (1958) (Court admitted a technique that was "generally accepted by those who would be expected to be familiar with its use" *even though* "it cannot truthfully be said that the ... test has met with general acceptance by the medical profession as a whole.").

varying standards. Some fields have a tradition of vigorous debate, data gathering, and hypothesis testing, an ethos consistent with the scientific enterprise. In these fields, an idea does not become generally accepted until it passes a rigorous gauntlet of testing. Other fields lack these traditions and accept ideas with far less scrutiny.⁴¹ The courts have difficulty telling one of these fields from another. Indeed, and especially ironically for courts, they may mistake vigorous research and debate over the meaning of the findings for lack of agreement (rather than the process of reaching trustworthy findings) and the lack of research and debate as a sign of consensus (rather than a sign of an immature or retarded science).⁴² Under the *Frye* variant, because the courts have to rely on the standards set within each field, they find themselves accepting more readily the offerings of less rigorous fields and less readily the offerings of more rigorous fields. Fields that set higher thresholds will place a smaller proportion of their knowledge over the threshold.

Despite *Frye's* limitations, it remains the standard by which science is evaluated for courtroom use in many jurisdictions.⁴³ Increasingly, however, jurisdictions are using the alternative perspective articulated by the Court in *Daubert* and now the exclusive standard in the federal courts. Yet the *Daubert* Court did not abandon *Frye* because of its real or perceived defects.⁴⁴ Indeed, the general acceptance core of *Frye* was borrowed as one of the four principal factors that comprise the *Daubert* standard. The Court did not wholly follow *Frye* for the more simple reason that it did not find it to have been incorporated into the Federal Rules.⁴⁵

§ 1-3.0 THE FEDERAL RULES OF EVIDENCE AND THE VALIDITY TEST OF *DAUBERT*

Consistent with its recent practice of applying the plain meaning rule to the Federal Rules of Evidence, the Supreme Court stated in *Daubert* that it

41. Important examples of the latter fields are many of the forensic identification sciences. See, e.g., D. Michael Risinger, Mark P. Denbeaux & Michael J. Saks, *Exorcism of Ignorance as a Proxy for Rational Knowledge: The Lessons of Handwriting Identification "Expertise,"* 137 PA. L. REV. 731 (1989); Michael J. Saks & Jonathan J. Koehler, *What DNA "Fingerprinting" Can Teach the Law About the Rest of Forensic Science,* 13 CARDOZO L. REV. 361 (1991); I.W. Evett, *Criminalistics: The Future of Expertise,* 33 J. FORENSIC SCI. SOC'Y 173 (1993).

42. See *United States v. Christophe*, 833 F.2d 1296, 1299 (9th Cir.1987), in which the Ninth Circuit concluded that proffered expert testimony on eyewitness identification "does not conform to a generally accepted explanatory theory [because] psychologists do not generally accept the claimed dangers of eyewitness identification in a trial setting." *Id.* To support this conclusion, the court cited a single article:

Michael McCloskey & Howard Egeth, *Eyewitness Identification: What Can a Psychologist Tell a Jury?*, 38 AM. PSYCHOLOGIST 550, 551 (May 1983). For a contrasting viewpoint, see the California Supreme Court's decision in *People v. McDonald*, 37 Cal.3d 351, 208 Cal. Rptr. 236, 690 P.2d 709, 721 (Cal.1984), in which the court dismissed these same scientists as a minority viewpoint whose theories were "vigorously disputed by their peers." *Id.*

43. Joseph R. Meaney, *From Frye to Daubert: Is a Pattern Unfolding,* 35 JURIMETRICS 191 (1995).

44. The Court did make note of the controversy surrounding the merits of *Frye*: "The merits of the *Frye* test have been much debated, and scholarship on its proper scope and application is legion." *Daubert*, 113 S.Ct. at 2793.

45. *Id.* at 2794.

was simply interpreting the Rules as written.¹ A reading of even a small sample of the voluminous literature dedicated to explaining *Daubert*,² however, suggests that the meaning of Rule 702 is not so plain.³ Indeed, the variety of views in the lower courts before *Daubert*, and especially the then prevailing reliance on the general acceptance test of *Frye*,⁴ indicate a certain lack of clarity in Rule 702. Ironically, perhaps, the Court's interpretive style betrayed no break with the past,⁵ yet most courts and commentators find *Daubert* to herald a substantial change from past practice.⁶ Federal courts, of course, are bound to follow this new course, and states, in increasing numbers, have followed suit.⁷

§ 1-3.0

1. *Daubert*, 113 S.Ct. at 2793 ("We interpret the legislatively-enacted Federal Rules of Evidence as we would any statute."). Professor Andrew Taslitz, *Daubert's Guide to the Federal Rules of Evidence: A Not-So-Plain-Meaning Jurisprudence*, 32 HARVARD J. ON LEGISL. 3 (1995), has recently argued, persuasively, that the *Daubert* Court did not faithfully adhere to a plain-meaning test. For general discussion and criticism of the Court's method of interpreting the Rules, see Randolph N. Jonakait, *The Supreme Court, Plain Meaning, and the Changed Rules of Evidence*, 68 TEX. L. REV. 745 (1990)(warning that application of the plain meaning standard will have a negative impact on evidence law and will fail to satisfy policy goals); Eileen A. Scallen, *Classical Rhetoric, Practical Reasoning and the Law of Evidence*, 44 AM. U. L. REV. 1717 (1995)(arguing that the best approach to construction of the Evidence Rules is practical reasoning); Glen Weissenberger, *The Supreme Court and the Interpretation of the Federal Rules of Evidence*, 53 OHIO ST. L.J. 1307 (1992)(arguing that application of the doctrine of legislative intent is misplaced in the interpretation of the Federal Rules of Evidence).

2. Well over one-hundred articles have been published in response to the decision. For a representative sample, see, Margaret A. Berger, *Procedural Paradigms for Applying the Daubert Test*, 78 MINN. L. REV. 1345 (1994); Bert Black et al., *Science and the Law in the Wake of Daubert: A New Search for Scientific Knowledge*, 72 TEX. L. REV. 715 (1994); David L. Faigman, *Mapping the Labyrinth of Scientific Evidence*, 46 HASTINGS L.J. 555 (1995); Richard D. Friedman, *The Death and Transfiguration of Frye*, 34 JURIMETRICS J. 133 (1994); Paul C. Giannelli, *Daubert and Forensic Science*, 1 SHEPARD'S EXPERT & SCI. EVID. Q. 457 (1994); Paul S. Miller et al., *Daubert and the Need of Judicial Scientific Literacy*, 77 JUDICATURE 254 (1994); Linda Sandstrom Sinnard, *Daubert's Gatekeeper: The Role of the District Court Judge in Admitting Expert Testimony*, 68 TUL. L. REV. 1457 (1994); Symposium, *Evidence After the Death of Frye*, 15 CARDOZO L. REV. 1745 (1994). See generally 3 CHRISTOPHER B. MUELLER

& LAIRD C. KIRKPATRICK, FEDERAL EVIDENCE § 353, at 665-67 (2d ed. 1994).

3. See Taslitz (1995), supra note 1, at 4-5 (arguing that the Court did not use a plain-meaning standard in *Daubert*—and it's a good thing too).

4. Without commenting on its pertinence to the Court's "plain-meaning" approach to interpreting the Rules, the Court noted *Frye's* ascendancy: "In the 70 years since its formulation in the *Frye* case, the 'general acceptance' test has been the dominant standard for determining the admissibility of novel scientific evidence at trial." *Daubert*, 113 S.Ct. at 478.

5. Paul C. Giannelli, *Daubert: Interpreting the Federal Rules of Evidence*, 15 CARDOZO L.REV. 1999 (1994).

6. In addition to the multitude of articles published on *Daubert*, see supra note 2, the profession has responded with books (including this one) and programs to improve judges' proficiency with scientific methods. For instance, the Federal Judicial Center (FJC) has held programs on scientific evidence for judges throughout the country, including New Orleans (Dec. 12-13, 1994), San Francisco (Jan. 23-24, 1995), Boston (July 13-14, 1995) and Seattle (Aug. 30-Sept. 2, 1995). In addition, although not prompted by *Daubert*, but certainly magnified by it, the FJC recently published the SCIENTIFIC EVIDENCE REFERENCE MANUAL.

7. The states divide roughly into six categories concerning their response to *Daubert*.

First, nineteen states have accepted the essential principles of *Daubert*, either because they were persuaded by the Supreme Court's reasoning or they already adhered to a substantially similar test. See *Nelson v. State*, 628 A.2d 69 (Del.1993); *Jordan v. Georgia Power Company*, 219 Ga.App. 690, 466 S.E.2d 601 (1995); *State v. Parkinson*, 128 Idaho 29, 909 P.2d 647 (1996); *Steward v. State*, 652 N.E.2d 490 (Ind.1995); *Hutchison v. American Family Mutual Insurance Co.*, 514 N.W.2d 882 (Iowa 1994); *Mitchell v. Commonwealth*, 908 S.W.2d

Although *Frye* was not the only alternative to *Daubert's* validity test, it does represent the basic alternative perspective to it. In fact, if *Daubert* is a significant break from the past, the departure lies in the changed focus of the admissibility determination. *Frye* asks judges to decide the admissibility of scientific expert testimony by deferring to the opinions of scientists in the "pertinent field." Thus, under *Frye*, judges need not have any facility with scientific methods to make the admissibility decision. They must merely have some basis for knowing what most scientists believe. Under *Daubert*, the trial court itself is initially responsible for determining the admissibility of scientific expert testimony by determining that the science supporting that opinion is valid.⁸ Most courts considering the matter, however, hold that a separate

100 (Ky.1995); *State v. Foret*, 628 So.2d 1116 (La.1993); *Green v. Cessna Aircraft Co.*, 673 A.2d 216 (Me.1996); *Commonwealth v. Lanigan*, 419 Mass. 15, 641 N.E.2d 1342 (1994); *State v. Weeks*, 270 Mont. 63, 891 P.2d 477 (1995); *State v. Cavaliere*, 140 N.H. 108, 663 A.2d 96 (1995); *State v. Goode*, 341 N.C. 513, 461 S.E.2d 631 (1995); *Taylor v. State*, 889 P.2d 319 (Okla.Crim.App.1995); *State v. O'Key*, 321 Or. 285, 899 P.2d 663 (1995); *State v. Schweitzer*, 533 N.W.2d 156 (S.D.1995); *E.I. du Pont de Nemours & Co., Inc. v. Robinson*, 923 S.W.2d 549 (Tex.1995); *State v. Streich*, 163 Vt. 331, 658 A.2d 38 (1995); *Wilt v. Bucker*, 191 W.Va. 39, 443 S.E.2d 196 (1993), cert. denied, ___ U.S. ___, 114 S.Ct. 2137, 128 L.Ed.2d 867 (1994); *Springfield v. State*, 860 P.2d 435 (Wyo.1993).

Second, eight states have stated their openness to reconsidering the rule they apply to scientific evidence. See *Mattox v. State Dept. of Revenue, Child Support Enforcement Div.*, 875 P.2d 763 (Alaska 1994); *Jones v. State*, 314 Ark. 289, 862 S.W.2d 242 (1993); *Lindsey v. People*, 892 P.2d 281 (Colo.1995); *Dotto v. Okan*, 269 Ill.App.3d 808, 207 Ill.Dec. 190, 646 N.E.2d 1277 (1995); *Fairview Hospital and Health Care Services v. St. Paul Fire & Marine Insurance Co.*, 535 N.W.2d 337 (Minn.1995); *Ripa v. Owens-Corning Fiberglas Corp.*, 282 N.J.Super. 373, 660 A.2d 521 (1995); *Commonwealth v. Crews*, 536 Pa. 508, 640 A.2d 395 (1994); *State v. Russell*, 125 Wash.2d 24, 882 P.2d 747 (1994), cert. denied, ___ U.S. ___, 115 S.Ct. 2004, 131 L.Ed.2d 1005 (1995).

Third, eleven states have rejected the *Daubert* standard, at least for the time-being, preferring to remain with the *Frye* test or an alternative state formulation of general acceptance and relevancy. See *State v. Bible*, 175 Ariz. 549, 858 P.2d 1152 (1993), cert. denied, ___ U.S. ___, 114 S.Ct. 1578, 128 L.Ed.2d 221 (1994); *People v. Leahy*, 8 Cal.4th 587, 34 Cal.Rptr.2d 663, 882 P.2d 321 (1994); *State v. Ali*, 233 Conn. 403, 660 A.2d 337 (1995); *Flanagan v. State*, 625 So.2d 827 (Fla.1993); *State v. Haddock*, 257 Kan. 964, 897 P.2d 152 (1995); *Schultz v. State*, 106 Md.App. 145, 664 A.2d 60

(1995); *People v. Peterson*, 450 Mich. 349, 537 N.W.2d 857 (1995) amended 450 Mich. 1212, 548 N.W.2d 625 (1995); *Callahan v. Cardinal Glennon Hospital*, 863 S.W.2d 852 (Mo.1993); *State v. Carter*, 246 Neb. 953, 524 N.W.2d 763 (1994); *People v. Wesley*, 83 N.Y.2d 417, 611 N.Y.S.2d 97, 633 N.E.2d 451 (1994); *City of Fargo v. McLaughlin*, 512 N.W.2d 700 (N.D. 1994).

Fourth, six states follow their own state version of a relevance/reliability determination, usually based on the respective state code of evidence. See *Taylor v. United States*, 661 A.2d 636 (D.C.1995); *State v. Maelega*, 80 Hawai'i 172, 907 P.2d 758 (1995); *State v. Anderson*, 118 N.M. 284, 881 P.2d 29 (1994); *State v. Clark*, 101 Ohio App.3d 389, 655 N.E.2d 795 (1995); *State v. Dinkins*, 462 S.E.2d 59 (S.C. 1995); *State v. Peters*, 192 Wis.2d 674, 534 N.W.2d 867 (App.1995).

Fifth, four states remain undecided, remaining on the fence for now. See *Soares v. Vestal*, M.D., 632 A.2d 647 (R.I.1993); *State v. Smith*, 1994 WL 361851 (Tenn.Crim.App.1994); *Dikeou v. Osborn*, 881 P.2d 943 (Utah.Ct.App. 1994); *Cotton v. Commonwealth*, 19 Va.App. 306, 451 S.E.2d 673 (1994), withdrawn and vac'd on rehearing, 20 Va.App. 596, 459 S.E.2d 527 (1995).

Finally, to date, three states have yet to cite *Daubert* or discuss its applicability to scientific evidence. These states include Alabama, Mississippi and Nevada.

8. See *Cavallo v. Star Enterprise*, 892 F.Supp. 756, 774 (E.D.Va.1995), aff'd in part, rev'd in part, 100 F.3d 1150 (4th Cir. 1996) ("Daubert assigned district courts a more vigorous role to play in ferreting out expert opinion not based on the scientific method."). See, e.g., *Wilson v. City of Chicago*, 6 F.3d 1233, 1238-39 (7th Cir.1993), cert. denied, ___ U.S. ___, 114 S.Ct. 1844, 128 L.Ed.2d 470 (1994) ("The elimination of formal barriers to expert testimony has merely shifted to the trial judge the responsibility for keeping 'junk science' out of the courtroom. . . . It is a responsibility to be taken seriously."); *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311,

hearing to determine the validity of the basis for scientific evidence is not necessary.⁹ Typically, however, courts do hold “*Daubert* hearings” or “Rule 104(a) hearings” in order to assess the validity of the science. Moreover, *Daubert* apparently permits judges to exclude expert testimony as invalid even in the absence of an objection by the opponent of the evidence.¹⁰ *Daubert*, therefore, expects judges to have a sufficient appreciation of the scientific method to make this preliminary assessment.¹¹

§ 1-3.1 The Requirement of Relevancy

Rule 702 provides as follows:

1315 (9th Cir.1995)(*Daubert II*), cert. denied, ___ U.S. ___, 116 S.Ct. 189, 133 L.Ed.2d 126 (1995)(“Federal judges face a far more complex and daunting task in a post-*Daubert* world than before.”); *Casey v. Ohio Medical Products*, 877 F.Supp. 1380, 1383 (N.D.Cal. 1995)(“The responsibilities of district courts under *Daubert* are indeed heavy ones.”). See also *In re Joint Eastern & Southern District Asbestos Litigation v. United States Mineral Products Co.*, 52 F.3d 1124, 1132 (2d Cir. 1995)(“The *Daubert* Court significantly changed the standards governing the admissibility of scientific evidence by expanding district court’s discretion to evaluate the reliability and relevance of contested evidence.”).

9. *United States v. Johnson*, 28 F.3d 1487, 1496 (8th Cir.1994), cert. denied, ___ U.S. ___, 115 S.Ct. 768, 130 L.Ed.2d 664 (1995)(not error for trial court to make preliminary assessment “based upon [the expert’s] foundational testimony before the jury”); *United States v. Quinn*, 18 F.3d 1461, 1465 (9th Cir.1994), cert. denied, ___ U.S. ___, 114 S.Ct. 2755, 129 L.Ed.2d 871 (1994)(Same). But see *Hoult v. Hoult*, 57 F.3d 1, 4 (1st Cir.1995)(holding that a preliminary assessment of validity is necessary before admission of expert testimony).

10. See *Hoult v. Hoult*, 57 F.3d 1, 4 (1st Cir.1995)(“We think *Daubert* does instruct district courts to conduct a preliminary assessment of the reliability of expert testimony, even in the absence of an objection.”).

11. The Court explained this responsibility as follows:

Faced with a proffer of expert scientific testimony, then, the trial judge must determine ... whether the reasoning or methodology underlying the testimony is scientifically valid.... We are confident that federal judges possess the capacity to undertake this review.

Daubert, 113 S.Ct. at 2796. Scientific expert testimony is admissible only after the judge has determined by a preponderance of the evi-

dence, pursuant to Rule 104(a), that the supporting science is valid. *Daubert*, 113 S.Ct. at 2796, 2796 n. 10 (citing *Bourjaily v. United States*, 483 U.S. 171, 107 S.Ct. 2775, 97 L.Ed.2d 144 (1987)). See *infra* § 1-3.3.4 for a fuller discussion of the application of the 104(a) standard to Rule 702.

See also *Recent Developments in the Law: Confronting the New Challenges of Scientific Evidence*, 108 HARV.L.REV. 1481, 1532 (1995):

In 1897 Justice Holmes observed that “[f]or the rational study of the law the black-letter man may be the man of the present, but the man of the future is the man of statistics and the master of economics.” Now, almost a century later, the Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* has directed federal judges to take a scientific approach to the admissibility of scientific evidence.

quoting Oliver W. Holmes, Jr., *The Path of the Law*, 10 HARV. L. REV. 457, 469 (1920)(citation omitted). In a recent decision, Judge Ellis drew a distinction between the judge ensuring that the experts relied on tests that adhered to the scientific method and the judge knowing the science produced by that method:

In granting the ... summary judgment, the Court scrupulously attempted to walk this fine line: analyzing the experts’ adherence to the scientific methodology, while declining to weigh the evidence before it. Significantly, nothing in the Court’s review and analysis of this issue required any scientific training. Rather, the Court did nothing more than use the customary legal tools of logical reasoning to carry out its gatekeeping function.

Cavallo v. Star Enterprise, 892 F.Supp. 756, 774-75 (E.D.Va.1995), *aff’d in part, rev’d in part*, 100 F.3d 1150 (4th Cir. 1996); see also *Bradley v. Brown*, 42 F.3d 434, 438 (7th Cir. 1994)(“The district court took its gatekeeping function conscientiously while at the same time refusing to ‘don the amateur scientist’s cap in ruling on scientific validity.’”)(quoting *Bradley v. Brown*, 852 F.Supp. 690, 698

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.¹²

Focusing on the language “assist the trier of fact,” many courts and commentators characterized this rule as a “relevancy test.”¹³ In the area of scientific evidence, the Court explained, relevance foremost is a question of fit. Specifically, whatever the validity of the science, it must pertain to some disputed issue in the case.¹⁴ As the Court states succinctly, Rule 702 “requires a valid scientific connection to the pertinent inquiry as a precondition to admissibility.”¹⁵ Only when the science pertains to a factual question in the case can expert testimony be helpful to the trier of fact.¹⁶ This helpfulness component is at the core of Rule 702.

The “helpfulness” standard departs from the more stringent standard that was prevalent before the Federal Rules and is still in use in some jurisdictions today. This standard requires that the expert testimony provide knowledge that is “beyond the ken” of an ordinary person.¹⁷ Although some jurisdictions continue to adhere to this more stringent standard, sometimes implicitly,¹⁸ most follow the Rule 702 mandate that permits expert testimony

(N.D.Ind.1994), *aff'd*, 42 F.3d 434 (7th Cir. 1994).

12. FED. R. EVID. 702.

13. See *Daubert*, 113 S.Ct. at 2796 (stating that the language “assist the trier of fact” . . . goes primarily to relevance”).

14. See *Daubert*, 113 S.Ct. at 481; see also 3 JACK B. WEINSTEIN & MARGARET A. BERGER, WEINSTEIN’S EVIDENCE ¶ 702[02], at 702–18 (1994) (“Expert testimony which does not relate to any issue in the case is not relevant and, ergo, non-helpful.”); *Fusco v. General Motors Corp.*, 11 F.3d 259, 264 (1st Cir.1993)(excluding reenactment offered to illustrate “scientific principles,” because it “did not adequately replicate the conditions of the accident”); *United States v. Libutti*, 1994 WL 774646 (D.N.J.1994)(concluding that expert testimony regarding “pathological gambler’s lifestyle” did not “fit” and was irrelevant to the defendant’s mens rea in a prosecution for multiple tax offenses); *United States v. Powers*, 59 F.3d 1460 (4th Cir.1995), cert. denied, ___ U.S. ___, 116 S.Ct. 784, 133 L.Ed.2d 734 (1996)(evidence indicating the defendant was not a “fixated pedophile” held irrelevant where the charge was “incest abuse”); *Gier v. Educational Service Unit No. 16*, 66 F.3d 940 (8th Cir.1995)(concluding that psychological evaluations are “not reliable enough to make factual or ‘investigative conclusions’ in legal proceedings”); *United States v. Downing*, 753 F.2d 1224, 1242 (3d Cir.1985) (“[E]xpert testimony proffered in the case [must be] sufficiently tied to the facts of the case that it will aid the jury in resolving a factual dispute.”).

15. *Daubert*, 113 S.Ct. at 2796; see also *In re Paoli R.R. Yard PCB Litig. (Paoli II)*, 35 F.3d 717, 745 n. 13 (3d Cir.1994)(“[fit] is higher than bare relevance”), cert. denied, ___ U.S. ___, 115 S.Ct. 1253, 131 L.Ed.2d 134 (1995).

16. See e.g., *Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106, 1113–14 (5th Cir. 1991)(en banc), cert. denied, 503 U.S. 912, 112 S.Ct. 1280, 117 L.Ed.2d 506 (1992); *Viterbo v. Dow Chem. Co.*, 826 F.2d 420, 424 (5th Cir. 1987); *Peterson v. Sealed Air Corp.*, Nos. 86–C–3498 & 88–C–9859, 1991 WL 66370, at *7 (N.D.Ill.1991)(excluding testimony that Cytosin causes transitional cell carcinoma when the plaintiff suffered from basaloid cell type cancer); *Novak v. United States*, 865 F.2d 718, 723–24 (6th Cir.1989); *Bailiff v. Manville Forest Prods. Corp.*, 772 F.Supp. 1578, 1583–84 (S.D.Miss.1991); *Marder v. G.D. Searle & Co.*, 630 F.Supp. 1087, 1089–90, 1093 (D.Md.1986), *aff'd sub nom. Wheelahan v. G.D. Searle & Co.*, 814 F.2d 655 (4th Cir.1987).

17. See MCCORMICK ON EVIDENCE, § 13, at 54 (4th ed. 1992); 7 JOHN H. WIGMORE, EVIDENCE IN TRIALS AT COMMON LAW § 1923, at 29–32 (Chadbourn rev. 1978). See e.g., *Wal-Mart Stores, Inc. v. White*, 476 So.2d 614 (Ala.1985) (holding inadmissible expert testimony on the effect of rainwater on a store’s floor).

18. See e.g., *United States v. Thevis*, 665 F.2d 616, 641 (5th Cir.1982) (holding that the jury could weigh the credibility of eyewitness testimony using “common-sense evaluation,” thus, expert testimony on variables that could impair the accuracy of eyewitness identifica-

when it will merely assist the trier of fact.¹⁹ In this way, the helpfulness standard incorporates the idea of “probative value” to be found in Rule 401’s definition of relevance.²⁰

Arguably, of course, the notions of “fit” and “helpfulness” already exist in Rule 402’s relevancy requirement.²¹ Thus, if relevancy were the sole meaning of Rule 702, its existence would either be redundant or solely for emphasis. The Court, however, held that Rule 702 contains two other requirements. The first, explicitly stated in the Rule, is the qualifications test. This is the subject of the next section. The second, scientific validity, is somewhat more ambiguously stated in the rule, but has become its central operating construct. The validity test is considered in detail in the section following the discussion of qualifications.

§ 1-3.2 The Qualifications Test

Courts have always required experts to be “qualified” in order to testify.²² The more controversial issue is whether qualifications are not only a necessary, but also a sufficient condition for expert testimony. Although no modern court has held that qualifications alone suffice, many commentators suspect that, in practice, some courts adhere to this view.²³ In addition, this seemingly straightforward criterion turns out to contain considerable ambiguity. In particular, two issues arise. The first concerns what sorts of qualifications are necessary; for instance, must the expert have an advanced degree? The second concerns whether the expert’s credentials must be in the specialty area in which the expert is to testify.

§ 1-3.2.1 Necessary Qualifications

Rule 702 defines expertise broadly. Not just Ph.D.s and M.D.s are contemplated by the Rule, but a wide assortment of specialists, ranging from

tions was unnecessary); *State v. Poland*, 144 Ariz. 388, 698 P.2d 183, 194 (1985)(concluding that there was “nothing that an [eyewitness expert] witness would testify to that was not within the juror’s common experience”); *State v. Porraro*, 121 R.I. 882, 404 A.2d 465, 471 (1979)(ruling that eyewitness expert testimony was inadmissible because the subject matter was “not beyond the ken of the jurors”).

19. WEINSTEIN & BERGER, *supra* note 14, ¶ 702[02].

20. Rule 401 provides as follows:

“Relevant evidence” means evidence having any tendency to make the existence of any fact that is of consequence to the determination of the action more probable or less probable than it would be without the evidence.

FED. R. EVID. 401.

21. Rule 402 provides as follows:

All relevant evidence is admissible, except as otherwise provided by the Constitution of

the United States, by Act of Congress, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority. Evidence which is not relevant is not admissible.

FED. R. EVID. 402.

22. For an excellent overview of the qualifications requirement, see Margaret A. Berger, *Evidentiary Framework*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 37, 55-67 (Federal Judicial Ctr. ed. 1994).

23. See e.g., Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half Century Later*, 80 COLUM.L.REV. 1197, 1210 (1980). Cf. *Hopkins v. Dow Corning*, 33 F.3d 1116, 1124 (9th Cir. 1994), cert. denied, ___ U.S. ___, 115 S.Ct. 734, 130 L.Ed.2d 637 (1995)(“The district court is not required to hold a Rule 104(a) hearing, but rather must merely make a determination as to the proposed expert’s qualifications.”).

nuclear physicists to real estate agents.²⁴ Because the range is wide, so are the standards for qualifications.²⁵ Rule 702 requires only that the expert be qualified “by knowledge, skill, experience, training, or education.”²⁶ By necessity, therefore, courts approach the issue of what background qualifications are necessary in a flexible manner.

In general, courts interpret the main qualifications requirement in relation to the expert’s claimed expertise and the demands of the testimony. Hence, experts on medical matters are expected to have medical degrees, appropriate certifications and experience,²⁷ but auto mechanics might only need years of experience and demonstrable skills.²⁸ In many contexts, experience alone will be sufficient to qualify a witness,²⁹ while in others, the lack of experience will disqualify an expert.³⁰ As a practical matter, this means courts consult the experts’ respective fields for guidance regarding what constitutes a “qualified” expert. Not all fields, however, have well-articulated standards and many subjects of interest to the law are studied by fields with widely varying professional requirements.³¹

24. See 2 J. WIGMORE, EVIDENCE § 556, at 751 (Chadbourn rev. 1979) (The witness’ expertise “may have been attained, so far as legal rules go, in any way whatever; all the law requires is that it should have been attained.”).

25. The Advisory Committee’s Note to Fed. R. Evid. 702 states as follows:

[Rule 702] is broadly phrased. The fields of knowledge which may be drawn upon are not limited merely to the “scientific” and “technical” but extend to all “specialized” knowledge. Similarly, the expert is viewed, not in a narrow sense, but as a person qualified by “knowledge, skill, experience, training or education.” Thus within the scope of the rule are not only experts in the strictest sense of the word, e.g., physicians, physicists, and architects, but also the large group sometimes called “skilled” witnesses, such as bankers or landowners testifying to land values.

26. FED. R. EVID. 702.

27. See e.g., *Edmonds v. Illinois Central Gulf Railroad*, 910 F.2d 1284, 1287 (5th Cir.1990)(clinical psychologist not qualified to testify on plaintiff’s heart condition); see also *Stull v. Fuqua Industries, Inc.*, 906 F.2d 1271, 1275 (8th Cir.1990).

28. See e.g., *Fox v. Dannenberg*, 906 F.2d 1253, 1256-57 (8th Cir.1990).

29. See *Davis v. United States*, 865 F.2d 164, 168 (8th Cir.1988)(“Rule 702 does not state a preference for academic training over demonstrated practical experience.”); *Circle J. Dairy, Inc. v. A.O. Smith Harvestore Products, Inc.*, 790 F.2d 694, 700 (8th Cir.1986) (“Rule 702 . . . does not rank academic training over demonstrated practical experience.”). Courts’ reliance on experience as a mark of expertise is

especially frequent when police officers testify to the modus operandi of various crimes. See e.g., *United States v. Sparks*, 949 F.2d 1023, 1026 (8th Cir.1991)(use of street gangs to distribute drugs), cert. denied, 504 U.S. 927, 112 S.Ct. 1987, 118 L.Ed.2d 584 (1992); *United States v. Solis*, 923 F.2d 548, 550 (7th Cir. 1991)(use of beepers in drug trafficking); *United States v. Hoffman*, 832 F.2d 1299, 1309-10 (1st Cir.1987)(code words used in drug trafficking). See generally Annot., *Admissibility of Expert Evidence Concerning the Meaning of Narcotics Language in Federal Prosecution for Narcotics Dealing—Modern Cases*, 104 A.L.R. Fed. 230 (1991); Gail Sweeney Stephenson, Note, *Police Expert Witnesses and the Ultimate Issue Rule*, 44 LA L. REV. 211 (1983).

30. See e.g., *O’Conner v. Commonwealth Edison Co.*, 13 F.3d 1090, 1107 & n. 19 (7th Cir.1994), cert. denied, ___ U.S. ___, 114 S.Ct. 2711, 129 L.Ed.2d 838 (1994)(“We do not believe that this limited experience [five cases of radiation-induced cataracts in twenty years] qualifies as a basis for a scientifically sound opinion.”).

31. Perhaps the best example of the difficulty with setting uniform standards comes from the study of human behavior, a topic of obvious and frequent legal relevance. Qualifications requirements vary widely between the fields which focus on this topic, including psychiatry, psychology, social work, counseling and others. Qualifications also vary widely within each of these fields. For instance, in psychology, some practitioners have the Ph.D., some the Ed.D., some the M.S.W., and some the M.A. or M.S. See *Jenkins v. United States*, 307 F.2d 637, 644 (D.C.Cir.1962)(“[W]e must examine the reality behind the title ‘psychologist.’”).

§ 1-3.2.2 Specificity of the Necessary Qualifications

The hallmark of late twentieth century science (and all expertise) is specialization. This trend leaves courts somewhat uncertain as to whether generalists should be permitted to testify about matters that are highly specialized.³² Once again, courts approach this matter flexibly.³³ Some courts require experts to have demonstrated expertise in the specific areas and topics on which they are to testify.³⁴ Other courts provide that generalists may testify on specialty areas and that their lack of expertise in those areas is a matter of weight for the trier of fact.³⁵ Too often, however, expedience leads courts to allow experts to venture into areas outside of their true expertise.³⁶

§ 1-3.3 Applying *Daubert*: The Standards for Determining Validity

The *Daubert* Court articulated four *non-exclusive* factors that courts should consider:³⁷ (1) testability (or falsifiability), (2) error rate, (3) peer

32. See *United States v. Roldan-Zapata*, 916 F.2d 795, 805 (2d Cir.1990) ("A witness may be qualified as an expert on certain matters and not others."), cert. denied, 499 U.S. 940, 111 S.Ct. 1397, 113 L.Ed.2d 453 (1991).

33. See generally Berger, *Evidentiary Framework*, supra note 22, at 59 ("The governing principle should be whether the expert can assist the trier of fact.")

34. See e.g., *Watkins v. Schriver*, 52 F.3d 769, 771 (8th Cir.1995) (holding that neurologist could not testify to cause of injury since he was not "an expert in either accident reconstruction or forensic medicine"); *Chikovskiy v. Ortho Pharmaceutical Corp.*, 832 F.Supp. 341, 344-46 (S.D.Fla.1993) (The court excluded the testimony of an obstetrician/gynecologist that the topical application of Retin-A causes birth defects, because the doctor had no demonstrated expertise in embryology, teratology or genetics.); *Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106, 1112-13 (5th Cir.1991), cert. denied, 503 U.S. 912, 112 S.Ct. 1280, 117 L.Ed.2d 506 (1992) (*en banc*) ("The questions ... do not stop if the expert has an M.D. degree. That alone is not enough to qualify him to give an opinion on every conceivable medical question."); *People v. Kelly*, 17 Cal.3d 24, 130 Cal.Rptr. 144, 549 P.2d 1240, 1250 (1976) ("Nash has an impressive list of credentials in the field of voice print analysis. However, these qualifications are those of a technician and law enforcement officer, not a scientist."); *State v. Priester*, 301 S.C. 165, 391 S.E.2d 227 (1990) (technologist cannot testify to the intoxicating effects of blood alcohol level).

35. See e.g., *Carroll v. Morgan*, 17 F.3d 787, 790 (5th Cir.1994) (holding that *Daubert* does not require a pathologist to testify to cause of death and the fact that three testifying pathologists disagreed with the cardiolo-

gist's conclusion is "grist for the jury"); *Payton v. Abbott Labs*, 780 F.2d 147, 155 (1st Cir.1985) ("The fact that the physician is not a specialist in the field in which he is giving his opinion affects not the admissibility of his opinion but the weight the jury may place on it.") (citing *Alvarado v. Weinberger*, 511 F.2d 1046, 1049 (1st Cir.1975)); *Quinton v. Farmland Indus., Inc.*, 928 F.2d 335, 337 (10th Cir. 1991) ("This assumption about the insufficiency of general medical study, which reflects the implausible view that such training qualifies a doctor to diagnose and treat a wide range of physical disorders in the real world but not to render expert opinions about particular examples in the courtroom, has been expressly rejected in the case of physicians."). See generally *McCORMICK*, supra note 17, § 203, at 875 n.40 ("Even a scientist eminently qualified in one area may not be knowledgeable in another. For example, an immunogeneticist may have a detailed understanding of the chemistry of blood types and typing procedures, but only a superficial acquaintance with the statistical method for computing a probability of paternity. Generally, cross-examination should expose such deficiencies.")

36. See *ANDRE A. MOENSSENS, FRED E. INBAU & JAMES E. STARRS, SCIENTIFIC EVIDENCE IN CRIMINAL CASES* (3d ed. 1986) ("[E]xperts, in their sworn testimony, frequently transgress into fields that are beyond their expertise.")

37. Although the Court emphasized that these four factors did not represent "a definitive checklist or test," many courts have applied them this way. *Daubert*, 113 S.Ct. at 2796; see, e.g., *Roback v. V.I.P. Transport, Inc.* No. 91-C-5902, 1994 WL 548197, at *4-*5 (N.D.Ill.1994); *Stanczyk v. Black & Decker, Inc.* 836 F.Supp. 565, 567-68 (N.D.Ill.1993).

review and publication and (4) general acceptance. Other courts and commentators offer additional factors that might be considered when assessing validity.³⁸ This section examines these four factors together with several of the additional factors that might contribute to a judge's evaluation of scientific validity.

At the outset, certain general observations can be made about the approach to validity³⁹ assessment encompassed by these four factors. Despite the substantial concern raised by many that *Daubert* demands a level of scientific sophistication among judges that would make them "amateur scientists,"⁴⁰ only two of the *Daubert* factors focus on the scientific merit directly; the remaining two provide proxies for merit. Specifically, the factors of peer review and general acceptance measure scientists' evaluation of validity and thus more closely resemble the deferential perspective inherent in *Frye*. The Court thus indicated that although judges must become sophisticated consumers of science,⁴¹ and must understand the philosophical and practical consider-

38. Professor Mark McCormick, *Scientific Evidence: Defining a New Approach to Admissibility*, 67 IOWA L. REV. 879, 911-12 (1982), a former state supreme court justice, lists 11 factors for determining admissibility:

- (1) the potential error rate in using the technique;
- (2) the existence and maintenance of standards governing its use;
- (3) presence of safeguards in the characteristics of the technique;
- (4) analogy to other scientific techniques whose results are admissible;
- (5) the extent to which the technique has been accepted by scientists in the field involved;
- (6) the nature and breadth of the inference aduced;
- (7) the clarity and simplicity with which the technique can be described and its results explained;
- (8) the extent to which the basic data are verifiable by the court and jury;
- (9) the availability of other experts to test and evaluate the technique;
- (10) the probative significance of the evidence in the circumstances of the case;
- (11) the care with which the technique was employed in the case.

See also, *United States v. Downing*, 753 F.2d 1224, 1239-41 (3d Cir.1985) (adding to the *Daubert* four, body of professional literature, nonjudicial uses of the science, novelty of the technique and the qualifications of the witness); *Wade-Greaux v. Whitehall Laboratories*, 874 F.Supp. 1441, 1478 (D.Vi. 1994)(same); *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311, 1317 (9th Cir.1995)(*Daubert II*), cert. denied, ___ U.S. ___, 116 S.Ct. 189, 133 L.Ed.2d 126 (1995)(discussed infra note 42, re discounting testing specifically designed to support litigations).

39. For some time, courts and commentators have confused the terms reliability and validity. See e.g., *United States v. Distler*, 671

F.2d 954, 962 (6th Cir.1981) cert. denied 454 U.S. 827, 102 S.Ct. 118, 70 L.Ed.2d 102 (confusing estimates of reliability with assertions of validity); Bert Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595 (1988)(conflating validity and reliability).

The *Daubert* Court noted this confusion and stated its support for the scientific meaning of those terms: "[S]cientists typically distinguish between 'validity' (does the principle support what it purports to show?) and 'reliability' (does the application of the principle produce consistent results?)." *Daubert*, 113 S.Ct. at 2795 n. 9. The Court stated clearly that "validity" is the germane inquiry: "In a case involving scientific evidence, evidentiary reliability will be based upon scientific validity." *Id.*

40. See e.g., *Daubert*, 113 S.Ct. at 2800 (Rehnquist, C.J., concurring) ("I do not think [Rule 702] imposes on [district court judges] either the obligation or the authority to become amateur scientists."); *Zuchowicz v. United States*, 870 F.Supp. 15 (D.Conn. 1994)("judges may not always have the 'special competence' to resolve complex issues which stand at the frontier of current medical and epidemiological inquiry").

41. The debate about judges' competence to evaluate scientific research is likely to continue for some time. See generally *Developments—Scientific Evidence*, supra note 11, at 1538-39 ("[E]ven before *Daubert*, many courts had successfully evaluated legal reliability according to principles of scientific validity and scientific reliability.").

Just how severe the burden is on federal judges, and whether this burden is too great for them to bear, remains a matter of some dispute. Judge Legge offered the following ruminations on the topic:

ations raised by the scientific method, they can sometimes use proxies to decide the issue. Of course, scientists themselves do the same when they evaluate scientific fields that are not their areas of specialty or when time prohibits a more thorough evaluation.

No single list of factors, however, can capture the sundry considerations that go into determining the validity of research results. Indeed, it is somewhat misleading to suggest one, for, as every scientist knows, validity is not a categorical conclusion. Scientists tend to speak of validity in terms of their confidence in the conclusion, not in terms of its "truth." Similarly, although judges must assess validity in order to make a categorical decision—admitting or excluding the testimony—judges need not have a categorical view of the science. Judges are expected to use the *Daubert* factors (and others) to determine if it is more likely than not that the methods and reasoning validly support the proffered scientific expert testimony.⁴²

§ 1-3.3.1 Testability (Falsifiability)

The problem of identifying uniquely scientific knowledge has occupied countless volumes in the philosophy of science. Of the sundry philosophical choices the Court could have made, it chose the criterion of falsifiability, which is most closely associated with Sir Karl Popper. Although the Court cited Popper in only a passing reference, it chose as its first factor his falsifiability criterion for distinguishing scientific from nonscientific and, especially, pseudoscientific statements. In short, the criterion of falsifiability provides that "a statement or theory is . . . falsifiable if and only if there exists at least one potential falsifier—at least one possible basic statement that conflicts with it logically."⁴³ As the Court quoted Popper, "the criterion

The responsibilities of district courts under *Daubert* are indeed heavy ones. The training of a judge is of course in law and not in medicine. . . . A court's analysis of medical causation necessarily forces a court to become as familiar as it can, with little or no scientific training, to understand the medical and scientific concepts. The vocabulary alone is daunting; and the danger of merely grabbing at words, and attaching too much significance to them, is very real. . . . Armed with a degree of intellectual curiosity inherent in district court judges, and guided by two centuries of reviewing the wisdom of other occupations, federal courts will perform the assigned task. Whether the *Daubert* analysis is ultimately viewed as "wise" law, or whether it promotes "good" science, must be answered at some time in the future.

Casey v. Ohio Medical Products, 877 F.Supp. 1380, 1383 (N.D.Cal.1995).

42. In addition to the sundry factors beyond the *Daubert* four suggested by courts and commentators, see *supra* note 38, Judge Kozinski, in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311 (9th Cir.1995) (*Daubert II*), cert. denied, ___ U.S. ___, 116 S.Ct. 189,

133 L.Ed.2d 126 (1995), offered the following practical observation:

One very significant fact to be considered is whether the experts are proposing to testify about matters growing naturally and directly out of research that they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying. That an expert testifies for money does not necessarily cast doubt on the reliability of his testimony, as few experts appear in court merely as an eleemosynary gesture. But in determining whether proposed expert testimony amounts to good science, we may not ignore the fact that a scientist's normal workplace is in the lab or the field, not the courtroom or the lawyer's office.

Id. at 1317. For applications of Judge Kozinski's insight, see *In re Hanford Nuclear Reservation Litigation*, 894 F.Supp. 1436, 1446-47 (E.D.Wash.1995); *Marbled Murrelet v. Pacific Lumber Co.*, 880 F.Supp. 1343, 1364-65 (N.D.Cal.1995).

43. K. POPPER, REALISM, AND THE AIM OF SCIENCE xx [From the Postscript to the Logic of Scientific Discovery] (W. Bartley, III ed. 1983).

of the scientific status of a theory is its falsifiability, or refutability, or testability.’”⁴⁴ The hallmark of scientific statements is that they are vulnerable to refutation.

Contrary to Popper’s original formulation of falsifiability, the Court selected this factor as one of four possible indices of validity. For Popper, however, falsifiability was *the* criterion of scientific status.⁴⁵ In fact, courts will find application of *Daubert* difficult if they treat testability as an optional factor. The other three factors all presuppose testability; in science, a non-testable hypothesis cannot have an error rate and is exceedingly unlikely to be published in a peer-reviewed journal and achieve general acceptance.⁴⁶ Since *Daubert*, courts generally appear to treat testability as a prerequisite rather than just another factor.⁴⁷ In practice, therefore, the *Daubert* testability criterion is entirely consistent with Popper’s philosophy.

The concept of falsifiability is separate from the question of when a scientific theory has been corroborated or falsified by observations.⁴⁸ The *status* of a statement as scientific depends on its amenability to test; the *merit* of a scientific statement depends on the degree to which it has survived attempts at falsification.⁴⁹ Both the status and the merit of purportedly scientific statements are subjects to be assessed by judges under *Daubert*.⁵⁰

44. See *Daubert*, 113 S.Ct. at 2796-97 (citing and quoting K. POPPER, CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE 37 (5th ed. 1989)).

45. Whereas the Court stated that testability was “a key question,” Popper would have said it was “the” key question. See *Daubert*, 113 S.Ct. at 2796.

46. See David L. Faigman, *To Have and Have Not: Assessing the Value of Social Science to the Law as Science and Policy*, 38 EMORY L.J. 1005, 1016-18 (1989); Bert Black, Francisco J. Ayala & Carol Saffran, *Brinks, Science and the Law in the Wake of Daubert: A New Search for Scientific Knowledge*, 72 TEX. L.REV. 715, 754-62 (1994).

47. See generally *Claar v. Burlington Northern Railroad Co.*, 29 F.3d 499, 503 (9th Cir.1994) (“[S]cientists whose conviction about the ultimate conclusion of their research is so firm that they are willing to aver under oath that it is correct prior to performing the necessary validating tests could properly be viewed . . . as lacking the objectivity that is the hallmark of the scientific method.”); *Bradley v. Brown*, 852 F.Supp. 690, 698 (N.D.Ind. 1994) (“The first of these considerations, which asks whether the theory or methodology has been subjected to the scientific method, is the most weighty.”); *Rosen v. Ciba-Geigy Corp.*, 892 F.Supp. 208, 212 (N.D.Ill.1995), *aff’d*, 78 F.3d 316 (7th Cir.1996), *cert. denied* — U.S. —, 117 S.Ct. 73, — L.Ed.2d — (1996) (“[The expert’s] opinion that the nicotine patch caused the heart attack has not been tested and is purely his own speculation. His

testimony is not the type of scientific knowledge the Supreme Court contemplated in *Daubert* and would be inadmissible at trial.”).

48. Popper (1983), *supra* note 43, at xx (“[Falsifiability] has to do only with the logical structure of statements and classes of statements. And it has *nothing* to do with the question whether or not certain possible experimental results would be accepted as falsifications.”) (emphasis in original).

49. See, e.g., *Buckman v. Bombardier Corp.*, 893 F.Supp. 547, 556 (E.D.N.C.1995) (noting and applying principle that testable propositions must be adequately tested). Sean O’Connor, *The Supreme Court’s Philosophy of Science: Will the Real Karl Popper Please Stand Up?* 35 JURIMETRICS 263 (1995).

50. *Daubert*, 113 S.Ct. at 2796 (“[A] key question to be answered in determining whether a theory or technique is scientific knowledge that will assist the trier of fact will be whether it can be (*and has been*) tested.”) (emphasis added).

The testability criterion also has what could be termed an affirmative component. Specifically, expert testimony that is testable should be tested. A complication of *Daubert*’s interpretation of Rule 702 is that on its face the opinion only applies to “scientific” expert testimony. It is silent regarding other forms of expert testimony encompassed by the Rule based on “technical or other specialized knowledge.” FED. R. EVID. 702. Simply stated, should courts—and, if so, when—permit expert testi-

Therefore, although *Daubert* added the necessary step that the basis for an expert's testimony must be both testable and have been tested, it did not articulate the manner in which this should be done. This raises the substantial complication of calling upon lower courts to establish those standards.

[1] *Evaluating Empirical Tests of Falsifiability*

Not all empirical tests of a theory are equally valuable. Research methods vary considerably, and some tests amount to no test at all.⁵¹ If *Daubert* is not to become a dead letter, judges must develop sufficient scientific literacy to recognize research designed to truly test a hypothesis as compared to research designed merely to supply impressive looking graphs and imposing numbers to a researcher's theory.⁵² In other words, judges (and lawyers) must be able to distinguish the methods of science from those methods that merely imitate science.⁵³

Some methods, such as gazing into a crystal ball, obviously have little scientific merit. But judges must also recognize those methods that, in reality, fail to progress significantly beyond crystal ball gazing or, as in many instances, beyond a researcher's creativity.⁵⁴ Moreover, judges must appreciate that assessing scientific research methods is a difficult and complex matter. There is no single way to conduct research to answer a particular question and research programs rarely answer factual questions definitively. Thus, there are no "perfect" studies or "final" answers in science.

mony on testable statements that have not been adequately tested by defining it as "technical" or "specialized," and thus not subject to the strictures of *Daubert*? This issue, the relationship between scientific and non-scientific knowledge in Rule 702 is discussed *infra* § 1-3.4.

51. See, e.g., *Schmaltz v. Norfolk & Western Railway Co.*, 878 F.Supp. 1119, 1122 (N.D.Ill.1995)("[T]he record before me fails to make clear why the incidence of eye irritation in rabbits exposed to high doses of [the chemical] could reasonably lead a doctor to conclude that an indirect exposure to [it] could cause pulmonary or respiratory conditions in humans."); *Williamson v. General Motors Corp.*, 1994 WL 660649 *5-*6 (N.D.Ga.1994)(noting that *Daubert* requires not simply that "some" tests be carried out, but that "adequate tests" be conducted).

52. See Paul S. Miller et al., *Daubert and the Need of Judicial Scientific Literacy*, 77 JUDICATURE 254 (1994).

53. Professor Richard Feynman, the Nobel Prize-winning physicist, referred to the latter kinds of research as "cargo cult science." According to Professor Feynman, after World War II certain Pacific Islanders wanted the cargo planes to keep returning. These Islanders made runways, stationed a man with wood-

en headphones and bamboo for antennas, lighted some fires and waited for the planes to land. Cargo cult scientists act in the same way. "They follow all the apparent precepts and forms of scientific investigation, but they're missing something essential because the planes don't land." N.Y. Times, Feb. 17, 1988, at D27, col. 1. See generally PETER WORSLEY, *THE TRUMPET SHALL SOUND: A STUDY OF "CARGO" CULTS IN MELANESIA* (1957).

54. In *Thomas v. FAG Bearings Corp.*, 846 F.Supp. 1382 (W.D.Mo.1994), the court noted the following:

The Eighth Circuit has held that in the case of expert opinion testimony, "[w]hen basic foundational conditions themselves are conjecturally premised, it then behooves a court to remove the answer from one of admissible opinion to one of excludable speculation."

Id. at 1393 (quoting *Twin City Plaza, Inc. v. Central Surety & Insurance Corp.*, 409 F.2d 1195, 1200 (8th Cir.1969)). Applying this lesson to the case before it, the court found that "[t]he expert's opinions are concocted of impermissible bootstrapping of speculation upon conjecture." *Id.* at 1394. See also *Reynard v. NEC Corp.*, 887 F.Supp. 1500, 1504-08 (M.D.Fla.1995)(Court found that expert's conclusion that electromagnetic radiation from a cellular phone caused a brain tumor was

In large measure, the highly sophisticated and subtle subject of scientific methods is the principal subject of this book. Several chapters are devoted specifically to research methods⁵⁵ and statistical designs⁵⁶ and every substantive chapter revolves around the issue of the methods brought to bear on certain legally relevant factual questions.

[2] What, Exactly, Must Be Tested?

When applied to scientific research offered in the trial setting, the falsification criterion contains an added complexity. Specifically, it is not entirely clear which aspects of the science must have been tested in order to cross the threshold of admissibility, and which aspects are a matter of weight and thus for the trier of fact to determine. The *Daubert* Court wrote:

The inquiry envisioned by Rule 702 is, we emphasize, a flexible one. Its overarching subject is the scientific validity—and thus the evidentiary relevance and reliability—of the principles that underlie a proposed submission. *The focus, of course, must be solely on principles and methodology, not on the conclusions that they generate.*⁵⁷

This statement has caused some confusion in the scholarly literature, because it does not provide as clear a demarcation between the issues for judges and the issues for triers of fact as it implies.⁵⁸ When scientists conduct research, they generally do not draw sharp distinctions between the research methodology chosen and the conclusions drawn from that research. Some conclusions are permitted by a particular methodology and some are not. Thus, when studying the toxic effects of drugs, use of animals rather than humans as subjects restricts the conclusions that might be drawn from the work. The decision to use multiple regression analysis rather than analysis of variance (ANOVA) affects what conclusions might be drawn from the data. Failure to include a comparison group in a study of leukemia rates in a particular neighborhood would obviously affect what conclusions could be reached. There are no shortage of such examples. Stated simply, the value of a methodology or of the reasoning employed in a study depends entirely on what hypothesis is being studied and, thus, what conclusions are within contemplation. Research on the carcinogenic character of second-hand smoke conducted on white rats, by subjecting them to the equivalent of ten packs-a-day, might employ exactly the right methodology and reasoning for concluding that such smoke causes cancer in white rats; but if the researcher is interested in generalizing the study to humans, then we must evaluate the methodology and reasoning in light of that purpose. Scientific conclusions are inextricably connected to the methodologies used to reach them. Thus, Justice Blackmun's attempt to divide responsibility between judges (methodology and reasoning) and jurors (conclusions) in this fashion was bound to fail; at least, it was bound to fail as originally stated.

“worse than speculation” and “not supported by any objective source.”).

55. See Chapter 2.

56. See Chapter 3.

57. *Daubert*, 113 S.Ct. at 2797 (emphasis added).

58. Kenneth J. Chesebro, *Taking Daubert's "Focus" Seriously: The Methodology/Conclusion Distinction*, 15 CARDOZO L. REV. 1745, 1745-53 (1994); see also David E. Bernstein, *The Admissibility of Scientific Evidence After Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 15 CARDOZO L. REV. 2139, 2164-66 (1994).

There is, however, another way to understand Justice Blackmun's distinction between methodology/reasoning and conclusions that appeals to both legal and scientific mind-sets. Most science comes to the courtroom as part of a four-tiered system of knowledge acquisition. The most general or abstract might be termed "general theory," the next most abstract is "general application," the third might be termed "general technology," and the fourth, and most concrete for legal purposes, might be termed "individual application." An example will illustrate these tiers. DNA profiling is perhaps the most powerful and, thus, the most troubling forensic technology ever to be used in a court of law. But in the courtroom, DNA evidence is a product of a complex web of science and technology. First, at the level of "general theory," is the biological theory of the DNA molecule. This theory posits, among other things, that every person's DNA makeup is unique. Second, at the level of "general application," the general theory has been studied in respect to various populations. In doing so, scientists have hypothesized and analyzed data about the complexion and distribution of DNA characteristics in populations of more or less homogeneity. Third, at the level of "general technology," scientists and technicians have devised various techniques for "profiling" DNA, including the two best known of Restriction Fragment Length Polymorphisms (RFLP) and Polymerase Chain Reaction (PCR), the latter used to amplify DNA found in small forensic samples. Finally, and most obviously pertinent to the law, at the level of "individual application," lab technicians take this general technology and apply it to individual cases to determine whether a match has been found between a forensic sample and a known sample.

Virtually all science that becomes relevant to the legal process operates at these four levels, though the levels are not always easy to distinguish in practice. Not all science succeeds quite as well as DNA, however. Consider the currently important issue of the alleged relationship between breast implants (silicone gel) and connective tissue disorders. At the level of general theory, scientists consider the toxicological effects of the chemical makeup of silicone gel on the human body. At the level of general application, scientists have conducted a number of studies, both epidemiological and animal, to investigate whether a statistical or causal relationship exists between silicone gel and a variety of ailments. Next, at the level of general technology lies the question whether the state of the art permits, assuming that general application indicates a causal relation, identification of those individuals who suffer from particular ailments because of the implants and those who suffer from those same ailments for other reasons. Finally, assuming that both general application and general technology permit it, the question remains whether some particular plaintiff's ailments are attributable to her breast implants.

This understanding of the division of science into levels of abstraction offers the best interpretation of Justice Blackmun's distinction between methodology/reasoning and conclusions. Specifically, the first three levels of science, "general theory," "general application" and "general technology," are all aspects of science that transcend individual cases and for which the judge is more likely, over time, to be the better evaluator of scientific merit. These three "general" levels are contemplated by Justice Blackmun's "meth-

odology and reasoning” category. For example, if the plaintiff proffers expert testimony concerning an alleged link between bendectin and birth defects, the judge should evaluate the general research to determine if it permits an opinion to be offered in the particular case. This would entail examining the general theory supporting the teratogenic properties of the chemical composition of the drug, the general application of these theories as evidenced by epidemiological and animal studies and the availability of a “general technology” (perhaps “differential diagnosis”) that would permit a doctor to make a valid conclusion about individual cases. This scientific baseline, the methods and reasoning that permit conclusions to be drawn in particular cases, would be subject to the gatekeeping function of *Daubert* as defined by Rule 104(a)(i.e., the judge would have to determine that this basis is valid by a preponderance of the evidence). If this scientific foundation permits valid conclusions to be drawn about individual plaintiffs, then the jury must determine what weight to attribute to the conclusions offered by an expert relying on this valid scientific foundation.⁵⁹

This reading of Justice Blackmun’s distinction between the roles of judge and jury for assessing scientific evidence is entirely consistent with the traditional roles of these two decision makers. Judges, by virtue of their education and experience will have a better vantage point by which to assess the merit of science and technology that is general and does not change from case to case. Moreover, given the essentially “objective” nature of the scientific enterprise, courts should be reluctant to allow juries in different jurisdictions to decide common issues differently. The effects of second-hand smoke are the same in Iowa and Florida. By giving judges a strong initial role in evaluating scientific findings that transcend particular cases, the courts will go a long way toward achieving consistency. The question whether a particular plaintiff’s lung cancer is due to second-hand smoke, or possibly has a genetic cause, is unique to the particular case. If doctors have the theory and technology (i.e., reasoning and methodology) to make these determinations, then the accuracy of the conclusion that the plaintiff’s cancer was caused by the defendant’s cigarettes should be for the trier of fact to decide.

It must be emphasized that the third tier queries the availability of a technology or method that will permit statements about individual cases. (What some courts call “specific causation.”) Once the court has determined that such a technology exists and that it was applied in the particular case, the trier of fact must assess the weight it receives. This determination is designated as individual application in the four-tiered analysis. For instance, if plaintiffs claim that drug Z caused their child’s birth defects and research supports such a connection, and the other factors that also cause this condition are known well enough to be ruled out, the jury should hear the evidence and decide its value. Questions such as an inaccurate health history (e.g., the mother took other drugs during pregnancy associated with birth defects but did not reveal that fact), or evaluation of the child’s condition

⁵⁹. Of course, gross errors in the application of a valid methodology could lead to exclusion under Rule 104(b), if no reasonable juror

could find that the fact is true. See *infra* § 1-3.3.4 for a discussion contrasting Rules 104(a) and 104(b).

(e.g., drug Z is associated with one type of birth defect but the child has another) should go to the jury.

Not all scientific expert testimony, of course, will be able to meet validity requirements at every level of the scientific enterprise, especially at the start because validity tests are not yet available. In the usual case, science will be validated at the levels of general theory and general application before it can be extended to individuals in a reliable fashion. This does not mean juries will be left without guidance, for the general science itself very often provides substantial assistance. Moreover, allowing experts to take the next step and apply the science to the case without research supporting their ability to do so invites expert speculation borne out of expert witness fees or a zeal for the party's cause. In fact, many scientists refuse to take this step, because of the lack of competence to offer an opinion better than triers of fact could do on their own. For example, experts on the reliability of eyewitness identifications do not testify on case specific facts. Like much science, researchers looking at factors associated with unreliable identifications are able to specify factors that interfere with identifications, such as "weapons focus," but they cannot state with any confidence whether a particular witness is accurate. Their testimony might still be of use to triers of fact, but the science simply does not permit an opinion on case specific facts.⁶⁰ Such humility should be appreciated by the courts. Sometimes, the law asks factual questions that scientists, or any expert, cannot answer any better than laypersons.

§ 1-3.3.2 Error Rate

At first glance, Justice Blackmun's inclusion of error rates would seem obvious. Yet, on closer inspection, employing this important concept might seem perplexing. It appears that "error" occurs in science in a multitude of ways, not all of which are quantifiable. It is useful once again to distinguish between the general levels of science and the application of that general work to an individual. This time we begin with the latter.

[1] *Error Rates in Stating Features of an Individual*

The typical use of the term "error rate" refers to the number of "mistakes" a particular technique or method will make in some specific number of trials. In this sense, error rate corresponds primarily to the "general technology" level of science outlined above. A polygraph, therefore, which is correct 65% of the time would appear to have an "error rate" of 35%. But what does it mean in this and other scientific contexts to make a mistake? Upon closer examination, there are two types of mistakes that might be made. Again in the polygraph context, the examiner might mistakenly conclude that the subject is telling the truth when he is lying, what is called a "false negative." Or the examiner might mistakenly conclude that the subject is

⁶⁰ Some courts find this limitation on expert testimony fatal. See e.g., *United States v. Serna*, 799 F.2d 842 (2d Cir.1986)(Expert's inability to testify about the reliability of a particular eyewitness' testimony indicated lack of probative value.). But see Advisory Committee's Note for Fed. R. Evid. 702 ("Most of the

literature assumes that experts testify only in the form of opinions. The assumption is logically unfounded. [Rule 702] accordingly recognizes that an expert on the stand may give a dissertation or exposition of scientific or other principles relevant to the case, leaving the trier of fact to apply them to the facts.").

lying when he is telling the truth, what is called a "false positive." A scientist's judgment of the value of a technique, if any, will inevitably depend on both the amount and kind of error.

Importantly, the Court did not specify what error rate should generally be expected; there are many good reasons for this wise omission. First, the costs of making an error are different in different contexts. For example, the error rate associated with predictions of violence is fairly high as the chapter by John Monahan, *infra*, indicates.⁶¹ Yet, at the same time, psychiatric predictions appear to be slightly better than chance. The costs of making a mistake, therefore, should guide a court's evaluation of the proffered evidence. Thus, a judge might require a relatively low error rate before admitting predictions of violence in a capital case, but permit higher error rates in a probation matter.⁶² This determination, however, cannot simply be an application of Rule 702. Rule 702 queries whether the scientific evidence will "assist the trier of fact." By definition, and subject to the other qualifications discussed in this Section, any science that is even just slightly better than flipping a coin is likely to meet this test; thus, "error rate" would not be a viable separate inquiry, so long as it did not approach chance. The Rule 702 error rate factor thus embodies, at least in part, a Rule 403 analysis.⁶³ But in practice, it would be virtually impossible to disentangle the Rule 702 probative value component of scientific evidence from the matter of error rate. Because scientific knowledge is not known with certainty, its value (i.e., relevance) depends substantially on the costs associated with being wrong.

[2] Error Rates Attributable to the Research Methods Used in Studying Population Features

Perhaps the most important source of error in science is attributable to the research methods scientists use when studying a hypothesis. This is not due to the limitations of scientists, but rather the limitations of the scientific method. This source of error corresponds to the three general levels of science, general theory, general application and general technology, outlined above.

In the real world of scientific investigation, there are a multitude of limitations that inevitably affect the methods that might be chosen and thus the knowledge that the study is capable of generating. The list of sources of error (or limitations) is virtually infinite, including such matters as sample size (two, twenty, or twenty thousand?), sample population studied (college students, registered voters, or white rats?), choice of comparison group

61. See Chapter 7.

62. The Supreme Court has already decided that in the capital sentencing context error rate is irrelevant as a constitutional matter, because juries should be able to distinguish accurate predictions from inaccurate ones; the Court reached this conclusion despite statements from psychologists and psychiatrists that they could not make this distinction. *Barefoot v. Estelle*, 463 U.S. 880, 103 S.Ct. 3383, 77 L.Ed.2d 1090 (1983). Of course, the

Constitution provides the minimum protection guaranteed to criminal defendants, so rules of evidence might still require a higher threshold of scientific validity than the *Barefoot* Court contemplated.

63. Although the opinion does not tie the error rate factor to Rule 403, Justice Blackmun emphasized the important role this Rule plays in the context of scientific evidence. *Daubert*, 113 S.Ct. at 2798; see *infra* § 1-3.7.

(random assignment, self-selection, or none?), apparatus or materials used (live, video, or written?) and so on.⁶⁴

Errors come in two forms, random and systematic. Sampling error is one type of random error. A random sample of 20 is less likely to represent an underlying population than a random sample of 2000. Another source of random error is unreliable coding of data. Researchers might accidentally code some people who are exposed to a substance as not exposed and vice versa. When enough is known about the parameters of measurements, inferential statistics permit quantification of the probability that results are due to random errors.

Systematic errors, unlike random errors, tend to work in a single direction and, therefore, introduce a systematic bias into the data. For example, the coding of whether individuals were or were not exposed to a substance may be systematically biased if researchers base their codes on individual self reports and if some of the people asked have already become ill. Under these circumstances epidemiologists are concerned about what is called recall bias. Those who are sick will be more likely to have searched through their past and recalled every exposure than those who are well. As a consequence, there will be an artificially high correlation between exposure and illness.⁶⁵ Inferential statistics cannot quantify systematic errors. A basic advantage of experimental research is its ability to control for many systematic errors.

Because of the limitations inherent in scientific studies, few scientists would be confident in stating conclusions from one or even a few studies. Only through repetition and thus replications, using various designs and methods, do scientists gain confidence that a hypothesis has been sufficiently corroborated. No magic number or moment determines this point, however; like many areas of the law, science presents a broad spectrum of grays that only over a considerable period of time sharpens into black and white.

§ 1-3.3.3 Peer Review and Publication

For the average scientist, publication in a peer reviewed journal is the mark of successful completion of a research project. Moreover, not all peer-reviewed journals are equal in status, for some carry a certain cachet. Since scientists view the quality of scholarship, in part, through the lens of the journal name in which it is situated, it should be no surprise that judges too notice this criterion.⁶⁶ At the same time, even the highest quality journals sometimes publish work that is later found to be wrong. In addition, mainstream peer-reviewed journals, by definition, are more likely to publish

64. See Chapter 2, for discussion of these and other issues as possible sources of error in scientific investigation.

65. See Chapter 28.

66. For better or worse, using journal placement as the criterion of quality is a phenomenon well known in law. Of course, most law journals are edited by students, while scientific journals are edited by scientists. The accuracy of using a journal's name as an indication of quality might depend on this differ-

ence. For a view on one side of this issue, but not likely to be shared by many scientists (or law professors), see John M. Kobayashi, *Admissibility Thresholds for Testimony and Evidence Offered by Experts*, in 2 CIVIL PRACTICE AND LITIGATION IN FEDERAL AND STATE COURTS, § G-2, at 44 ("The searching scrutiny and evaluation imposed by most first-rate Law Review editors is very rarely found in scientific peer reviews.").

conventional scholarship and might be slow to recognize revolutionary findings or methods. The *Daubert* Court considered these costs and benefits and concluded that peer review and publication is a factor to be considered in assessing admissibility, but it is not a necessary prerequisite.⁶⁷

The limitations of peer review and publication as a criterion are associated with those of using general acceptance, discussed below, as a factor—both criteria are mere proxies for the determinative factor. The value of peer review depends on the quality of those reviewers. If scientists publish in journals with lax standards, this criterion is not likely to lead to the exclusion of bad science.

Given that peer review and publication is merely a proxy for validity, judges must consider carefully the range of journals that qualify under this standard. Judges would be well-advised to return to the first two factors the Court identified, falsifiability and error rate. These two criteria clearly indicate the Court's choice of a conventional, scientific realist, view of the scientific method. Publication in journals that do not share the values reflected in these first two factors, therefore, should warn judges that the studies need to be scrutinized with particular care. To be sure, just as the Court did not establish publication as a prerequisite to admissibility, so too publication in non-rigorous journals should not mean *per se* exclusion. But in both cases, when studies lack placement in mainstream journals or when they have not been published at all, judges should use caution before admitting the expert who is to rely on them.

§ 1-3.3.4 General Acceptance

Similar to peer review and publication, general acceptance is a proxy for scientific validity; and like peer review and publication, general acceptance is only as good as the field that is surveyed. Under *Frye*, of course, general acceptance was the standard by which expert testimony was judged. Its reappearance in *Daubert* suggests that it has returned through the back door when it was not welcome through the front. But general acceptance operates differently under *Daubert*, where it is used in conjunction with other factors and is no longer a necessary or sufficient condition for admission. In fact, as one of several criteria, general acceptance is likely to lead to surprising outcomes.

Shortly after *Daubert* was decided, a major debate arose over whether the new test would be more liberal (i.e., allow more expert testimony) or would be more conservative (i.e., allow less expert testimony). This question cannot be answered simply. Although the Court cited the principal embraced by the Federal Rules of Evidence to liberalize admissibility standards,⁶⁸ it adopted the most conservative test contained in the Rules for preliminary assessments

67. *Daubert*, 113 S.Ct. at 2797 (“The fact of publication (or lack thereof) in a peer-reviewed journal thus will be a relevant, though not dispositive, consideration in assessing the scientific validity of a particular technique or methodology on which an opinion is premised.”).

68. This policy is reflected in Rule 402. FED. R. EVID. 402. Those who cite this Rule to argue for liberal admission standards of expert testimony overlook that, by its own terms, this rule is subject to the other rules. Rule 402, therefore, provides little assistance with the construction of Rule 702.

of fact. As noted above, Rule 104(a) mandates that judges determine the validity of the science underlying an expert's testimony rather than submit the question to the jury. This is the same, relatively rigid, standard applied to the hearsay rules. For example, under Rule 804(b)(2), the exception for "dying declarations," the judge must decide, among other things, that the statement was made under a belief of impending death. In contrast, Rule 104(b), which the Court has applied in other contexts, mandates merely that the judge find that a reasonable jury could believe the preliminary fact. Under Rule 404(b), for instance, the 104(b) standard is applied to other act evidence proffered to demonstrate motive, intent, identity and so on.⁶⁹

As for the answer to the persistent question whether *Daubert* should lead to more or less expert testimony, the reality will probably lie somewhere in between. In those areas of science with a tradition of rigorous research, *Daubert* can be expected to be more liberal, but in those areas without such a tradition, it should be expected to be more conservative. The first question *Daubert* requires judges to ask is, "where are the data?," and failure to produce them should result in exclusion of the expert opinion.⁷⁰ As judges become familiar with the scientific method and the fields that employ it well, they will become more skeptical of those fields that use it poorly.⁷¹ In general, trial courts can be expected to admit expert opinion in fields in which rigorous testing is part of the culture. In those fields, substantial testing of hypotheses that have not yet achieved general acceptance will likely be permitted as support for an expert's opinion.

§ 1-3.4 *Daubert's* Application to "Technical, or Other Specialized Knowledge"

A principal question left unresolved by *Daubert* is the standard to be applied when assessing the admissibility of expert testimony that is not, or not quite, scientific.⁷² Rule 702 applies, in addition to scientific knowledge, to "technical, or other specialized knowledge [that] will assist the trier of fact." There are, of course, a myriad of disciplines that might be helpful to triers of fact that make no pretense to being scientific. In addition, there is a host of disciplines that either have or claim a measure of scientific precision, but which also contain a surplus of art and possibly artifice. The *Daubert* Court expressed no opinion on whether the new "conceptual framework" applied across the entire span of Rule 702.⁷³ In *Daubert*, the Court expressly limited its analysis to "scientific knowledge," but, importantly, did not comment on whether the validity standard extends to technical or specialized knowledge.

69. FED. R. EVID. 404(b). See *Huddleston v. United States*, 485 U.S. 681, 108 S.Ct. 1496, 99 L.Ed.2d 771 (1988).

70. This statement might be qualified by the possibility that Courts will fail to apply *Daubert* to testable, but not yet scientifically tested, evidence. See *infra* § 1-3.4.1.

71. See Michael J. Saks & Jonathan J. Koehler, *What DNA "Fingerprinting" Can Teach the Law About the Rest of Forensic Science*, 13 CARDOZO L. REV. 363 (1991).

72. Courts using the *Frye* test also sometimes failed to apply it with "traditional" rigor to science perceived as not quite scientific, such as psychology. See e.g., *Campbell v. People*, 814 P.2d 1, 8 (Colo.1991); *Fishback v. People*, 851 P.2d 884, 889 (Colo.1993).

73. Cf. AMERICAN COLLEGE OF TRIAL LAWYERS, STANDARDS AND PROCEDURES FOR DETERMINING THE ADMISSIBILITY OF EXPERT EVIDENCE AFTER *DAUBERT* 7 (1994)("[A] single conceptual framework for evaluating the admissibility of all types of expert evidence" should be adopted.).

The Court simply abstained from deciding this issue: "Our discussion is limited to the scientific context because that is the nature of the expertise offered here."⁷⁴ Since *Daubert*, lower courts have disagreed concerning whether the gatekeeping responsibility extends to "technical or other specialized knowledge," though a large majority favor extension of this function to all expert testimony.⁷⁵ The Sixth Circuit, in *Berry v. City of Detroit*,⁷⁶ summarized what appears to be the majority rule as follows: "Although . . . *Daubert* dealt with scientific experts, its language relative to the gatekeeper function for federal judges is applicable to all expert testimony offered under Rule 702."⁷⁷ The two principal gray areas that regularly confront the courts are forensic evidence and the social sciences. This section begins with a general discussion of the issue and then considers the specific problems associated with forensic evidence and the social sciences.

§ 1-3.4.1 When Must a Fact Be a Matter of Scientific Inquiry?

Many courts and commentators see in *Daubert* a response to so-called "junk science" and the perceived problem of the hired-gun expert witness.⁷⁸ If this perception is correct, then courts should be reluctant to abandon *Daubert's* prescription too quickly when confronted by scientifically suspect expert testimony.⁷⁹ Such abandonment would lead to ironic and unfortunate outcomes. "Junk scientists"⁸⁰ and hired guns, who might be excludable under *Daubert* for failing to meet the rigors of science, would find that the key to admission lies in eschewing the methods of science altogether. Junk scientists

74. *Daubert*, 113 S.Ct. at 2795 n.8.

75. Most federal courts apply *Daubert's* gatekeeping mandate to the whole of Rule 702, though recognizing that the four *Daubert* factors might not apply the same way, or at all, to nonscientific expert testimony. See *United States v. Alzanki*, 54 F.3d 994, 1005-06 (1st Cir.1995), cert. denied, ___ U.S. ___, 116 S.Ct. 909, 133 L.Ed.2d 841 (1996); *United States v. Velasquez*, 64 F.3d 844, 849-52 (3d Cir.1995); *United States v. Dorsey*, 45 F.3d 809, 813-14 (4th Cir.1995); *Berry v. City of Detroit*, 25 F.3d 1342, 1350 (6th Cir.1994), cert. denied, ___ U.S. ___, 115 S.Ct. 902, 130 L.Ed.2d 786 (1995); *Deimer v. Cincinnati Sub-Zero Products, Inc.*, 58 F.3d 341, 343-45 (7th Cir.1995); *Sorensen v. Shaklee Corp.*, 31 F.3d 638, 649 (8th Cir.1994); *United States v. Quinn*, 18 F.3d 1461, 1465 (9th Cir.1994), cert. denied, ___ U.S. ___, 114 S.Ct. 2755, 129 L.Ed.2d 871 (1994). Several courts, however, do not apply a validity (or accuracy) test to nonscientific evidence, preferring instead a general helpfulness standard; of particular note, the Second Circuit follows this approach. See *Iacobelli Construction, Inc. v. County of Monroe*, 32 F.3d 19, 25 (2d Cir.1994); *United States v. Ruth*, 42 M.J. 730, 732 (1995).

76. 25 F.3d 1342 (6th Cir.1994), cert. denied ___ U.S. ___, 115 S.Ct. 902, 130 L.Ed.2d 786 (1995).

77. *Id.* at 1350.

78. See, e.g., *Whiting v. Boston Edison Co.*, 891 F.Supp. 12, 24 (D.Mass.1995)(citing *Wilson v. City of Chicago*, 6 F.3d 1233, 1238 (7th Cir.1993), cert. denied, ___ U.S. ___, 114 S.Ct. 1844, 128 L.Ed.2d 470 (1994))("Daubert establishes the duty of a trial judge to play the role of a 'gatekeeper' insuring that the fact-finding process does not become distorted by what is popularly called 'junk science.'").

79. See generally Edward J. Imwinkelried, *The Next Step After Daubert: Developing a Similarly Epistemological Approach to Ensuring the Reliability of Nonscientific Expert Testimony*, 15 CARDOZO L. REV. 2271, 2289-94 (1994).

80. The term "junk science" appears to have been coined by Peter Huber. See PETER HUBER, *GALILEO'S REVENGE: JUNK SCIENCE IN THE COURTROOM* (1991); Peter Huber, *Junk Science in the Courtroom*, 26 VAL. U. L. REV. 723 (1992). Huber's statement of the crisis in the courtroom has been severely criticized. See e.g., Kenneth J. Chesebro, *Galileo's Retort: Peter Huber's Junk Scholarship*, 42 AM. U. L. REV. 1637, 1726 (1993)(attributing "the prominence of the book and its author to clever public relations, not merit.").

would simply become junk technicians and junk specialists.⁸¹ This is probably not what the *Daubert* Court anticipated or intended. Indeed, wholesale abandonment of *Daubert* outside of “scientific” evidence is not sound logically or as a practical matter.⁸²

Although the *Daubert* Court spoke of the importance of “scientific” knowledge, the key to Rule 702 lies in the search for “facts” that are, without expert assistance, beyond a jury’s ability to appreciate fully.⁸³ The purpose of expert testimony under Rule 702 is to “assist the trier of fact;” and the trier of fact’s task is to weigh facts put into evidence. Rule 702 contemplates that sometimes nonscientific disciplines will have access to facts that might assist jurors. Perhaps the best way to approach Rule 702, then, is to understand its task as regulating the supply of facts to the jury in a manner that states a preference for science as the preeminent method for discovering facts.⁸⁴

Although the scientific method continues to attract its share of detractors and skeptics, the significant advances in science and technology in the twentieth century illustrate the power of that method. In identifying, predicting, and controlling the world around us, science is by far the most powerful intellectual technique known. The recognition of the power of science, however, should not lead to blind allegiance to its dictates. Science provides no assistance over broad and profoundly important areas of human concern, most particularly that of values. Moreover, science is slow, even plodding, and it often requires ideal conditions that rarely exist or studies only small numbers of variables that limit the ability to generalize any findings. Finally, researchers’ values guide the questions they ask and are not always easily disentangled from the answers they report.⁸⁵

These limitations on science are implicit in Rule 702’s recognition that “technical or other specialized knowledge” should sometimes be permitted to form the foundation for expert opinion.⁸⁶ But given the power of the scientific method, these alternatives should suffice only where science provides too little assistance or so much assistance that it amounts to overkill. In general, two problems recur that limit science’s usefulness to the law. The first involves factual questions that do not lend themselves to the scientific method because they are either inherently not amenable to it or they are so complex that

81. See generally Clifton T. Hutchinson & Danny S. Ashby, *Daubert v. Merrell Dow Pharmaceuticals, Inc.: Redefining the Bases for Admissibility of Expert Scientific Testimony*, 15 CARDOZO L. REV. 1875, 1879–81 (1994) (current standards promote use of “experts—who see in the given case just what the lawyer needs”).

82. See *Asplundh Manufacturing Division v. Benton Harbor Engineering*, 57 F.3d 1190 (3d Cir.1995) (applying a *Daubert*-inspired analysis to lay opinion offered under Rule 701 concerning a technical subject).

83. See John W. Strong, *Language and Logic in Expert Testimony: Limiting Expert Testimony by Restrictions of Function, Reliability and Form*, 71 OR. L. REV. 349, 355–56 (1992).

84. See David L. Faigman, *The Evidentiary Status of Social Science Under Daubert: Is It “Scientific,” “Technical” or “Other” Knowledge?* 1 PSYCHOLOGY, PUBLIC POLICY AND LAW 960 (1995).

85. For a general discussion of the limitations of science and a criticism of the overly “positivistic” approach taken by some commentators (and arguably the *Daubert* Court itself), see Andrew E. Taslitz, *Interpretive Method and the Federal Rules of Evidence: A Call for a Politically Realistic Hermeneutics*, 32 HARV. J. ON LEGIS. 331, 367–71 (1995).

86. FED. R. EVID. 702.

scientists do not yet have the tools to study them; the second concerns matters so elementary that nonscientists' extensive experience with them should be sufficient for the law's purposes.

Some facts are simply not amenable to the methods of science; science, as the Supreme Court recognizes, operates in the realm of testable hypotheses. For example, an expert might be called upon to validate the authenticity of a painting. The expert's conclusion that the painting was painted by, say, Cezanne, cannot be tested, since it is a unique event. This is not to say that the law should not demand the best methods that art experts and other nonscientists have in their arsenal, only that those methods are not "scientific."⁸⁷ Indeed, *Daubert* might be read to impose a responsibility on judges to apply standards of good art evaluation just as it requires them to apply good science to scientific evidence. Thus, just as there are a number of factors by which scientists evaluate the validity of science (four of which the Court specifically articulated), there are factors that art historians bring to their work for ensuring the best results possible given the inherent limitations of the subject.

Some facts of relevance to the law involve matters so complex that scientists have not, and perhaps can never, isolate the phenomena sufficiently to study them in depth. Indeed, many of the factual questions the law raises about human behavior are examples of complex phenomena not easily studied. For example, the psychological effects of extreme stress present formidable difficulties for psychologists. To recognize that many reputedly scientific matters remain on the margins of scientific skill, however, should not lead to scientific nihilism.⁸⁸ The appropriate response to empirical complexity should not be to call in the witchdoctor for a magic spell, but rather to demand the best science available and remain aware of its limitations. For instance, although meteorologists remain some distance from being able to accurately predict as complex a phenomenon as the weather,⁸⁹ they far out-perform their witchdoctor competitors. Under Rule 702, judges must be sophisticated enough to appreciate the differences in the methodological tools used by meteorologists and those wielded by the authors of the *Farmers Almanac*.

At the other extreme, the law depends on facts that are readily known through extensive study or experience, but with which triers of fact are likely to have little familiarity. A common example of specialized knowledge contemplated by Rule 702 is that possessed by mechanics.⁹⁰ The law permits auto

87. Some aspects of an art expert's evaluation of a painting purported to be a Cezanne might very well be testable and thus scientific. For example, radio carbon dating of the paint to determine whether Cezanne *could* have painted it is amenable to systematic and rigorous testing.

88. The so-called "hard sciences" also raise questions that might never be amenable to testing, see e.g., STEPHEN W. HAWKING, *A BRIEF HISTORY OF TIME: FROM THE BIG BANG TO BLACK HOLES* 74-75 (1988) (Professor Hawking discusses the physical impossibility of building a

particle accelerator large enough to test grand unified theories of the universe directly.).

89. See generally JAMES GLEICK, *CHAOS: MAKING A NEW SCIENCE* 7 (1987) ("Predictability is one thing in a cloud chamber where two particles collide at the end of a race around an accelerator. It is something else altogether in the simplest tub of roiling fluid, or in the earth's weather, or in the human brain.").

90. See MICHAEL H. GRAHAM, *FEDERAL PRACTICE AND PROCEDURE* § 6641, at 244 (1992) ("The local carpenter and auto mechanic are illustrative of admissible skilled witness testimony.").

mechanics to testify, so long as they spent enough time studying the matter, because their knowledge is thought to be readily obtainable.⁹¹ But recognizing that some facts can be known without the elaborate methods of science does not refute the relevance of the scientific method; it only indicates that sometimes that level of expertise is not necessary. The workings of a carburetor are no less susceptible to scientific understanding than the workings of an atom. The law merely assumes that an experienced mechanic can accurately describe the former but only a scientist can accurately describe the latter. In short, Rule 702 implicitly relaxes the requirement for a scientific demonstration when a less rigorous, less time consuming and less expensive alternative would provide sufficiently accurate information. When the subject of expert testimony is straightforward, the law dispenses with the requirement of scientific proof because it is excessive, not because it is unavailable.

[1] Is Forensic Science Science?

It remains too early to discern how courts will respond to the wide range of techniques that fall within the forensic science category. The principal difficulty, it appears, is that many of these techniques have been relied upon for so long that courts might be reluctant to rethink their role in the trial process. Topics like handwriting identification analysis, ballistics, bite marks, fiber analysis and so on are the staples of expert testimony. Yet, even from a distance, it is immediately apparent that many forensic techniques could not pass the most minimal *Daubert* scrutiny.⁹² At the very least, *Daubert* requires judges to ask where are the data.⁹³ In many forensic areas, effectively no research exists to support the practice. But does *Daubert* require such research to be done?

The *Daubert* opinion is silent on this matter. It can be safely said, however, that *Daubert* should not be interpreted to lead to its own destruction. Consider the example of handwriting identification analysis.⁹⁴ There are no studies of any value that support the validity of the forensic technique of handwriting identification.⁹⁵ In fact, what research exists casts a shadow on any such claims. Handwriting identification analysis would fail under even the most lax scientific standards for validation.

Perhaps, handwriting identification analysis and the other forensic sciences should be evaluated under the presumably more lax standards of the "technical and other specialized knowledge" prong of Rule 702.⁹⁶ Several

91. See generally McCORMICK ON EVIDENCE, supra note 17, at 21-22.

92. See Randolph N. Jonakait, *Real Science and Forensic Science*, 1 SHEPARD'S EXPERT & SCI. EVIDENCE Q. 435, 441 (1994); Randolph N. Jonakait, *Forensic Science: The Need for Regulation*, 4 HARV. J.L. & TECH. 109 (1991); Michael J. Saks, *Implications of the Daubert Test for Forensic Identification Science*, 1 SHEPARD'S EXPERT & SCI. EVIDENCE Q. 427 (1994).

93. Of course, *Daubert* requires not only that scientist-experts supply some data, but that they demonstrate the validity of that data. See supra § 1-3.3.1[1].

94. Handwriting identification analysis is a subspecialty of forensic document examination.

95. *United States v. Starzecpyzel*, 880 F.Supp. 1027, 1038 (S.D.N.Y.1995); see generally D. Michael Risinger, Mark P. Denbeaux & Michael J. Saks, *Exorcism of Ignorance as a Proxy for Rational Knowledge: The Lessons of Handwriting Identification "Expertise,"* 137 P.A.L.REV. 731, 738-51 (1989).

96. Interestingly, a recent extensive review of case law and commentary conducted by the editors of the Harvard Law Review does not even contemplate the possibility that *Daubert*

arguments favor this alternative. First, at least some forensic techniques do not claim scientific status or, alternatively, any such pretensions could be dispelled through an instruction to the jury. In addition, common sense or intuition indicate that the testimony of these specialists is accurate. Finally, little harm follows their introduction, since jurors can understand their fairly simplistic approach to the matter there is no aura of infallibility that surrounds it.⁹⁷

These arguments, however, are not persuasive. First of all, the Court's use of "testability" has a strong affirmative component. Testability, according to the Court, is the hallmark of science. This implies not only that scientific evidence that is testable have been tested, but that testable specialized knowledge must be tested too!⁹⁸ Any other interpretation would eviscerate *Daubert*.⁹⁹ The key to continued admissibility under such a reading would be to claim specialized status and thereafter refrain from conducting any tests. The forensic sciences that have proved to be false when finally tested should provide a cautionary tale to judges evaluating *Daubert's* applicability to forensic evidence.¹⁰⁰

Moreover, it is not obvious why the nonscientific prong is any less demanding than the scientific prong. Certainly, the plain meaning of Rule 702 does not support different treatment. Rule 702 refers to the several legitimate bases for expert testimony serially and without distinguishing one from the other. Under Rule 702, the trial court must be persuaded by a preponderance of the evidence that the basis for the expert's testimony, whether it is scientific, technical or specialized knowledge, is accurate (valid). The *Daubert* criteria are factors that contribute to that determination when the expert testimony is scientifically based. This gatekeeping responsibility does not change with technical or specialized knowledge; in these contexts the factors might be different (or the same), but the need for a validity assessment does not change. Forensic evidence should not find the other doors into the courtroom easier to enter. Ultimately, the matter turns on how observers should determine the accuracy of what forensic experts offer.

does not apply to the forensic sciences. *Developments—Scientific Evidence*, supra note 11, at 1557-82. In contrast, the same review devotes considerable attention to *Daubert's* application to the social sciences. *Id.* at 1523-27. This is just the opposite of how courts seem to view the matter. See infra § 1-3.4.1[2].

97. See McCORMICK, supra note 17, § 203, at 876; *Developments—Scientific Evidence*, supra note 11, at 1502 (referring to this point as the "show and tell" factor: "[if] the basic facts ... are presented to the jury in an engaging, 'show and tell' manner, then courts seem to deem the evidence less dangerous to admit").

98. See *Hopkins v. NCR Corp.*, 1994 WL 757510 (M.D.La.), aff'd, 53 F.3d 1281 (5th Cir. 1995)("The Court realizes that certain aspects of the *Daubert* test cannot be applied to expert

testimony in many areas of so called 'specialized knowledge.' However, in a case where the expert opinion could be substantiated by scientific or similar methodology, ... the factors expressed in *Daubert* are particularly relevant to measuring the reliability of the expert's testimony.").

99. See *Berry v. City of Detroit*, 25 F.3d 1342 (6th Cir.1994), cert. denied, ___ U.S. ___, 115 S.Ct. 902, 130 L.Ed.2d 786 (1995)("Although ... *Daubert* dealt with scientific experts, its language relative to the 'gatekeeper' function for federal judges is applicable to all expert testimony offered under Rule 702.").

100. See generally Berger, *Evidentiary Framework*, supra note 22, at 75 (discussing voiceprinting and paraffin testing as failed forensic evidence).

Although some forensic experts claim nonscientific status, in fact their fields typically extoll their “scientific” approach.¹⁰¹ Even if they did not, their subject matter is eminently amenable to empirical methods. Certainly no reasonably educated person would allow an astronomer to testify about observations of the sky made without a telescope. Why courts should continue to permit forensic experts to testify on observations made without benefit of the tools they have available is not clear.

The argument that common sense indicates the basic accuracy of forensic experts’ technologies cannot be taken very seriously. The history of science is replete with obvious knowledge that later turned out to be wildly incorrect. From the flat earth theory to the earth as the center of the universe theory (both “obvious” theories to our senses, and both just as obviously incorrect), the scientific method is designed to test intuition.¹⁰² Rule 702 simply incorporates a basic tenet of our time that is not subject to serious debate.

It is also argued that little harm comes from permitting experts to testify to specialized knowledge by which juries are unlikely to be overwhelmed.¹⁰³ This argument suffers from several flaws in logic. First, it assumes that these experts are not introducing normative considerations in the guise of facts; “facts” that are not within the charge of the trier of fact to decide.¹⁰⁴ Moreover, this argument turns the admissibility standard on its head. Rule 702 provides that the evidence must be valid in order to be admitted; Rule 403 permits otherwise admissible evidence (i.e., valid evidence) to be excluded if its probative value is substantially outweighed by unfair prejudice. Rule 403 is a rule of exclusion, not inclusion. This argument essentially adopts the view that otherwise inadmissible evidence (i.e., without demonstrated validity) is admissible if the prejudice is not too great. Rule 403 (and Rule 702) cannot be read in this fashion.

[2] Is Social Science Science?

In principle, the character of social science does not differ substantially from forensic science in regard to its “scientific” status under Rule 702. The fact that the multitude of syndromes and other clinical paraphernalia might also fall outside of *Daubert’s* scope might alone give courts pause before reading *Daubert* too narrowly. Yet, in terms of complexity and difficulty in testing the phenomena of interest, social scientists might have a better excuse than forensic scientists for having little data to support their opinions.¹⁰⁵

101. For instance, one prominent professional association that includes a large number of handwriting identification experts is the American Academy of Forensic Sciences.

102. See generally Faigman, *To Have and Have Not*, supra note 46, at 1020 (“The testing of theories forms the battlefield of the scientific enterprise, and it is in the trenches that science maintains its principal advantages over common sense.”).

103. See, e.g., *State v. Borrelli*, 227 Conn. 153, 629 A.2d 1105, 1110–1111 (1993) (The court held that expert testimony on the general effects of domestic violence was not subject

to the Frye test, since “the method is accessible to the jury, and not dependent on familiarity with highly technical or obscure scientific theories.”). See generally *Developments—Scientific Evidence*, supra note 11, at 1493.

104. This is a problem more associated with social science than forensic science and is discussed in the following section.

105. See generally David McCord, *Syndromes, Profiles and Other Mental Exotica: A New Approach to the Admissibility of Nontraditional Psychological Evidence in Criminal Cases*, 66 OR. L. REV. 19 (1989).

Moreover, despite the free use of the science label, the general perception is that social science is soft¹⁰⁶ and non-threatening.¹⁰⁷ In fact, however, courts applying the *Daubert* standard appear to readily assume that it applies to social scientists.¹⁰⁸ This is a wise course to follow.

Just as with forensic science, social science is, in principle, testable, though it is often advanced before any significant testing has been done. The previous section's discussion concerning forensic science, therefore, applies equally to the social sciences. The social sciences differ, however, in two significant respects. The first might support treating it as specialized rather than scientific¹⁰⁹ while the second counsels caution in such a move. On the one hand, whereas most forensic science is eminently testable, much social science that is legally relevant is very difficult to test. On the other hand, social science, more than forensic science, is likely to convey normative considerations that are outside the jury's charge to decide.

Because social science's subject matter is the human animal, many hypotheses prove quite difficult to test. In particular, experiments on, and direct observations of, certain phenomena can be complicated, both by the complexity of the subject and, often, by ethical considerations. For instance, researchers studying the battered woman syndrome cannot simply record the psychological manifestations of violence between family members without

106. The basis for this view is perhaps exemplified by the testimony of a psychiatrist in a 1954 Louisiana case: "In response to the question: 'Is that your conclusion that this man is a malingerer?' Dr. Unsworth responded: 'I wouldn't be testifying if I didn't think so, unless I was on the other side, then it would be a post traumatic condition.'" Ladner v. Higgins, 71 So.2d 242, 244 (La.Ct.App.1954).

Many courts have been reluctant to apply *Frye's* general acceptance standard to social science. See G. JOSEPH & S. SALTZBURG, EVIDENCE IN AMERICA: THE FEDERAL RULES IN THE STATES § 51.5, at 24 (1987) ("All of this underscores the point that *Frye's* utility in determining the admissibility of testimony regarding psychology is questionable at best.").

107. McCord, supra note 105, at 86 ("[T]he jury most likely has the ability to fairly and intelligently weigh the strengths and weaknesses of psychological evidence without being overwhelmed or overawed by it.").

108. See *United States v. Hall*, 93 F.3d 1337 (7th Cir. 1996) (concluding that Rule 702 and *Daubert* apply fully to social science expert testimony). See e.g., *State v. Foret*, 628 So.2d 1116 (La.1993) (Louisiana Supreme Court adopted *Daubert's* validity test and excluded expert testimony on child abuse accommodation syndrome.); *Gier v. Educational Serv. Unit Number 16*, 845 F.Supp. 1342, 1344-45 (D.Neb.1994), affirmed, 66 F.3d 940 (8th Cir. 1995) (same). There are several possible explanations for why courts automatically apply *Daubert* to social science but have hesitated in

applying it to forensic science. First, social scientists have for some time insisted they were scientists; and, indeed, some social science research is very rigorous. Perhaps courts ask themselves why some social scientists do good research while others do not. The forensic sciences have been more uniform in their eschewing rigorous testing. This might change, however, in light of the example of DNA profiling, a technique that survived the sort of rigorous testing envisioned by *Daubert*, but which most forensic techniques never experience. See Saks & Koehler, supra note 71, at 363-64. Alternatively, or in addition, the social sciences have been perceived for some time as a problem child for the law. Although judges regularly turn to social science research, too much reliance on it is perceived as muddled thinking or worse. See e.g., *Ballew v. Georgia*, 435 U.S. 223, 98 S.Ct. 1029, 55 L.Ed.2d 234 (1978) (Justice Powell characterized Justice Blackmun's use of social science to set a constitutional floor for jury size as "heavy reliance on numerology derived from statistical studies."). Also, the social sciences tend to be associated with criminal defendants, whereas forensic work typically supports prosecutors. Finally, forensic science often appears obvious, whereas social science often appears creative.

109. See e.g., *Officer v. Teledyne Republic/Sprague*, 870 F.Supp. 408, 410 (D.Mass. 1994) (court asserted that the *Daubert* standard has "less use in fields like design engineering where 'general acceptance' is the norm, not the exception").

proffering assistance from mental health professionals or reporting the situation to the appropriate authorities.¹¹⁰ But these limitations on the social sciences should not change the essential legal analysis significantly. In every scientific field, from physics to psychology, there are hypotheses that defy direct observation or straightforward testing. Our inability to “see” an electron, for example, does not foreclose a rigorous examination of its existence, nature, and form. Difficult and complex theories require more imaginative research designs. And, certainly, the difficulty of studying certain social phenomena does not excuse sloppy research.¹¹¹ One of the basic lessons of *Daubert* should not be lost: *Daubert* exhorts scientists to do good science and expects them to be scientists first and expert witnesses (and advocates) second.¹¹²

To the extent that social science is not tested, it contains the potential for a large advocacy component. To be sure, the forensic sciences too pose this danger, but they tend to be fairly blunt in specifically favoring the side paying the fees (typically the prosecution). The social science normative component is more complex. In a wide range of contexts, permitting social science expert testimony leads to the admission of information that the jury would not otherwise hear.¹¹³ Moreover, it might be presented through an eloquent and highly experienced witness. In effect, this form of testimony appears to call upon the jury to nullify the law, because the defendant is particularly sympathetic.

There are numerous examples. In battered woman self-defense cases, admission of battered woman syndrome means the jury hears evidence of the abuse and torture the woman endured before the fatal act. In rape trauma syndrome cases, use by defendants can lead to character evidence of the alleged victim that is ordinarily protected by rape shield statutes.¹¹⁴

§ 1-3.5 *Daubert* and Appellate Review

The appropriate standard of appellate review of expert testimony was never settled when *Frye* was the prevailing standard¹¹⁵ and the *Daubert* Court

110. See Schuller & Hastings, Chapter 8.

111. In fact, the problem cases in social science tend not to suffer from the complexity of the subject, but instead simply fail to apply even the most basic principles of research methodology. See Chapters 8 (battered woman syndrome), and 10 (repressed memories), as examples, *infra*.

112. Cf. *Thomas J. Kline, Inc. v. Lorillard, Inc.*, 878 F.2d 791, 800 (4th Cir.1989) (“Although it would be incorrect to conclude that Gordon’s occupation as a professional expert alone requires exclusion of her testimony, it would be absurd to conclude that one can become an expert simply by accumulating experience in testifying.”), cert. denied, 493 U.S. 1073, 110 S.Ct. 1120, 107 L.Ed.2d 1027 (1990); *In re Air Crash Disaster at New Orleans*, 795 F.2d 1230, 1234 (5th Cir.1986) (“[E]xperts whose opinions are available to the highest

bidder have no place testifying in a court of law, before a jury, and with the imprimatur of the trial judge’s decision that he is an ‘expert.’”).

113. See e.g., *State v. Kelly*, 97 N.J. 178, 478 A.2d 364, 377-78 (1984) (discussing the prior acts of abuse committed by the decedent against the defendant).

114. See Chapter 10, § 10-1.5.

115. See generally Alan W. Tamarelli, Jr., Note, *Daubert v. Merrell Dow Pharmaceuticals, Inc.: Pushing the Limits of Scientific Reliability—The Questionable Wisdom of Abandoning the Peer Review Standard for Admitting Expert Testimony*, 47 VAND. L. REV. 1175, 1196 (1994) (finding that the *de novo* standard prevailed under *Frye*, since “the appellate court could take its own head count of experts and determine the extent to which a scientific method was accepted”).

did not address the matter.¹¹⁶ Most courts applying *Daubert* assume that the traditional abuse of discretion standard applies to the *Daubert* test.¹¹⁷ This conclusion, however, is not shared by all courts and, in any case, the reality of appellate review is somewhat more complicated than the simple pronouncements of deference indicate.¹¹⁸

Some courts apply a less deferential standard to lower courts' evaluations of scientific evidence.¹¹⁹ Although these courts tend to remain reticent about their reasons for not deferring to lower courts' preliminary fact-finding in the area of scientific evidence,¹²⁰ this context is readily distinguishable from the ordinary preliminary fact issue.

Unlike virtually all other preliminary fact questions made under Rule 104(a), a large component of the decision surrounding scientific evidence transcends individual cases.¹²¹ Such issues as whether Bendectin is a teratogen, electromagnetic fields contribute to childhood leukemia, cigarettes cause cancer, or whether procedures for DNA profiling are valid, appear across jurisdictions.¹²² Appellate courts conducting an independent substantive re-

116. *Developments—Scientific Evidence*, supra note 11, at 1527 (“The standard of review for assessing lower courts’ decisions regarding the admissibility of expert testimony remains unclear.”).

117. See e.g., *Carroll v. Litton Systems, Inc.*, 47 F.3d 1164, 1995 WL 56862 (4th Cir. 1995), cert. denied — U.S. —, 116 S.Ct. 70, 133 L.Ed.2d 31 (1995) (“We review a district court’s decision on the admissibility of scientific evidence under Rule 702 for abuse of discretion.”); *United States v. Bonds*, 12 F.3d 540, 554 (6th Cir.1993) (In a post-*Daubert* review of evidence admitted under *Frye*, the court observed that “[w]e review the trial court’s admission of testimony and other evidence under the abuse of discretion standard.”); *Duffee v. Murray Ohio Manuf. Co.*, 91 F.3d 1410, 1411 (10th Cir. 1996) (same).

118. In *Cook v. American Steamship Co.*, 53 F.3d 733 (6th Cir.1995), the court offered the following guide to the thicket of appellate review:

The trial court’s preliminary factfinding under Rule 104(a) is reviewed for clear error. These facts include, but are not limited to, whether the witness’s “knowledge, skill, experience, training, or education,” are such as to qualify him or her to testify as an expert at all, and it may include a determination of the tests that the proffered expert conducted, if any. The court’s determination whether the opinion the expert wishes to proffer is properly the subject of “scientific, technical, or other specialized knowledge” is a question of law we review de novo. . . . Finally, the trial court’s determination whether the proffered expert opinion “will assist the trier of fact to understand the evidence or to determine a fact in issue,” is a relevancy determi-

nation and therefore one we review for abuse of discretion.

Id. at 738.

119. See *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 749–50 (3d Cir.1994), cert. denied — U.S. —, 115 S.Ct. 1253, 131 L.Ed.2d 134 (1995); *Joiner v. General Electric Co.*, 78 F.3d 524, 529 (11th Cir. 1996). See also, *Taylor v. State*, 889 P.2d 319, 332 (Okla.Crim.App.1995); *State v. O’Key*, 321 Or. 285, 899 P.2d 663 (1995).

120. An exception to this reticence is Judge Becker’s statement in *In re Paoli R.R. Yard PCB Litig. (Paoli II)*, 35 F.3d 717 (3d Cir. 1994). Judge Becker’s “hard-look” approach, and in particular his “one-way” application of it, is considered more fully infra notes 123–126 and accompanying text.

121. See *Reed v. State*, 283 Md. 374, 391 A.2d 364, 367 (1978) (In applying *de novo* review under *Frye*, the court stated: “The answer to the question about the reliability of a scientific technique or process does not vary according to the circumstances of each case. It is therefore inappropriate to view this threshold question of reliability as a matter within each trial judge’s individual discretion.”).

122. These issues fall into the category that Professors Monahan and Walker labeled “social frameworks.” See Laurens Walker & John Monahan, *Social Frameworks: A New Use of Social Science in Law*, 73 VA.L.REV. 559, 563–70 (1987). (The authors describe an emerging use of social science in law in which empirical information is offered to provide a background context for deciding factual issues crucial to the resolution of a specific case.)

view of the science can contribute substantially to the process of settling these matters.

In *Paoli II*,¹²³ Judge Becker articulated a process of appellate review that includes a substantial role for appellate judges in the process of assessing the merit of scientific evidence. In regard to scientific evidence, he explained, admissibility primarily depends on the methodological foundation supporting the expert testimony.¹²⁴ Therefore, although certain advantages flow from the trial court's proximity to the experts involved, the appellate judge is in nearly as good a position as the lower court to evaluate the merits of the science. These differences support a less deferential review of admissibility decisions regarding expert testimony, especially when these decisions lead to summary judgments. Judge Becker explained as follows:

[T]here are factors that counsel in favor of a hard look at (more stringent review of) the district court's exercise of discretion. For example, because the reliability standard of Rules 702 and 703 is somewhat amorphous, there is a significant risk that district judges will set the threshold too high and will in fact force plaintiffs to prove their case twice. Reducing this risk is particularly important because the Federal Rules of Evidence display a preference for admissibility.¹²⁵

This "hard-look" doctrine thus is uni-directional in that it is applied specifically to avoid erroneous exclusions of expert testimony that would result in summary judgments. Heightened scrutiny would not be deployed to identify erroneous decisions to admit expert testimony that might have led to errors at trial. As the above excerpt indicates, this doctrine will primarily benefit plaintiffs. Judge Becker stated the rule as follows:

[W]hen the district court's exclusionary evidentiary rulings with respect to scientific opinion testimony will result in a summary judgment, we will give them a "hard-look" (more stringent review . . .) to determine if a district court has abused its discretion in excluding evidence as unreliable.¹²⁶

The "hard-look" doctrine, however, might not accurately capture the essential principle of *Daubert*, nor does it articulate with sufficient specificity an alternative principle that might guide appellate review. Foremost, although *Daubert* recognizes and emphasizes the liberal thrust of the Rules, the decision also frames a gatekeeping function for trial court judges that limits this liberality. The gatekeeping responsibility does not change in relation to the proponent of the evidence or the outcome, such as summary judgment, that follows the admissibility decision. To the extent that appellate judges share some of the gatekeeping responsibilities borne by trial judges, Judge Becker fails to explain why the nature of that responsibility changes at the appellate level. Indeed, bad science is a concern for the legal process whether it leads to erroneous dismissals of meritorious claims or to erroneous verdicts of non-meritorious claims.

123. 35 F.3d 717 (3d Cir.1994), cert. denied ___ U.S. ___, 115 S.Ct. 1253, 131 L.Ed.2d 134 (1995).

124. Id. at 749-50.

125. Id. at 750 (citing *Daubert*, 113 S.Ct. at 2794).

126. Id. (citation omitted).

Any participation of appellate judges in the gatekeeping function must conform to traditional practices under the federal rules and, in particular, Rules 702 and 104(a). In the usual application of Rule 104(a), trial courts make a context-specific factual determination. For instance, trial courts must find, by a preponderance of the evidence, that a conspiracy existed before permitting evidence under the exclusion for statements made by a coconspirator;¹²⁷ and the trial court must similarly find that a statement was made under a belief of impending death before permitting evidence under the exception for dying declarations.¹²⁸ Because these facts are specific to the case before the judge and do not repeat themselves in the same form in other cases, substantial deference to the judge as fact finder flows from the judge's proximity to the matter. When the preliminary facts are not case-specific, the logic of deferring to the lower court is less compelling.¹²⁹

As noted above, science comes to the courtroom bearing two perspectives, one concerns general features that transcend the individual case and the other features of the particular case. This inherent structure of science might also direct the level of deference applied on appeal. Recall that these two levels can be seen as four categories of science, general theory, general application, general technology, and individual application. When the first three levels of scientific inquiry do not involve the special circumstances of individual cases, appellate courts are able to evaluate the research at least as well as lower courts. In fact, given the sometimes complex nature of scientific evidence, appellate courts' greater opportunity to consider these matters might give them a better vantage point from which to evaluate the science. Moreover, although it has so far remained largely implicit in court decisions, the determination concerning the admissibility of particular applications of science present complex policy judgments. Use of polygraph tests in criminal trials, for example, implicate a defendant's right to a fair trial. Rape trauma syndrome also raises fair trial concerns when used by prosecutors and raises concerns over impeaching the character of rape complainants when used by the defense. Scientific evidence in mass toxic tort cases, such as asbestos and lead, raise concerns about the most efficient administration of the civil justice system. The list is virtually without end. This policy aspect of the admissibility determination makes it appear less a question of "fact" and more a mixed question of "law and fact". Appellate courts have substantial responsibility for reviewing mixed questions of law and fact. Appellate courts should have a similar responsibility in regard to the general theory, general application and general technology components of scientific expert testimony. The application of methods of science that permit valid statements to be made about particular features of an individual should be subject to an abuse of discretion standard of review.¹³⁰

127. *Bourjaily v. United States*, 483 U.S. 171, 107 S.Ct. 2775, 97 L.Ed.2d 144 (1987). The trial court must also find, under Rule 801(d)(2)(E), that the statement was made "during the course and in furtherance of the conspiracy."

128. See generally MCCORMICK ON EVIDENCE, supra note 17, at 523-24. In applying Rule

804(b)(2), the court must also find that the declarant is unavailable under 804(a). *Id.*

129. See *State v. O'Key*, 321 Or. 285, 899 P.2d 663 (1995).

130. The distinction between *de novo* review and abuse of discretion outlined here parallels the distinction made, supra, concerning

§ 1-3.6 Application of *Daubert* to Criminal Cases

Although created in a civil case within the swirl of controversy surrounding fears of exploding litigation, federal courts apply *Daubert* with equal force to their criminal docket. Rule 702 does not distinguish between the civil and criminal contexts in regard to expert testimony and courts quickly assumed *Daubert's* applicability to criminal cases. In fact, much of *Daubert's* early evolution occurred through court responses to DNA evidence offered in criminal prosecutions.¹³¹

Although *Daubert's* applicability to criminal cases is largely non-controversial, several issues deserve highlighting in regard to *Daubert's* impact in this context. First, an amendment to the Federal Rules of Evidence passed by the United States House of Representatives in 1995, separates civil and criminal cases in regard to scientific evidence.¹³² If it were to become law, this amendment would retain the active gatekeeping role for judges in civil cases, but would mandate a less active role in criminal cases. This amendment would thus have the perverse result of mandating rigorous scrutiny of scientific evidence in civil cases, where plaintiffs rely on science most, and light scrutiny in criminal cases, where prosecutors rely on science most. Politically, this bias against civil plaintiffs and criminal defendants is understandable, but as a matter of fairness and justice it is not.

A second important issue pertinent to *Daubert's* application to criminal cases concerns the rigor with which courts will assess forensic evidence. Prosecutors rely heavily on empirical techniques that remain largely untested; techniques, such as handwriting identification and bitemarks, that have a long tradition of admission, but whose continuing vitality under *Daubert* remains in doubt. Indeed, the vitality of *Daubert* itself might be assessed on whether courts embrace the gatekeeping function seriously enough to challenge forensic scientists to live up to the title "scientist."

§ 1-3.7 Expert Testimony and Rule 403

The *Daubert* Court devoted relatively little attention to the balance of probative value and unfair prejudice encapsulated into Rule 403.¹³³ In time,

use of a 104(a) standard for the general levels of science and use of a 104(b) standard for individual level scientific facts. Stated in a nutshell, scientific facts evaluated under 104(a) would receive *de novo* review, whereas scientific facts evaluated under 104(b) would be reviewed under an abuse of discretion standard. See supra § 1-3.3.1[2].

131. See, e.g., *United States v. Bonds*, 12 F.3d 540 (6th Cir.1993); *United States v. Martinez*, 3 F.3d 1191 (8th Cir.1993), cert. denied, 510 U.S. 1062, 114 S.Ct. 734, 126 L.Ed.2d 697 (1994); *Government of the Virgin Islands v. Penn*, 838 F.Supp. 1054 (D.V.I.1993).

132. Attorney Accountability Act of 1995, H.R. 988, 104th Cong., 1st Sess. (1995); see generally Franklin M. Zweig et al., *Breaking the Chain of Proofs: Congress's Pending Law*

Reforms Would Change the Law of Evidence, 34 THE JUDGE'S J. 17, 46-50 (1995).

133. In fact, the Court's brevity allows us to quote its full Rule 403 discussion here:

Finally, Rule 403 permits the exclusion of relevant evidence "if its probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury..." Judge Weinstein has explained: "Expert evidence can be powerful and misleading because of the difficulty in evaluating it. Because of this risk, the judge in weighing possible prejudice against probative force under Rule 403 of the present rules exercises more control over experts than over lay witnesses."

Daubert, 113 S.Ct. at 2798 (quoting Judge Jack B. Weinstein, 138 F.R.D. 631, 632 (1991).

however, this Rule might prove to be the most important tool lower courts have for managing scientific evidence.¹³⁴ Because of the typically blunt nature of the concept of scientific validity, courts are likely to use Rule 403 to sharpen their gatekeeping function.¹³⁵ Under Rules 702 and 104(a), judges must decide whether the proponent of scientific evidence has demonstrated the scientific basis for the testimony by a preponderance of the evidence. In many cases, however, while judges might find scientific evidence to be “valid,” in that it is more likely than not “accurate,”¹³⁶ they might believe that it is not valid enough, in light of the dangers associated with its use.

Consider the example of expert testimony reporting the results of a polygraph examination. Polygraphy might be offered for a wide variety of purposes and admitted in a wide variety of ways. It is typically offered to attack or support the veracity of witnesses, ranging from criminal defendants to non-party witnesses in civil cases. Courts respond to these proffers using rules ranging from *per se* exclusion to case-by-case evaluation. But in all of these contexts, Rule 403 provides the blueprint.¹³⁷

Although the research supporting the validity of polygraphy remains controversial, and the matter is far from settled, significant research has been conducted on the accuracy of polygraph tests.¹³⁸ Despite the flaws associated with this research, a court could reasonably conclude that polygraphy was more likely than not valid. But few courts, if any, would complete their scrutiny there.

Polygraphy is a potentially awesome technique that might displace jurors' traditional task of evaluating credibility. A large percentage of courts and observers fear the overwhelming impact polygraphy might have, causing jurors to overlook the significant errors associated with even the best applica-

134. See *United States v. Dorsey*, 45 F.3d 809, 813-14 (4th Cir.1995), cert. denied ___ U.S. ___, 115 S.Ct. 2631, 132 L.Ed.2d 871 (1995).

135. See *United States v. Posado*, 57 F.3d 428 (5th Cir.1995) (“While not discussed at length in *Daubert*, the presumption in favor of admissibility established by Rules 401 and 402, together with *Daubert*'s ‘flexible’ approach, may well mandate an enhanced role for 403 in the context of the *Daubert* analysis, particularly when the scientific or technical knowledge proffered is novel or controversial.”).

136. Although it has taken substantial time for courts to adopt “validity” as the operative construct, as courts begin to work with this term they will find that it is not a simple or straightforward synonym for “accuracy.” Validity, in scientific usage, is an enormously complex and subtle concept. One classic text cautions readers as follows:

We shall use the concepts validity and invalidity to refer to the best available approximation to the truth or falsity of propositions, including propositions about cause.... [W]e

should always use the modifier “approximately” when referring to validity, since one can never know what is true. At best, one can know what has not yet been ruled out as false. Hence, when we use the terms valid and invalid . . . , they should always be understood to be prefaced by the modifiers “approximately” or “tentatively.”

THOMAS D. COOK & DONALD T. CAMPBELL, *QUASI-EXPERIMENTATION: DESIGN & ANALYSIS ISSUES FOR FIELD SETTINGS* 37 (1979). The authors then devote 57 pages specifically to the issue of “validity,” examining such variants as “statistical conclusion validity,” “internal and external validity,” and “construct validity.” *Id.* at 37-94. See generally Joseph Sanders, *Scientific Validity, Admissibility, and Mass Torts After Daubert*, 78 *MINN.L.REV.* 1387, 1399-1405 (1994).

137. See, e.g., *Ulmer v. State Farm & Casualty Co.*, 897 F.Supp. 299 (W.D.La.1995); *United States v. Crumby*, 895 F.Supp. 1354 (D.Ariz.1995).

138. See Chapter 14.

tion of the technology.¹³⁹ The regulation of this technology is largely accomplished through the balancing mechanism provided by Rule 403.

Virtually all other forms of scientific evidence present similar difficulties and opportunities. Therefore, for instance, some courts permit hypnotically refreshed recall so long as the witness' statements are recorded before hypnosis and any testimony at trial is limited to those facts recalled prior to hypnosis;¹⁴⁰ some courts view psychiatric predictions of violence as more problematic at the capital sentencing stage of trials than in ordinary civil commitment proceedings;¹⁴¹ courts overwhelmingly find that the little probative value they consider expert testimony on the unreliability of eyewitness identification to have, is easily outweighed by unfair prejudice.¹⁴² Whether explicit or, more often, implicit, Rule 403 is an integral part of admissibility decisions surrounding scientific expert testimony.

§ 1-3.8 Court-Appointed Experts Under Rule 706

Although rules of evidence have long provided for court-appointed experts, judges are reluctant to embrace this option.¹⁴³ However, the chorus of voices calling for judges to exercise Rule 706 has grown louder and nearly deafening.¹⁴⁴ The impetus for this clamor is obviously *Daubert's* mandate to

139. See, e.g., *United States v. Alexander*, 526 F.2d 161, 168 (8th Cir.1975) ("When polygraph evidence is offered . . . , it is likely to be shrouded with an aura of near infallibility, akin to the ancient oracle of Delphi"); *State v. Catanese*, 368 So.2d 975, 981 (La.1979) ("trier of fact is apt to give almost conclusive weight to the polygraph expert's opinion").

For empirical research concerning the impact of polygraphs, see Ann Cavoukian & Ronald J. Heslegrave, *The Admissibility of Polygraph Evidence in Court: Some Empirical Findings*, 4 LAW & HUM. BEHAV. 117 (1980); Stephen C. Carlson, et al., *The Effect of Lie Detector Evidence on Jury Deliberations: An Empirical Study*, 5 J. POLICE SCI. & ADMIN. 148 (1977); Alan Markwart & Brian E. Lynch, *The Effect of Polygraph Evidence on Mock Jury Decision-Making*, 7 J. POLICE SCI. & ADMIN. 324 (1979). Cf. J. Widacki & F. Horvath, *An Experimental Investigation of the Relative Validity and Utility of the Polygraph Technique and Three Other Methods of Criminal Investigation*, 23 J. OF FORENSIC SCIENCES 596 (1978).

140. See Chapter 12.

141. See Chapter 7.

142. See Chapter 11.

143. See WEINSTEIN'S EVIDENCE, supra note 14, ¶ 706(1), at 706-13; Joe S. Cecil & Thomas E. Willging, *Accepting Daubert's Invitation: Defining a Role for Court-Appointed Experts in Assessing Scientific Validity*, 43 EMORY L. J. 995, 1004 (1994).

144. See, e.g., *Sorensen v. Shaklee Corp.*, 31 F.3d 638, 649 (8th Cir.1994); *United States v. Shonubi*, 895 F.Supp. 460 (E.D.N.Y.1995). See also WEINSTEIN'S EVIDENCE, supra note 14, at ¶ 706[01]; AAAS-ABA NAT'L CONFERENCE OF LAWYERS & SCIENTISTS TASK FORCE ON SCIENCE & TECHNOLOGY IN THE COURTS, ENHANCING THE AVAILABILITY OF RELIABLE AND IMPARTIAL SCIENTIFIC AND TECHNICAL EXPERTISE TO THE FEDERAL COURTS: A REPORT TO THE CARNEGIE COMMISSION ON SCIENCE, TECHNOLOGY, AND GOVERNMENT (1991); AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, EXECUTIVE SUMMARY, SCIENCE, TECHNOLOGY AND THE COURTS: THE USE OF COURT APPOINTED EXPERTS (Jan. 1994); Margaret A. Berger, *Novel Forensic Evidence: The Need for Court-Appointed Experts after Daubert*, 1 SHEPARD'S EXPERT & SCI. EVIDENCE Q. 487 (1994); Samuel R. Gross, *Expert Evidence*, 1991 WIS. L. REV. 1113, 1211; Rebecca J. Klemm, *A Court-Appointed Expert as the Sole Source of Statistical Analysis*, 34 JURIMETRICS J. 149 (1994); Tahirih V. Lee, *Court Appointed Experts and Judicial Reluctance: A Proposal to Amend Rule 706 of the Federal Rules of Evidence*, 6 YALE L. & POL'Y REV. 480 (1988); Ellen Relkin, *Some Implications of Daubert and Its Potential for Misuse: Misapplication to Environmental Tort Cases and Abuse of Rule 706(a) Court Appointed Experts*, 15 CARDOZO L. REV. 2255 (1994); Joseph Sanders, *From Science to Evidence: The Testimony on Causation in the Bendectin Cases*, 46 STAN. L. REV. 1 (1993). But see Richard O. Lempert, *Civil Jurors and Complex Cases: Let's Not Rush to Judgment*, 80 MICH. L. REV. 68, 124 (1981).

judges to act as gatekeepers to keep out invalid science and the concomitant concern that they will have difficulty accomplishing this task.¹⁴⁵

Researchers at the Federal Judicial Center, Joe Cecil and Thomas Willging, recently conducted a survey of federal judges examining the use of court appointed experts.¹⁴⁶ In general, they found that judges relied little on this mechanism. Two factors, in particular, explain judges failure to seek expert assistance. First, many judges view the appointment of experts as a highly unusual act, only to be done under extraordinary circumstances.¹⁴⁷ Second, a significant portion of the judges expressed their belief that the adversarial process should be relied upon, and that court appointed experts would take the matter away from the able hands of the parties.¹⁴⁸

Because the survey was conducted only shortly after *Daubert* was decided, it remains unknown whether court appointed experts will continue to be perceived as generally unnecessary. As trial judges define the parameters of their new gatekeeping function, they might increasingly turn to experts to assist them. Under a *Frye*-style general acceptance test, judges could be expected not to seek expert assistance. Needing only to evaluate the support in the field, judges did not have to understand the science in any detail. *Daubert* requires judges to have a greater facility with the actual underlying scientific basis, and court appointed experts might be sought for educational purposes.

The second factor leading judges not to seek expert assistance, the adversarial process, is not very compelling under close scrutiny. Several aspects of this complaint must be evaluated. First, although all aspects of the trial process incorporate some measure of the adversarial principle, this principle is most closely tied to arguments made to triers of fact (and, in particular, juries). Thus, judges regularly raise, research and resolve legal matters *sua sponte*. The "factfinding" judges do under Rule 104(a) resembles such legal issues, in that these facts are found by judges as a necessary prerequisite to the application of legal rules. Moreover, the task for court-appointed experts will often be to educate the judge on technical matters, so that the judge can make a better informed decision.¹⁴⁹ In fact, over time, the

145. Chief Justice Rehnquist, concurring in the opinion, wrote separately to question whether Rule 702 should be interpreted to require judges to become "amateur scientists." *Daubert*, 113 S.Ct. at 2800; see also *E.I. du Pont de Nemours & Co. v. Robinson*, 923 S.W.2d 549 (Tex.1995)(dissenters echoed Chief Justice Rehnquist's concern in response to Texas' adoption of *Daubert*).

146. Cecil & Willging, *supra* note 142.

147. *Id.* at 1015-18 (Cecil and Willging report that of the eighty-one judges asked "why they thought the authority had been exercised so infrequently," fifty judges expressed the opinion that "appointment of an expert [is] an extraordinary action.").

148. *Id.* at 1018-19.

149. For example, Cecil and Willging quote several judges in their survey on judicial use of

court appointed experts who expressed the view that these experts should educate them to be better judges; the experts were not hired to decide the merits. One judge commented as follows:

"I instructed [the expert] that his role was to help me and that he was not to decide the case. His main role was to interpret the language to me, give me background on computer technology, tell me how the various systems work."

Cecil & Willging, *supra* note 142, at 1026. Other judges shared this perspective. One said, "[I] emphasized that I did not want him to give his opinion on the substance of the dispute, but to explain and guide me through the testimony." *Id.* And another "defined the expert's role as that of 'interpreter.'" *Id.*

use of court-appointed experts should decline as judges' sophistication with scientific methods increases. Finally, in most cases, the court-appointed expert will not displace parties' own experts, but will merely add an alternative view to the judge's deliberations. The judge's expert will often pay dividends by helping move the parties to resolve issues not seriously disputed and allow them to concentrate on those that are.

However, court-appointed experts are no panacea and they will not free judges from making difficult decisions regarding scientific evidence. Also, scientists, though perhaps not identified with the parties to a matter, possess biases of their own. Inevitably, scientists are more or less conservative concerning their willingness to draw certain inferences or make certain conclusions based on the available data. While these biases cannot be avoided, court-appointed experts should make them explicit so that judges can take them into account to the extent possible in making their decisions.