

THE ADMISSIBILITY OF DIFFERENTIAL DIAGNOSIS TESTIMONY TO PROVE CAUSATION IN TOXIC TORT CASES: THE INTERPLAY OF ADJECTIVE AND SUBSTANTIVE LAW

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I

INTRODUCTION

In *E.I. du Pont de Nemours & Co., Inc. v. Robinson*,¹ the Texas Supreme Court adopted an interpretation of the rules concerning the admissibility of expert testimony nearly identical to that adopted two years earlier by the United States Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*² The court affirmed the trial judge's exclusion of Dr. Carl Whitcomb, the plaintiff's only causation expert, who was prepared to testify that the defendant's contaminated fungicide damaged the plaintiff's pecan orchard. In a vigorous dissent, Justice Cornyn noted that the expert's testimony was based in part on a series of first-hand observations of the orchard.³ He noted that the excluded testimony "is roughly analogous to that which may be offered by a physician, who may testify based on nothing more than a personal examination, the patient's history, and correspondence with other physicians."⁴ Physicians are fre-

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1. 923 S.W.2d 549 (Tex. 1995).

2. 509 U.S. 579 (1993).

3. The observations were:

(1) many leaves had an unusual coloration or were deformed in shape, but the pattern of occurrences were inconsistent with frost damage, insect infestation, or nutrient deficiencies; (2) many nuts had failed to form properly, but the deformities were not consistent with nutrient deficiencies or drought; (3) roots had failed to develop normally, but the abnormalities were inconsistent with freeze damage, drought, or root rot; (4) new growth in the limbs of the trees had failed to develop normally or had experienced die-back; (5) soil conditions were of adequate depth and consistency to support a pecan orchard; (6) drainage patterns in the orchard were sufficient to prevent excess accumulations of rainfall that could damage pecan trees; and (7) insects were not present in any appreciable level.

Robinson, 923 S.W.2d at 562.

4. *Id.*

quently called upon to offer opinions identifying an injury's cause based both on a physical examination of a patient and the exclusion of other causes of the patient's condition. When this type of testimony is presented by physicians, it frequently goes by the name of "differential diagnosis," although some courts have more appropriately called it "differential etiology."⁵

Justice Cornyn may have believed that the expert's testimony in *Robinson* must be admissible because it was so similar to the typical testimony of many medical doctors. Such testimony had been employed in tort cases for many years without criticism from courts or commentators.⁶ Perhaps, however, Justice Cornyn foresaw the opposite implication: If Dr. Whitcomb's testimony was inadmissible, it might call into question the differential diagnosis testimony of many physicians. Had Judge Cornyn investigated the law review literature more thoroughly, he would have discovered that such questioning had already begun in the late 1980s and early 1990s.⁷ A number of factors seem to have played a role in this change, among them the increasing use of scientific experts in court, the rise of toxic tort actions, and renewed interest in the criteria used to judge the admissibility of expert testimony. As the 1990s progressed, courts were presented with more admissibility challenges to differential diagnosis testimony. There is now a considerable body of case law on point.⁸

Most would agree that the result of these challenges is a body of evidence law that creates more barriers to the admissibility of this evidence.⁹ However,

5. In medical dictionaries, differential diagnosis is defined as "diagnosis based on comparison of symptoms of two or more similar diseases to determine which the patient is suffering from." TABER'S CYCLOPEDIA MEDICAL DICTIONARY 404 (14th ed. 1981). However, in legal usage, the term is not restricted to the process of distinguishing among diseases. Rather, the term also is used to describe the process of differentiating among the possible causes of the plaintiff's ailment. It is with respect to this latter, perhaps incorrect, usage that differential diagnosis has become controversial in legal settings. Differential diagnosis is defined as "a process whereby medical doctors experienced in diagnostic techniques provide testimony countering other possible causes . . . of the injuries at issue." See *Cavallo v. Star Enterprise*, 892 F. Supp. 756, 771 n.31 (E.D. Va. 1995), *aff'd in part, rev'd in part, remanded*, 100 F.3d 1150 (4th Cir. 1996). Some courts do recognize that the legal usage is contrary to the medical usage and employ the more appropriate term "differential etiology" (the study of the causes of disease). See *Zuchowicz v. United States*, 140 F.3d 381, 385 (2d Cir. 1998).

6. A Westlaw search of the term "differential diagnosis" generates 452 cases, the earliest decided in 1948. See *Travelers Ins. Co. v. Industrial Accident Comm'n*, 195 P.2d 48 (Cal. Ct. App. 1948), *vacated*, 203 P.2d 747 (Cal. 1949).

7. For two of the earliest articles discussing differential diagnosis, see Bert Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595 (1988); E. Donald Elliott, *Toward Incentive-Based Procedure: Three Approaches for Regulating Scientific Evidence*, 69 B.U. L. REV. 487 (1989).

8. See, e.g., *Raynor v. Merrell Pharms., Inc.*, 104 F.3d 1371, 1376 (D.C. Cir. 1997) (Bendectin and fetal birth defects); *Ambrosini v. LaBarraque*, 101 F.3d 129 (D.C. Cir. 1996) (Depo-Provera and birth defects); *Hall v. Babcock & Wilcox*, 69 F. Supp. 2d 716 (W.D. Pa. 1999) (exposure to radiation and cancer); *Pick v. Am. Med. Sys.*, 958 F. Supp. 1151 (E.D. La. 1997) (silicone penile implant and autoimmune disorder); *Golod v. Hoffman La Roche*, 964 F. Supp. 841 (S.D.N.Y. 1997) (Tegison and eye injury); *Berry v. CSX Transp.*, 709 So. 2d 552 (Fla. App. 1998) (organic solvents and encephalopathy); *Norfolk S. Ry. Co. v. Baker*, 514 S.E.2d 448 (Ga. App. 1999) (diesel exhaust and nasopharyngeal cancer).

9. Recent articles that discuss differential diagnosis include: Henry Berry, *Logical Analysis: A Method of Examination of Expert Medical Opinion Through the Basic Logic of Medical Reasoning*, 34 TORT & INS. L.J. 949 (1999); Harvey Brown, *Eight Gates for Expert Witnesses*, 36 HOUS. L. REV. 743 (1999); Lars Noah, *Pigeonholing Illness: Medical Diagnosis as a Legal Construct*, 50 HASTINGS L.J. 241 (1999); Richard T. Stilwell, *Kumho Tire: The Battle of the Experts Continues*, 19 REV. LITIG. 193

there is no complete consensus on the requirements for admitting such testimony. On the contrary, the case law is unsettled in some regards.¹⁰ This lack of agreement is not surprising, because differential diagnosis testimony attempts to address some very difficult causal questions, especially when offered in toxic tort cases.

In this article, we use the differential diagnosis opinions to explore a pair of interrelationships. First, we are interested in the relationship between admissibility and causation. In this regard, it is important to understand that in many toxic tort cases the center of gravity on causal questions has shifted to an earlier point in the trial. No longer solely a question for the jury, causation is resolved in an in limine hearing before a jury is even empaneled.¹¹ The central point is that adjective law¹² and substantive law do not exist in isolation from each other. Our goal is to shed light on how admissibility decisions shape causal questions and, in turn, how causal principles affect admissibility decisions regarding differential diagnosis. Second, we are interested in the relationship between law and science. Specifically, we argue that the *Daubert* decision has caused courts to be more “scientific” in assessing the admissibility of such testimony. In Part II, we present the basic causal framework employed by most courts in toxic tort cases. Part III sketches out the admissibility rules developed in *Daubert* and its progeny. Part IV examines the differential diagnosis opinions in the context of both the causation analysis of Part II and the admissibility rules presented in Part III. Part V attempts to explain differences in the opinions based on causal and non-causal factors. It argues that a key to understanding the developing case law in this area is to appreciate the degree to which courts have adopted the interpretive conventions of science in assessing admissibility.

As we shall see, while some cases simply seem to be wrongly decided, many cases could go either way. These cases offer us an opportunity to examine present judicial views as to how tight a causal chain plaintiffs must present to state a prima facie case in this evolving area of law. The final part offers a few thoughts on the proper balance between causal clarity and the role of the jury in tort cases.

(2000); Note, *Navigating Uncertainty: Gatekeeping in the Absence of Hard Science*, 113 HARV. L. REV. 1467 (2000).

10. See *infra* Part IV for a discussion of areas of agreement and disagreement.

11. One of the unanticipated beneficial consequences of a renewed judicial interest in admissibility is that it has generated a large number of cases addressing complex causal questions. Prior to the rise of this body of law, causal questions were addressed much less frequently. Close questions were simply left to the jury and whatever verdict came out of this black box was rarely overturned on causal grounds.

12. Adjective law is defined as the body of rules governing procedure and practice. As opposed to that body of law which the courts are established to administer (called “substantive law”), it means the rules according to which the substantive law is administered, such as the Federal Rules of Civil Procedure. See BLACK’S LAW DICTIONARY 42 (7th ed. 1999).

II

CAUSAL ISSUES IN TOXIC TORT CASES

Cause-in-fact in toxic tort cases is usually thought of as two separate issues: general causation and specific causation.¹³ General causation asks whether exposure to a substance causes harm to anyone. Specific causation asks whether exposure to a substance caused a particular plaintiff's injury. Under traditional tort theory, a successful plaintiff must prevail by a preponderance of the evidence on both issues.¹⁴ The plaintiff must not only show that, more likely than not, the substance causes the injury in question, but also that, more likely than not, the plaintiff's specific injury was caused by the substance.¹⁵

It would be a mistake to argue that the causal issues in toxic tort cases are fundamentally different from those presented in other tort cases. However, toxic tort cases do differ in degree in several significant ways.¹⁶ First, often there is causal ambiguity. The level of exposure to a substance or a drug—the dose rate—is often uncertain. Evidence of a relationship between the substance and the injury is often uncertain.¹⁷ The timing between exposure and disease may be suspect.¹⁸ These difficulties may create both admissibility and sufficiency questions. Second, there is a fundamental problem of multiple causation. Asbestos, the subject of the first great toxic tort case,¹⁹ is atypical because it causes “signature” diseases. Asbestosis and mesothelioma are diseases so strongly related to asbestos exposure that there is little doubt that a person with these illnesses who has been exposed to asbestos contracted them because of the exposure.²⁰ Other substances, however, do not cause unique injuries, and substances that do cause signature diseases may also cause others.²¹ If, for example, an individual is exposed to asbestos and develops lung cancer, one cannot be certain that the exposure caused the disease. It could be caused by something else, such as ciga-

13. Arguably, these are separate issues in all tort cases. However, the general causation issue is often obvious. That cars striking trees at 60 mph might cause injury to occupants is not a point requiring expert testimony. See Note, *Navigating Uncertainty: Gatekeeping in the Absence of Hard Science*, *supra* note 9, at 1473.

14. See, e.g., *DeLuca v. Merrell Dow Pharms.*, 911 F.2d 941, 958 (3d Cir. 1990).

15. See Ronald J. Allen, *The Nature of Juridical Proof*, 13 *CARDOZO L. REV.* 373 (1991).

16. For useful discussions of the special causal problems arising in toxic tort cases, see Gerald W. Boston, *A Mass-Exposure Model of Toxic Causation: The Content of Scientific Proof and the Regulatory Experience*, 18 *COLUM. J. ENVTL. L.* 181 (1993); David A. Fischer, *Successive Causes and the Enigma of Duplicated Harm*, 66 *TENN. L. REV.* 1127 (1999); Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substance Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 *Nw. U. L. REV.* 643 (1992); Mark Parascandola, *What is Wrong with the Probability of Causation?*, 39 *JURIMETRICS J.* 29 (1998); David Rosenberg, *The Causal Connection in Mass Exposure Cases: A “Public Law” Vision of the Tort System*, 97 *HARV. L. REV.* 849 (1984).

17. See Heidi Li Feldman, *Science and Uncertainty in Mass Exposure Litigation*, 74 *TEX. L. REV.* 1 (1995).

18. See *Heller v. Shaw Indus.*, 167 F.3d 146 (3d Cir. 1999).

19. See *Borel v. Fibreboard Paper Prods. Corp.*, 493 F.2d 1076 (5th Cir. 1973).

20. See Victor Roggli, *Asbestos*, in 3 *MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY* 285-325 (David Faigman et al. eds., 1997).

21. For example, asbestos also causes lung cancer. See *id.*

rette smoking.²² Third, and related to the problem of multiple causation, there is often limited evidence of specific causation, that is, evidence that the substance caused the injury to this particular plaintiff.²³ Plaintiffs may find it difficult to prove that a particular injury was the result of the defendant's substance or another cause.

Courts have provided some solutions to these causal difficulties. The most noteworthy is the use of general causation evidence, such as epidemiological studies, to prove or disprove specific causation.²⁴ However, this solution is viable only where there is good evidence on general causation.²⁵ Courts have been less willing to entertain alternatives permitting proportionate recoveries based on the probability that a specific injury was caused by a given exposure, or collectivized, risk-based claims in mass exposure cases.²⁶ All of these proposed solutions tacitly recognize the difficulty of proving specific causation, and some explicitly attempt to relieve the plaintiff of the burden of proof on this element. Because courts have generally refused to relieve the plaintiff from proving specific causation, differential diagnosis evidence is often a crucial component of the plaintiff's case.²⁷ Without some evidence that the substance in

22. See Piero Mustacchi, *Lung Cancer Latency and Asbestos Liability*, 17 J. LEGAL MED. 277 (1996).

23. In a few areas there is a fourth difficulty, an indeterminate defendant. The most well-known situation of this kind is the DES litigation, but the problem has arisen in asbestos and lead paint exposure cases as well. In the DES context, many courts have provided a special remedy to plaintiffs facing this problem, the most well-known being market-share liability. See *Sindell v. Abbott Labs.*, 607 P.2d 924 (Cal. 1980).

24. Prior to the emergence of epidemiological evidence in the toxic tort context, some courts adopted what Professor David Rosenberg called a "strong version" of the preponderance of the evidence rule. See David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 851, 857 (1984), quoted in *In re Agent Orange Prods. Liab. Litig.*, 611 F. Supp. 1223, 1261 (E.D.N.Y. 1985). To prove specific causation, the plaintiff must offer more than statistical correlation. See Rosenberg, *supra*, at 856. The plaintiff must also offer some "particularistic" proof of a causal connection. See *id.* Other courts adopted a "weak version" of the rule. A verdict for the plaintiff may be supported solely on statistical, that is epidemiological, evidence. See *id.* at 857-58. Over time, the "weak" version has gained ascendancy. Under this rule, an injured plaintiff may reach the jury if she can present epidemiological studies indicating at least a doubling of the risk of injury due to exposure to a substance (a relative risk of 2.0 or greater). See *In re Joint E. & S. Dist. Asbestos Litig.*, 758 F. Supp. 199, 203 (S.D.N.Y. 1991), *rev'd on other grounds*, 964 F.2d 92 (2d Cir. 1992); *DeLuca v. Merrell Dow Pharms., Inc.*, 911 F.2d 941, 958-59 (3d Cir. 1990); *Landrigan v. Celotex Corp.*, 605 A.2d 1079, 1087 (N.J. 1992).

25. In fact, the quality of the general causation evidence varies from very good—the teratogenic effects of Bendectin—to very poor—whether exposure to jet fuel can cause chronic conjunctivitis. See *Cavallo v. Star Enter.*, 892 F. Supp. 756 (E.D. Va. 1995); MICHAEL GREEN, *BENDECTIN AND BIRTH DEFECTS: THE CHALLENGES OF MASS TOXIC SUBSTANCES LITIGATION* (1996). The courts have also been willing to ease the plaintiff's burden by applying a substantial factor rather than a but-for test in these cases. The use of a substantial factor test has often been implicit. Few if any defendants have successfully advanced the argument that the plaintiff has failed to show but for causation. It is interesting that this fundamental issue has received relatively little attention in the present context. In this brief article, we set aside any further discussion of but for versus substantial factor causal analysis.

26. See Margaret Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117 (1997); Steve Gold, *Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence*, 96 YALE L. J. 376 (1986); Rosenberg, *supra* note 24, at 851; David Rosenberg, *Individual Justice and Collectivizing Risk-Based Claims in Mass-Exposure Cases*, 71 N.Y.U. L. REV. 210, 211 (1996).

27. See *Lennon v. Norfolk & W. Ry. Co.*, 123 F. Supp. 2d 1143, 1154 (N.D. Ind. 2000).

question caused the specific injury to the specific plaintiff, courts are likely to grant the defendant summary judgment. To get this evidence to the jury, the plaintiff must first pass through the *Daubert* gate.²⁸

III

DAUBERT, KUMHO, AND THE ADMISSIBILITY OF EXPERT EVIDENCE

The question of when to trust an expert is as old as expert testimony itself.²⁹ Prior to *Daubert*, the most important admissibility opinion was *Frye v. United States*.³⁰ In that case, the defendant, accused of murder, offered the results of a precursor to the lie detector test to prove his innocence.³¹ The court refused to admit the testimony based on the test results until the technique was “sufficiently established to have gained general acceptance in the particular field in which it belongs.”³² After the adoption of the Federal Rules of Evidence, a number of federal circuit courts abandoned the *Frye* test.³³ Some circuits, however, continued to use *Frye* after the adoption of the Rules. The Ninth Circuit was among this latter group.³⁴ In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,³⁵ Jason Daubert and Eric Schuler sued the defendant, the manufacturer of Bendectin, a morning sickness drug. They claimed that the drug, taken by their mothers during pregnancy, caused the plaintiffs’ limb reduction birth defects.³⁶ The trial judge granted the defendant summary judgment after concluding that the strongest inference a jury could draw from the evidence was that “Bendectin could possibly have caused plaintiffs’ injuries,” a finding insufficient to avoid

28. See *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993).

29. See David L. Faigman et al., *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, 1800 (1994) (reporting that the first clear reference to an expert witness called by and on behalf of a party occurred in the case of *Folkes v. Chadd*, 99 Eng. Rep. 589 (1782)). For commentary on the history of expert witnesses, see Learned Hand, *Historical and Practical Considerations Regarding Expert Testimony*, 15 HARV. L. REV. 40 (1901); Stephan Landsman, *Of Witches, Madmen, and Products Liability: An Historical Survey of the Use of Expert Testimony*, 13 BEHAV. SCI. & L. 131 (1995).

30. 293 F. 1013 (D.C. Cir. 1923). Our discussion here borrows heavily from 1 MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY (David Faigman et al. eds., 1997).

31. See *Frye*, 293 F. at 1013.

32. *Id.* at 1014.

33. The most influential early circuit court opinion rejecting *Frye* is *United States v. Downing*, 753 F.2d 1224 (3d Cir. 1985). In a case involving expert testimony on eyewitness identification, Judge Becker said that, to be admitted, the evidence must survive the trial court’s preliminary inquiry. See *id.* at 1226. In an in limine proceeding, the judge should balance the reliability of the scientific principles the expert employed against the likelihood that the evidence may overwhelm or mislead the jury. In addition, the trial court should examine the “fit” between the proffered scientific testimony and the contested issues in the case. See *id.* at 1226. Concern with reliability and fit have become cornerstones of post-*Daubert* jurisprudence. Another pre-*Daubert* case that rejected *Frye* is *Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106 (5th Cir. 1991) (en banc).

34. See *United States v. Solomon*, 753 F.2d 1522, 1526 (9th Cir. 1985).

35. See *Daubert v. Merrell Dow Pharms., Inc.*, 727 F. Supp. 570 (S.D. Cal. 1989).

36. See *id.*

granting the defendant's motion.³⁷ On appeal, the Ninth Circuit affirmed.³⁸ It held that the plaintiff's expert testimony was inadmissible because its underlying methodology diverged substantially from the procedures and techniques generally accepted in the field.³⁹

The Supreme Court granted certiorari, primarily to announce *Frye's* demise.⁴⁰ The Court held that, although the Federal Rules of Evidence do not incorporate the *Frye* test, they do require more than relevance.⁴¹ Rule 702 requires reliability as well as relevance; testimony that is relevant but unreliable is inadmissible.⁴² This raises the question: What constitutes reliability? In *Daubert*, where all of the experts purported to be scientists,⁴³ the Court turned to science for an answer. Reliable opinions are those reached using the "methods and procedures of science."⁴⁴ The court added that "[i]n a case involving scientific evidence, *evidentiary reliability* will be based upon *scientific validity*."⁴⁵

Though the *Daubert* court did not outline a systematic presentation of what scientists mean when they inquire about validity, it did offer four factors courts might consider when making a reliability/validity assessment: (1) Whether the expert's theory or technique is falsifiable and has been tested;⁴⁶ (2) the reliability of a procedure and its potential rate of error;⁴⁷ (3) whether the theory or technique has been subjected to peer review⁴⁸ and the results have been published;⁴⁹ and (4) in a partial resurrection of the *Frye* test, whether the expert's methods and reasoning enjoy general acceptance in a relevant scientific community.⁵⁰ In addition, the Court noted that Rule 702 requires that expert evidence "assist the trier of fact to understand the evidence or to determine a fact in issue."⁵¹ Justice Blackmun said that "[t]his condition goes primarily to relevance The consideration has been aptly described by Judge Becker as one of 'fit.' 'Fit' is not always obvious, and scientific validity for one purpose is not necessarily scientific validity for other, unrelated purposes."⁵² The "fit" requirement involves an

37. *Id.* at 576.

38. *See Daubert v. Merrell Dow Pharms., Inc.*, 951 F.2d 1128 (9th Cir. 1991).

39. *See id.* at 1129-30.

40. *See Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993).

41. *See id.* at 589.

42. *See id.*

43. *See id.* at 589-90.

44. *Id.* at 590.

45. *Id.* at 590 n.9 (emphasis in original). For a discussion of the complex issue of scientific validity in the toxic tort context, see 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); Joseph Sanders, *Scientific Validity, Admissibility, and Mass Torts after Daubert*, 78 MINN. L. REV. 1387 (1994).

46. *See Daubert*, 509 U.S. at 593.

47. *See id.* at 594.

48. *See id.* at 593-94.

49. *See id.*

50. *See id.*

51. *Id.* at 591.

52. *Id.* (citing *United States v. Downing*, 753 F.2d 1224, 1242 (3d Cir. 1985)).

assessment of whether the expert's chain of reasoning contains an inferential gap that is too wide.⁵³

The Court expressly limited this holding to scientific evidence.⁵⁴ In addition, the opinion clearly stated that the four reliability factors—testability, error rate, peer review and publication, and general acceptance—are not exclusive.⁵⁵ These positions present two related questions to post-*Daubert* courts: Does *Daubert's* reliability requirement apply at all to non-scientific evidence and, if it does, what role do the *Daubert* factors play in these cases?

Many courts concluded that *Daubert* did apply to non-scientific testimony, but often they could not agree about the proper role of the *Daubert* factors. *Moore v. Ashland Chemical, Inc.*⁵⁶ provides an instructive example. In *Moore*, the plaintiff became ill after he was forced to clean up a spill of solvents inside the back of a truck.⁵⁷ The trial judge excluded the causation testimony of one of his experts, a specialist in pulmonary, environmental, and internal medicine, which stated that one hour of exposure caused the plaintiff to contract reactive airways dysfunction syndrome.⁵⁸ The plaintiff appealed, and the Fifth Circuit reversed, ruling that the exclusion was in error.⁵⁹ It held that, while the *Daubert*

53. Sometimes “fit” may be understood to refer to the relationship between the general question asked by a line of research and the question in the case. Judge Becker provides an example: “[A]nimal studies may be methodologically acceptable to show that chemical X increases the risk of cancer in animals, but they may not be methodologically acceptable to show that chemical X increases the risk of cancer in humans.” *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 743 (3d. Cir. 1994).

Courts may also find a lack of fit when the studies presented by the expert simply fail to support the expert's position. Using the “fit” requirement in this way causes courts to move closer to excluding an expert's testimony because of the expert's conclusion. This is something the Supreme Court in *Daubert* specifically cautioned against when it said that the focus of the 702 validity inquiry “must be solely on principles and methodology, not on the conclusions that they generate.” *Daubert*, 509 U.S. at 595.

Most appellate courts downplayed the Supreme Court's methodology-conclusion distinction. For example, in an important *Paoli* opinion following *Daubert*, Judge Becker himself said “we think that [the distinction between principles and methods versus conclusions] has only limited practical import. . . . [A] challenge to ‘fit’ is very close to a challenge to the expert's ultimate conclusion about the particular case, and yet it is part of the judge's admissibility calculus under *Daubert*.” *In re Paoli*, 35 F.3d at 746.

In *General Electric Co. v. Joiner*, 522 U.S. 136 (1997), the Supreme Court endorsed Judge Becker's view:

[N]othing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence which is connected to existing data only by the *ipse dixit* of the expert. A court may conclude that there is simply too great an analytical gap between the data and the opinion proffered.

Id. at 146.

54. See *Daubert*, 509 U.S. at 590 n.8.

55. See *id.* at 594 n.12.

56. 126 F.3d 679 (5th Cir. 1997), rehearing en banc granted, opinion vacated, 151 F.3d 269 (5th Cir. 1998).

57. See *Moore*, 151 F.3d at 271-72.

58. See *Moore*, 126 F.3d at 699-700.

59. The appeal followed a trial on the merits. See *id.* at 679. The case went to trial because the trial court did allow the plaintiff's treating physician to testify on causation. This was a strange pair of rulings because, as the appellate court notes, most of the testimony of the treating physician was based on the tests and assessment of the excluded witness. See *Moore*, 151 F.3d at 269, 288 n.6. The jury returned a verdict for the defendant, the plaintiff appealed, and the Fifth Circuit panel reversed and re-

standard applied to all expert evidence, the *Daubert* factors are “hard” science methods or techniques that should apply only to experts who profess to base their testimony on “hard” science knowledge.⁶⁰ These criteria should not be used to judge the admissibility of a clinical physician’s expert testimony.⁶¹ Rather, such testimony should be judged by the principles and methodology of the field of clinical medicine.⁶² After an en banc review, the circuit reversed and reinstated the judgement for the defendant.⁶³ The en banc opinion turned primarily on a “fit” analysis. However, it also supported the use of *Daubert* factors when assessing the admissibility of clinical medical testimony.⁶⁴

The proper role of the *Daubert* factors has arisen in other areas where the expert’s testimony rested on professional “experience.” For example, the issue presented itself with respect to forensic testimony in the criminal context⁶⁵ and products liability design defect testimony.⁶⁶ The Supreme Court finally inter-

manded. *See Moore*, 126 F.3d at 679. This determination resulted in an order granting a rehearing en banc. *See id.*

60. *Moore*, 126 F.3d at 682.

61. *See id.*

62. *See id.* at 701. Some commentators share the view that clinical medical causation testimony should not be covered by the *Daubert* factors. *See, e.g.*, 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, 2258-59 (1994).

Medical doctors practice clinical medicine and not experimental science. Other than pharmaceutical clinical trials, physicians typically do not conduct experiments on patients with toxic substances. Accordingly, a number of the “preliminary questions” set forth by the Supreme Court in *Daubert* have little or no bearing on the practice of medicine and treating physicians’ actual diagnosis of disease and its etiology. . . .

Certainly, doctors who diagnose and treat patients with life-threatening conditions should be able to testify to a reasonable degree of medical certainty as to the diagnosis and cause of a disease. However, the methodologies and modalities employed by the physician do not always “fit” within the paradigm of falsifiability, refutability, and testability, set forth in the majority opinion of *Daubert*.

Id.

63. *See Moore*, 151 F.3d at 279.

64. *See id.*

65. *See United States v. Jones*, 107 F.3d 1147 (6th Cir. 1997) (agreeing that handwriting experts are not scientists but affirming a trial judge’s decision to admit handwriting testimony, in part because his past experience as a witness was evidence that his testimony is reliable); *United States v. Starzeczpyzel*, 880 F. Supp 1027 (S.D.N.Y. 1995) (holding that handwriting experts are not practicing science within the meaning of *Daubert* because they do not test their theories and their findings have unknown error rates). In the aftermath of *Kumho*, however, at least one federal district court has refused to allow the government’s handwriting expert to testify that the defendant was the author of a note used in a bank robbery. *See United States v. Hines*, 55 F. Supp. 2d 62 (D. Mass. 1999).

66. *See Compton v. Subaru of Am., Inc.*, 82 F.3d 1513 (10th Cir. 1996) (holding that the *Daubert* factors are inapplicable in a products liability design defect context); *see also Talkington v. Atria Reclamelucifers Fabrieken BV (Cricket BV)*, 152 F.3d 254 (4th Cir. 1998); *McKendall v. Crown Control Corp.*, 122 F.3d 803, 806 (9th Cir. 1997). Not every court agrees, however. For example, in *Watkins v. Telsmith, Inc.*, the Fifth Circuit concluded that the *Daubert* factors do apply.

[T]he nonexclusive list of factors relevant under *Daubert* to assessing scientific methodology—testing, peer review, and “general acceptance”—are also relevant to assessing other types of expert evidence. Whether the expert would opine on economic valuation, advertising psychology, or engineering, application of the *Daubert* factors is germane to evaluating whether the expert is a hired gun or a person whose opinion in the courtroom will withstand the same scrutiny that it would among his professional peers. . . . Further, it seems exactly backwards that experts who purport to rely on general engineering principles and practical experience

vened in this debate in *Kumho Tire Co. v. Carmichael*.⁶⁷ In July 1993, eight members of the Carmichael family were involved in a serious automobile accident when the right rear tire of their minivan blew out.⁶⁸ After the accident, the plaintiffs' expert examined the tire and concluded that the failure was not the result of any abuse.⁶⁹ He therefore concluded that the failure was caused by a defect in either the tire's design or its manufacture. Prior to his testimony, however, the expert became ill and transferred the case to his employee, Dennis Carlson, who reviewed the file and confirmed the initial conclusion.⁷⁰ Carlson did not personally examine the tire before rendering his opinion; he first inspected the tire approximately one hour before his deposition.⁷¹ The defendant moved to exclude Carlson's testimony for failing to satisfy *Daubert*.⁷² The trial judge agreed, finding that "none of the four admissibility criteria outlined by the *Daubert* court are satisfied in this case."⁷³ Because the expert testimony was the plaintiffs' only evidence of defect, the district judge then granted the defendant summary judgment.⁷⁴ The plaintiffs appealed, arguing that the district court should not have applied *Daubert's* reliability framework because Carlson was not a "scientific" expert.⁷⁵

On appeal, the Eleventh Circuit undertook a de novo review of the trial court's decision to apply *Daubert*.⁷⁶ The court concluded that *Daubert* applies only to scientific testimony, that Carlson's testimony was non-scientific, and that the district court erred as a matter of law in applying the *Daubert* criteria.⁷⁷ The Eleventh Circuit declared itself prepared to affirm a well-reasoned trial court decision to exclude Carlson's testimony on reliability grounds if, upon remand, the trial court did so without invoking the *Daubert* criteria.⁷⁸ However, in another part of the opinion, the appellate court said that the question in this case is whether Carlson's testimony is based on his application of scientific principles or theories (which we should submit to a *Daubert* analysis) or on his utilization of personal experience and skill with failed tires (which we would usually expect

might escape screening by the district court simply by stating that their conclusions were not reached by any particular method or technique. The moral of this approach would be, the less factual support for an expert's opinion, the better.

121 F.3d 984, 990-91 (5th Cir. 1997); *see also* Peitzmeier v. Hennessy Indus., Inc., 97 F.3d 293, 297 (8th Cir. 1996).

67. 526 U.S. 137 (1999). Between *Daubert* and *Kumho*, the Supreme Court decided *General Electric Co. v. Joiner*, 522 U.S. 136 (1997). In *Joiner*, the Court concluded that the trial court's Rule 702 holdings should be reviewed under an abuse of discretion standard. *See Joiner*, 522 U.S. at 137.

68. *See Carmichael v. Samyang Tire, Inc.*, 131 F.3d 1433, 1434 (11th Cir. 1997).

69. *See id.*

70. *See id.*

71. *See id.*

72. *See Carmichael v. Samyang Tire, Inc.*, 923 F. Supp. 1514, 1520 (S.D. Ala. 1996)

73. *Id.* at 1521.

74. *See id.* at 1524.

75. *See Carmichael*, 131 F.3d at 1435.

76. *See id.* at 1435.

77. *See id.* at 1435-36.

78. *See id.* at 1436 n.9.

a district court to allow a jury to evaluate).⁷⁹ This sentence suggests that the court believed that a more lenient admissibility standard was appropriate for non-science experts.

The trial court, however, never had a second chance to evaluate the testimony. The Supreme Court granted certiorari, reversed the Eleventh Circuit, and held that excluding Carlson's testimony was not an abuse of discretion.⁸⁰ As to the role of the *Daubert* factors, the Court adopted a flexible position:

We also conclude that a trial court may consider one or more of the more specific factors that *Daubert* mentioned when doing so will help determine that testimony's reliability. But, as the Court stated in *Daubert*, the test of reliability is "flexible," and *Daubert's* list of specific factors neither necessarily nor exclusively applies to all experts or in every case. Rather, the law grants a district court the same broad latitude when it decides how to determine reliability as it enjoys in respect to its ultimate reliability determination.⁸¹

Justice Breyer noted that all four of the *Daubert* factors do not necessarily apply, even in situations where the reliability of scientific evidence is at issue.⁸² A claim may never have been exposed to peer review, because the particular issue may never have interested anyone.⁸³ It would be a mistake, however, to read *Kumho* as saying that the trial court simply may ignore the *Daubert* factors in non-science cases. The Court noted that "a trial court should consider the specific factors identified in *Daubert* where they are reasonable measures of the reliability of expert testimony."⁸⁴ In a concurring opinion, Justices Scalia, O'Connor, and Thomas added that the discretion enjoyed by the trial court does not include the discretion to abandon the gatekeeping function or to perform it inadequately.⁸⁵ The justices also said, "[t]hrough, as the Court makes clear today, the *Daubert* factors are not holy writ, in a particular case the failure to apply one or another of them may be unreasonable, and hence an abuse of discretion."⁸⁶ In effect, a trial court that fails to justify its decision not to use *Daubert* factors risks reversal.⁸⁷

The *Kumho* opinion included a detailed analysis of the excluded expert testimony.⁸⁸ Much of this testimony was the engineering equivalent of a differen-

79. *Id.* at 1436.

80. *See Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 142 (1999). Justice Stevens dissented from this part of the opinion and argued that the case should have been remanded to the Eleventh Circuit to determine whether the trial judge had abused his discretion. *See id.* at 159 (Stevens, J., concurring in part and dissenting in part).

81. *Id.*

82. *See id.* at 150-51.

83. *See id.* at 151.

84. *Id.* at 152.

85. *See id.* at 158-59 (Scalia, J., concurring)

86. *Id.* at 159.

87. *See Black v. Food Lion, Inc.*, 171 F.3d 308, 311-12 (5th Cir. 1999) ("In the vast majority of cases, the district court first should decide whether the factors mentioned in *Daubert* are appropriate. Once it considers the *Daubert* factors, the court then can consider whether other factors, not mentioned in *Daubert*, are relevant to the case at hand."); *see also Goebel v. Denver and Rio Grande W. R.R. Co.*, 215 F.3d 1083, 1087 (10th Cir. 2000).

88. *See Kumho*, 526 U.S. at 154-56.

tial diagnosis. As the Court noted, the issue was not whether it is ever possible for a tire expert to use visual and tactile inspection methods to determine whether a tire is defective, but rather, the specific causation question of whether this tire was defective and whether Carlson's methods were reliable with respect to the Carmichaels' tire.⁸⁹

Carlson's theory was that, if the vehicle had been overloaded or the tire under-inflated, it would have led to a phenomenon called "overdeflection."⁹⁰ Overdeflection can cause the tire to overheat, which in turn can undo the bond that holds the tire tread to the carcass.⁹¹ Carlson described four indicia of overdeflection and explained that a tire exhibiting two of the four indicia had been abused.⁹² Though he conceded that the tire did exhibit some of these indicia, he stated that these symptoms were not significant.⁹³ For example, according to Carlson, one of the symptoms of overdeflection is greater tread wear on the tire's shoulder than along the tire's center.⁹⁴ Carlson concluded that there was greater wear on the shoulders of this carcass, but he also concluded that it was not evenly distributed on both shoulders.⁹⁵ On this tire, the wear appeared primarily on one shoulder, whereas an overdeflected tire would show equal abnormal wear on both.⁹⁶ Therefore, this wear was not evidence of overdeflection.⁹⁷

This reasoning process is not unlike a physician's differential diagnosis testimony excluding other possible causes of a patient's illness. Why was this analysis not sufficiently reliable to gain admissibility? Another part of Carlson's testimony provides a partial answer. He was asked how many miles the tire had traveled prior to the accident.⁹⁸ According to the Supreme Court, he "could not say whether the tire had traveled more than ten, or twenty, or thirty, or forty, or fifty thousand miles, adding that 6,000 miles was 'about how far' he could 'say with any certainty.'"⁹⁹ To this, the Supreme Court responded:

89. *See id.*

90. Overdeflection "consists of under-inflating the tire or causing it to carry too much weight." *Id.* at 144.

91. *See id.*

92. *See id.* The court summarized his testimony:

These symptoms include (a) tread wear on the tire's shoulder that is greater than the tread wear along the tire's center; (b) signs of a "bead groove," where the beads have been pushed too hard against the bead seat on the inside of the tire's rim; (c) sidewalls of the tire with physical signs of deterioration, such as discoloration; and/or (d) marks on the tire's rim flange. . . . Carlson said that where he does not find at least two of the four physical signs just mentioned (and presumably where there is no reason to suspect a less common cause of separation), he concludes that a manufacturing or design defect caused the separation.

Id. at 144.

93. *See id.* at 144-45.

94. *See id.* at 144.

95. *See id.* at 145.

96. *See id.*

97. *See id.*

98. *See id.* at 154-55.

99. *Id.* at 155.

The [trial] court could reasonably have wondered about the reliability of a method of visual and tactile inspection sufficiently precise to ascertain with some certainty the abuse-related significance of minute shoulder/center relative tread wear differences, but insufficiently precise to tell “with any certainty” from the tread wear whether a tire had traveled less than 10,000 or more than 50,000 miles. And these concerns might have been augmented by Carlson’s repeated reliance on the “subjective[ness]” of his mode of analysis in response to questions seeking specific information regarding how he could differentiate between a tire that actually had been overdeflected and a tire that merely looked as though it had been.¹⁰⁰

Although the Supreme Court did not specifically tie its analysis to the *Daubert* factors, the reference to subjectivity suggests that it was questioning the falsifiability and perhaps the error rate of Carlson’s theory. The Court noted that Carlson’s overdeflection test—that a tire has not been abused unless it exhibits two of his four overdeflection indicia—is generally not accepted.¹⁰¹ According to the Court, the purpose of the relevancy and reliability requirements under *Daubert* is “to make certain that an expert, whether basing testimony upon professional studies or personal experience, employs in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field.”¹⁰² In the eyes of the court, Carlson’s testimony did not meet this standard.¹⁰³

If *Kumho* removed any uncertainty about whether the *Daubert* factors might apply to differential diagnosis testimony, it settled little else. The *Kumho* opinion itself is unclear on several points.¹⁰⁴ Because both the decision to admit expert testimony and the criteria used to make an admissibility decision are to be judged by an abuse of discretion standard on appeal, it is possible we will witness conflicting trial court admissibility decisions on similar facts.¹⁰⁵ This is all the more likely because, as discussed in the next section, the circuits have taken varying positions about the admissibility requirements for clinical medical testimony on causation. In the next section, we review the criteria used by the courts in making their judgments.

100. *Id.*

101. *See id.* at 157.

102. *Id.* at 152. The “same intellectual rigor” standard first appears in a pair of Seventh Circuit opinions authored by Judge Posner. *See Braun v. Lorillard Inc.*, 84 F.3d 230, 234 (7th Cir. 1996); *Rosen v. Ciba-Geigy Corp.*, 78 F.3d 316, 318 (7th Cir. 1996). Post-*Kumho* appellate opinions have been quick to adopt this standard. *See, e.g., Black v. Food Lion, Inc.*, 171 F.3d 308, 311 (5th Cir. 1999).

103. Indeed, no one has argued that Carlson himself, were he still working for Michelin, would have concluded in a report to his employer that a similar tire was similarly defective on grounds identical to those upon which he rested his conclusion here. Of course, Carlson himself claimed that his method was accurate, but, as we pointed out in *Joiner*, “nothing in either *Daubert* or the Federal Rules of Evidence requires a district court to admit opinion evidence that is connected to existing data only by the *ipse dixit* of the expert.” 522 U.S. at 146.

Kumho, 526 U.S. at 157.

104. For example, will a trial court have abused its discretion if it does not apply the *Daubert* factors to the proffered testimony and does not explain why it failed to do so? The concurring opinion suggests this might be the case, but the Court’s opinion is ambiguous. If a court does not choose to use the *Daubert* factors, it is not clear what other factors might be used in their stead. *See Joseph Sanders, Kumho and How We Know*, 64 LAW & CONTEMP. PROBS. 373 (Spring/Summer 2001).

105. *See Joiner*, 522 U.S. at 136; *Kumho*, 526 U.S. at 152.

IV

THE DIFFERENTIAL DIAGNOSIS ADMISSIBILITY OPINIONS

We should begin by noting that there is much common ground with respect to the admissibility of differential diagnosis testimony. Courts generally agree that, at least in toxic tort cases, whenever there are competing causes for the plaintiff's injury, an expert must attempt a differential diagnosis before his testimony will be admitted. For example, in *O'Connor v. Commonwealth Edison Co.*,¹⁰⁶ the court excluded expert testimony of a physician who claimed he could determine that the plaintiff's posterior subcapsular cataract was only caused by radiation by looking at it. Moreover, no opinion we know of has concluded that differential etiology, when properly performed, is inadmissible.¹⁰⁷ Here it is useful to follow Professor Paul C. Gianelli and divide the question of scientific validity into several categories: "(1) the validity of the underlying principle, (2) the validity of the technique applying the principle, and (3) the proper application of the technique on a particular occasion."¹⁰⁸ This formulation is repeated by Judge Becker in *United States v. Downing*.¹⁰⁹ Courts accept the general validity of the technique of differential diagnosis.

It is not sufficient, however, for an expert simply to state that she has performed a differential diagnosis. Much as the Supreme Court did in *Kumho*, courts that refuse to admit a differential diagnosis frequently cite the quality of the expert analysis—the application of the technique in the case at hand—as the reason for exclusion. Several pre-*Daubert* opinions adopted this position. In the Agent Orange litigation, Judge Jack Weinstein excluded the testimony of a physician who determined the cause of the plaintiffs' injuries on the basis of the plaintiffs' signed statements that they had been exposed to Agent Orange and had the listed symptoms.¹¹⁰ Similarly, in *Viterbo v. Dow Chemical Co.*,¹¹¹ the court excluded a physician's testimony that the defendant had caused plaintiff's illness, because the doctor had relied on a medical history that omitted important information.¹¹² The *Viterbo* court concluded:

We do not hold, of course, that admissibility of an expert opinion depends upon the expert disproving or discrediting every possible cause other than the one espoused by him. Here, however, Dr. Johnson has admitted that Viterbo's symptoms could have numerous causes and, without support save Viterbo's oral history, simply picks the cause that is most advantageous to Viterbo's claim. Indeed, Dr. Johnson's testimony is no more than Viterbo's testimony dressed up and sanctified as the opinion of an ex-

106. 807 F. Supp. 1376, 1397 (C.D. Ill. 1992).

107. See, e.g., *Westberry v. Gislaved Gummi AB*, 178 F.3d 257, 263 (4th Cir. 1999).

108. Paul C. Gianelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 COLUM. L. REV. 1197, 1201 (1980).

109. *United States v. Downing*, 753 F.2d 1224, 1234 (3d. Cir. 1985).

110. See *In re Agent Orange Prod. Liab. Litig.*, 611 F. Supp. 1223, 1234-38, 1246-47 (E.D.N.Y. 1985); see also *Ricciardi v. Children's Hosp. Med. Ctr.*, 811 F.2d 18, 25 (1st Cir. 1987) (expert cannot rely on consulting doctor's handwritten note when performing a differential diagnosis as to the cause of the plaintiff's neurological difficulties following surgery).

111. 826 F.2d 420 (5th Cir. 1987).

112. See *id.* at 423.

pert. Without more than credentials and a subjective opinion, an expert's testimony that "it is so" is not admissible.¹¹³

This standard for exclusion has continued among post-*Daubert* cases. In *In re Paoli*,¹¹⁴ the court affirmed the district court's exclusion of two experts who "based their conclusion as to a plaintiff's symptoms solely on the plaintiff's self-report of illness in preparation for litigation."¹¹⁵ Similar statements can be found in a number of cases up to the present time.¹¹⁶ For example, in *Wooley v. Smith & Nephew Richards, Inc.*,¹¹⁷ the court refused to admit the expert's opinion that a pedicle screw implant caused plaintiff's chronic pain because the expert failed to interview or examine the patient, or consider all of the patient's medical records.¹¹⁸

When doctors do employ standard diagnostic techniques, many courts are likely to admit their differential diagnosis testimony. The classic statement of this position comes from the *Paoli* opinion: "To the extent that a doctor utilizes standard diagnostic techniques in gathering this information, the more likely we are to find that the doctor's methodology is reliable."¹¹⁹ Moreover, most courts would agree with the *Paoli* court that a failure to account for all possible causes does not render expert opinion based on differential diagnosis inadmissible.¹²⁰ Nevertheless, substantial disagreement still remains on what constitutes a reliable differential diagnosis.¹²¹ Two dimensions highlight this disagreement: (1) whether one must "rule in" the putative cause before "ruling out" other causes;

113. *Id.* at 424.

114. *In re Paoli* R.R. Yard PCB Litig., 35 F.3d 717 (3d Cir. 1994).

115. *Id.* at 762.

116. *See* *Diaz v. Johnson Matthey, Inc.*, 893 F. Supp. 358, 376 (D.N.J. 1995):

The defendant points to several possible causes of Diaz's asthma that Dr. Auerbach either ignores or is unable to satisfactorily discount because he did not have before him all the necessary information. While Dr. Auerbach did use standard diagnostic techniques to measure the extent to which Diaz suffered lung impairment, he did little, if anything, to "rule out alternative causes."

Id.; *see also* *Pick v. Am. Med. Sys., Inc.*, 958 F. Supp. 1151, 1168 (E.D. La. 1997) ("Dr. Campbell may not render an opinion as to Barry Pick's specific condition as his diagnosis is not based on sound methodology. Differential diagnosis presumes that a sufficient and valid clinical investigation has been conducted.").

117. 67 F. Supp. 2d 703 (S.D. Tex. 1999).

118. *See id.* at 709. *Wooley* is one of many pedicle screw and spinal rod cases. In the great majority of published opinions, the expert witness has not been allowed to testify, often because of a failure to rule out other possible causes of the plaintiff's injury. *See, e.g.*, *Alexander v. Smith & Nephew, P.L.C.*, 90 F. Supp. 2d 1225 (N.D. Okla. 2000); *Lawson v. Smith & Nephew Richards, Inc.*, No. CW. A. 4:96-CV0297-RWS, 1999 WL 1129677 (N.D. Ga. Sept. 30, 1999); *Baker v. Smith & Nephew Richards, Inc.*, No. CIV.A.1:97-CV-1233-RWS, 1999 WL 1129650 (N.D. Ga. Sept. 30, 1999); *Coleman v. Danek Med., Inc.*, 43 F. Supp. 2d 637 (S.D. Miss. 1999); *Wheat v. Sofamor, S.N.C.*, 46 F. Supp. 2d 1351 (N.D. Ga. 1999); *Valente v. Sofamor, S.N.C.*, 48 F. Supp. 2d 862 (E.D. Wis. 1999); *Uribe v. Sofamor, S.N.C.*, No. 8:95CV464, 1999 WL 1129703 (D. Neb. Aug. 16, 1999); *Schmerling v. Danek Med., Inc.*, No. CIV.A.96-2749, 1999 WL 712591 (E.D. Pa. Sept. 10, 1999). *But see* *Sita v. Danek Med., Inc.*, 43 F. Supp. 2d 245, 254 (E.D.N.Y. 1999) (holding expert testimony to be admissible even though report was of dubious reliability).

119. *In re Paoli*, 35 F.3d at 758.

120. *See id.* at 764-65; *see also* *Westberry v. Gislaved Gummi AB*, 178 F.3d 257, 265-66 (4th Cir. 1999); *Heller v. Shaw Indus.*, 167 F.3d 146, 156 (3d Cir. 1999).

121. *See, e.g.*, *Glaser v. Thompson Med. Co.*, 32 F.3d 969 (6th Cir. 1994).

and (2) whether temporal order alone—that the cause preceded the effect—is sufficient to support the causal attribution.

A. Ruling in Before Ruling Out

In *Cavallo v. Star Enterprise*, the trial judge made the following comment:

The process of differential diagnosis is undoubtedly important to the question of “specific causation.” If other possible causes of an injury cannot be ruled out, or at least the probability of their contribution to causation minimized, then the “more likely than not” threshold for proving causation may not be met. But, it is also important to recognize that a fundamental assumption underlying this method is that the final, suspected “cause” remaining after this process of elimination must actually be capable of causing the injury. That is, the expert must “rule in” the suspected cause as well as “rule out” other possible causes. And, of course, expert opinion on this issue of “general causation” must be derived from a scientifically valid methodology.¹²²

The “rule in before ruling out” position of *Cavallo* presumes that, at least in toxic tort cases, a differential diagnosis, no matter how well done, can rarely prove general causation by itself. The *Cavallo* position has been repeated in numerous cases.¹²³ For example, in *Raynor v. Merrell Pharmaceuticals*, a Bendectin case, the D.C. Circuit compared the present case to its earlier opinion in *Ambrosini v. Labarraque*.¹²⁴ The court there held that “testimony on specific causation had legitimacy only as follow-up to admissible evidence that the drug in question could in general cause birth defects. That first step, establishing a link between Bendectin and human birth defects (general causation), is missing here.”¹²⁵ Similar holdings are to be found in *Kelley v. American Heyer-Schulte Corp.*,¹²⁶ *Grimes v. Hoffmann-LaRoche, Inc.*,¹²⁷ *Rutigliano v. Valley Business Forms*,¹²⁸ *Hall v. Baxter Healthcare Corp.*,¹²⁹ *In re Breast Implant Litigation*,¹³⁰

122. *Cavallo v. Star Enter.*, 892 F. Supp. 756, 771 (E.D. Va. 1995), *aff'd in part, rev'd in part*, 100 F.3d 1150 (4th Cir. 1996).

123. See *Raynor v. Merrell Pharms., Inc.*, 104 F.3d 1371, 1376 (D.C. Cir. 1997); see also *In re Breast Implant Litig.*, 11 F. Supp. 2d 1217, 1230 (D. Colo. 1998); *Kelley v. American Heyer-Schulte Corp.*, 957 F. Supp. 873, 882 (W.D. Tex. 1997); *Rutigliano v. Valley Bus. Forms*, 929 F. Supp. 779, 783 (D.N.J. 1996); *Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387, 1413 (D. Or. 1996).

124. 101 F.3d 129, 138-39 (D.C. Cir. 1996).

125. *Raynor*, 104 F.3d at 1376.

126. 957 F. Supp. at 882:

While epidemiological evidence is not a necessary element in every toxic tort case, it is certainly a very important element, especially when there is no evidence of the biological mechanism which links the product to the complained-of condition. In the absence of any evidence regarding general causation, the Court will not permit Dr. Espinoza to testify as to specific causation.

127. 907 F. Supp. 33, 38 (D.N.H. 1995):

In summary, even if I were to assume that Dr. Lerman’s experiment is methodologically sound, I must still exclude his opinion on general causation because the final essential step in the formulation of that opinion is based on an untested assumption which fails *Daubert’s* reliability and fit requirements. Since his opinion on specific causation is necessarily based on his opinion concerning general causation, that testimony must be excluded as well.

128. 929 F. Supp. at 783.

129. 947 F. Supp. 1387, 1413 (D. Or. 1996) (holding that “[t]estimony regarding specific causation in a given patient is irrelevant unless general causation is established”).

130. 11 F. Supp. 2d 1217, 1230 (D. Colo. 1998) (citation omitted):

National Bank of Commerce v. Associated Milk Producers, Inc.,¹³¹ and *Wynacht v. Beckman Instruments, Inc.*¹³²

The “rule in” requirement sometimes is presented as a question of dosage. Assuming that some dose of the substance at issue might cause harm, the question becomes: Does the expert have adequate grounds for asserting that the dosage to which the plaintiff was exposed could cause anyone harm? The recent case of *Mancuso v. Consolidated Edison* explained that

[a] fundamental tenet of toxicology is that the “dose makes the poison” and that all chemical agents, including water, are harmful if consumed in large quantities, while even the most toxic substances are harmless in minute quantities Therefore, in determining whether plaintiffs’ exposure to PCBs could have caused any illnesses that they have, it is necessary to establish the dose/response relationship between PCBs and those particular illnesses.¹³³

The *Mancuso* court rejected the testimony of the plaintiffs’ expert who was prepared to testify that exposure to PCB caused a variety of injuries.¹³⁴ The court concluded that the plaintiff’s expert “totally ignored the methodology prescribed by both the World Health Organization (WHO) and the National Academy of Sciences (NAS) for determining whether a person has been adversely affected by a toxin.”¹³⁵ As the court noted later in the opinion, there is a three step procedure to the methodology:

First, the level of exposure of plaintiff to the toxin in question must be determined; second, from a review of the scientific literature, it must be established that the toxin is capable of producing plaintiff’s illness—called “general causation”—and the dose/response relationship between the toxin and the illness—that is, the level of exposure which will produce such an illness—must be ascertained; and third, “specific causation” must be established by demonstrating the probability that the toxin caused

The process of differential diagnosis is undoubtedly important to the question of “specific causation.” If other possible causes of an injury cannot be ruled out, or at least the probability of their contribution to causation minimized, then the “more likely than not” threshold for proving causation may not be met. But, it is also important to recognize that a fundamental assumption underlying this method is that the final, suspected “cause” remaining after this process of elimination must actually be capable of causing the injury. That is, the expert must “rule in” the suspected cause as well as “rule out” other possible causes. And, of course, expert opinion on this issue of “general causation” must be derived from a scientifically valid methodology.

131. 22 F. Supp. 2d 942, 963 (E.D. Ark. 1998), *aff’d*, 191 F.3d 858 (8th Cir. 1999).

132. 113 F. Supp. 2d 1205, 1209 (E.D. Tenn. 2000):

There is a fundamental distinction between Dr. Ziem’s ability to render a medical diagnosis based on clinical experience and her ability to render an opinion on causation of Wynacht’s injuries. Beckman apparently does not dispute, and the Court does not question, that Dr. Ziem is an experienced physician, qualified to diagnose medical conditions and treat patients. The ability to diagnose medical conditions is not remotely the same, however, as the ability to deduce, delineate, and describe, in a scientifically reliable manner, the causes of these medical conditions.

133. *Mancuso v. Consolidated Edison Co.*, 56 F. Supp. 2d 391, 403 (S.D.N.Y. 1999), *rev’d on other grounds*, 216 F.3d 1072 (2d Cir. 2000). *Mancuso*’s expert apparently found that the concentration of PCBs at the plaintiff’s marina was four parts in ten billion, less than one ten-thousandths as high as the level which the EPA has found to be safe. *See id.* at 404.

134. *See id.* at 411.

135. *Id.*; *see also* 56 F. Supp. 2d at 394-95.

this particular plaintiff's illness, which involves weighing the possibility of other causes of the illness—a so-called “differential diagnosis.”¹³⁶

Other courts have taken similar positions.¹³⁷

Contrary to these holdings, several courts appear either to reject the requirement that one must first rule in before ruling out or to reject the requirement that plaintiff's experts cite clear evidence that the substance in question can cause injuries at the dose levels experienced by the plaintiff. For example, in a case decided not long after *Daubert*, physicians were permitted to testify that Hot Stuff “anabolic activator” caused diverticulosis and diverticulitis, based primarily on differential diagnosis, despite the fact that “there is no peer reviewed documentation that any of the ingredients in Hot Stuff, individually or in combination, causes diverticulosis, diverticulitis or diverticulum perforation.”¹³⁸ If other evidence proving general causation is a prerequisite for differential diagnosis testimony, the appellate court in *Kannankeril v. Terminix International, Inc.* erred when it reversed a district court decision to exclude the testimony of the plaintiff's only expert and enter a summary judgment for the defendant.¹³⁹ The plaintiff's expert concluded that her injuries were caused by Dursban, even though the evidence on dosage was quite limited.¹⁴⁰ In addition, the expert performed no clinical tests to support his causal opinion, and the only blood test conducted on the plaintiff was negative for Dursban.¹⁴¹ In *Westberry v. Gislaved Gummi*, the plaintiff's expert testified that his exposure to airborne talc in the workplace caused the aggravation of his pre-existing sinus condition.¹⁴² The appellate court affirmed the admission of this testimony by the trial court following a jury verdict for the plaintiff even though the expert “had no scientific literature on which to rely to ‘rule in’ talc as a possible basis for Westberry's sinus condition.”¹⁴³ In support of its position, the court noted that the plaintiff himself had testified to very high levels of talc in the workplace, and the Material Safety Data Sheet for talc provided that inhalation in high concentrations irritates mucous membranes.¹⁴⁴ Finally, in *Heller v. Shaw Industries*, the plaintiff claimed that her respiratory illnesses were caused by volatile organic compounds emitted from new carpet installed in her home.¹⁴⁵ Judge

136. *Id.* at 399.

137. *See, e.g.*, *Mitchell v. Gencorp Inc.*, 165 F.3d 778, 781 (10th Cir. 1999); *Moore v. Ashland Chem. Inc.*, 151 F.3d 269, 278 (5th Cir. 1998); *Savage v. Union Pac. R.R. Co.*, 67 F. Supp. 2d 1021, 1033-34 (E.D. Ark. 1999); *Cuevas v. E.I. DuPont de Nemours & Co.*, 956 F. Supp. 1306, 1312 (S.D. Miss. 1997); *Cartwright v. Home Depot U.S.A., Inc.*, 936 F. Supp. 900, 904 (M.D. Fla. 1996).

138. *Becker v. National Health Prods., Inc.*, 896 F. Supp. 100, 102 (N.D.N.Y. 1995); *see also McCulloch v. H.B. Fuller Co.*, 61 F.3d 1038, 1043 (2d Cir. 1995) (affirming admission of treating doctor's testimony despite the fact that he “could not point to a single piece of medical literature that says glue fumes cause throat polyps”).

139. *See Kannankeril v. Terminix Int'l, Inc.*, 128 F.3d 802 (3d Cir. 1997).

140. *See id.* at 808.

141. *See id.* at 805.

142. *See Westberry v. Gislaved Gummi AB*, 178 F.3d 257, 260 (4th Cir. 1999).

143. *Id.* at 264.

144. *See id.*

145. *See Heller v. Shaw Indus., Inc.*, 167 F.3d 146 (3d Cir. 1999).

Becker specifically rejected the requirement that plaintiff's expert always cite published studies on general causation reliably to conclude that a particular object caused a particular illness.¹⁴⁶ In *Heller*, the court seems to have assumed there was no research on the general causation question.

B. Temporal Order

The question of general causation aside, there remains the difficult question of what differential diagnosis evidence the expert must present to make an admissible argument on specific causation. Disagreements on this question are most evident in cases that discuss whether the temporal order of events alone—the injury followed the exposure—is sufficient to rule out other possible causes.¹⁴⁷ Most cases that have discussed the issue have stated that temporal order alone is insufficient to support an expert's opinion that substance X caused injury Y.¹⁴⁸ Statements to this effect may be found in a number of swine flu cases from the early 1980s.¹⁴⁹ Post-*Daubert* opinions that apply the *Daubert* factors frequently take the position that determinations of causation based solely

146. *See id.* at 155. However, the appellate court concluded that exclusion of the expert's testimony was not an abuse of discretion because the evidence did not support the doctor's reliance on the temporal relationship between the onset of the plaintiff's illness and the carpet installation nor his estimate of the levels of volatile organic compounds emitted by the carpet. *See id.* at 164.

147. Temporal order is one consideration in determining whether a relationship is causal. Researchers have developed a number of criteria that may be used in making this assessment. One of the best known is a set of criteria originally developed by Sir Austin Bradford Hill:

- (1) Is the temporal relationship correct? Does the "effect" follow the "cause"?
- (2) Is there evidence from true experiments in humans?
- (3) Is the association a strong one?
- (4) Is the association consistent from study to study?
- (5) Is there a dose-response gradient?
- (6) Is the association specific?
- (7) Does the association make biological sense?
- (8) Is there an appropriate analogy to other known causal relationships?

See ANDREW C. HARPER AND LAURIE J. LAMBERT, *THE HEALTH OF POPULATIONS: AN INTRODUCTION* 75-79 (1994).

148. This is not to say that temporal order is irrelevant to a causal analysis. *See, e.g.,* *Unthank v. United States (In re Swine Flu Immunization Prods. Liab. Litig.)*, 533 F. Supp. 703, 714 (D. Utah 1982):

The close temporal relation between the vaccination and onset of neurologic symptoms convinces us that the vaccine was in fact the proximate cause of those symptoms. The thirty-day interval between plaintiff's vaccination and the onset of her symptoms falls well within the ten week period in which the government concedes the vaccine may cause Guillain-Barre syndrome (GBS).

See also *Heller v. Shaw Indus., Inc.*, 167 F.3d 146 (3d Cir. 1999) (holding that exclusion of the expert's testimony was not an abuse of discretion because the evidence did not support the doctor's reliance on a temporal relationship between the onset of the plaintiff's illness and the carpet installation nor his estimate of the levels of volatile organic compounds emitted by the carpet).

149. *See, e.g.,* *Hasler v. United States*, 718 F.2d 202, 205 (6th Cir. 1983) ("Without more, [a] proximate temporal relationship will not support a finding of causation.") (reversing district court's finding that swine flu inoculation caused plaintiff's injuries because of a close temporal connection); *Bean v. United States (In re Swine Flu Immunization Prods. Liab. Litig.)*, 533 F. Supp. 567, 581 (D. Colo. 1980) (holding that a mere temporal relation is insufficient to establish causation between swine flu vaccine and drop foot).

on temporal order should be excluded for lack of reliability.¹⁵⁰ The following passage is typical of the reason given for exclusion:

Dr. Winters (and Dr. Shalat) propound the argument that because [acute lymphocytic leukemia (“ALL”)] is extremely rare in adult males, and because Gary Whiting was exposed to radiation before he contracted ALL, his ALL must have been caused by radiation exposure. This is a classic illustration of the logical fallacy *post hoc ergo propter hoc*. It ignores the fact that ALL can occur (and most often does) in adult males who have no history of occupational exposure to radiation, as well as the fact that adult males who are exposed to radiation at levels similar to Gary Whiting’s have no higher incidence of ALL than do unexposed adult males.¹⁵¹

150. See, e.g., *Conde v. Velsicol Chem. Corp.*, 804 F. Supp. 972, 1023 (S.D. Ohio 1992), *aff’d*, 24 F.3d 809 (6th Cir. 1994) (excluding expert testimony based solely on a temporal relationship between the exposure to insecticide and the injury, where there was no medical evidence of causation); *Porter v. Whitehall Labs., Inc.*, 9 F.3d 607, 611 (7th Cir. 1993) (excluding expert testimony of two doctors where their opinions were based solely on the temporal relationship between the ingestion of ibuprofen and the injury).

151. *Whiting v. Boston Edison Co.*, 891 F. Supp. 12, 23 n.52 (D. Mass. 1995). Further examples:

Dr. Schonfeld admits that he lacks knowledge of the nature and structure of these herbicides, and acknowledges that his RADS diagnosis is based on the temporal congruity between Mr. Schmaltz’s alleged exposure and the onset of his symptoms. It is well settled that a causation opinion based solely on a temporal relationship is not derived from the scientific method and is therefore insufficient to satisfy the requirements of Fed. R. Evid. 702.

Schmaltz v. Norfolk & W. Ry. Co., 878 F. Supp. 1119, 1122 (N.D. Ill. 1995).

[T]he witness admits that if the Plaintiff did not have breast implants but had the exact same symptoms and blood chemistry, then his diagnosis would have been non-implant-caused Sjogren’s Syndrome. Essentially, this is a bit like saying that if a person has a scratchy throat, runny nose, and a nasty cough, that person has a cold; if, on the other-hand, that person has a scratchy throat, runny nose, nasty cough, and wears a watch, they have a watch-induced cold.

Kelley v. American Heyer-Schulte Corp., 957 F. Supp. 873, 882 (W.D. Tex. 1997).

Dr. Johnson also summarily ruled out idiopathic [anterior ischemic optic neuropathy] despite noting that Nelson had classical risk factors for idiopathic AION: hypertension, diabetes mellitus, and a small optic nerve cup-disc ratio. The only reason he gave for this differential determination was the temporal proximity between Nelson’s Amiodarone therapy and the onset of his optic neuropathy. This type of *post hoc propter hoc* reasoning is the exact type of “scientific analysis” of which courts must be aware.

Nelson v. Am. Home Prods. Corp., 92 F. Supp.2d 954, 971 (W.D. Mo. 2000); see also *Valente v. Sofamor, S.N.C.*, 48 F. Supp. 2d 862, 872 (E.D. Wis. 1999) (“Instead, Dr. Trobiani’s [sic] simply assumes that if A occurred before B, then A must have caused B. Such reasoning cannot qualify as expert testimony.”); *Willert v. Ortho Pharms. Corp.*, 995 F. Supp. 979, 982 (D. Minn. 1998) (“Ultimately, the theory devolves into the thesis that because ‘B’ came after ‘A,’ ‘A’ caused ‘B.’ While this may be phenomenologically and temporally accurate, it does not prove causation”); *In re Breast Implant Litig.*, 11 F. Supp. 2d 1217, 1232 (D. Colo. 1998) (“A temporal relationship by itself provides no evidence of causation Even as to specific causation, temporality cannot withstand *Daubert* scrutiny.”); *Cuevas v. E.I. DuPont de Nemours & Co.*, 956 F. Supp. 1306, 1312 (S.D. Miss. 1997) (“Dr. Parent acknowledges that his opinion is based on the temporal relationship between the alleged exposure and Mr. Cuevas’ medical problems The Court agrees that this methodology is simply not sufficient to amount to reliable scientific knowledge and fails under *Daubert*.”); *Cartwright v. Home Depot U.S.A., Inc.*, 936 F. Supp. 900, 906 (M.D. Fla. 1996) (“Review of the entirety of Dr. McKay’s reports, affidavits, deposition testimony and supporting literature fails to identify what ‘methodology’ he did employ, other than reliance on the sequence of events.”); *Cavallo v. Star Enter.*, 892 F. Supp. 756, 773 (E.D. Va. 1995), *aff’d in part, rev’d in part*, 100 F.3d 1150 (4th Cir. 1996):

[A]t bottom, [the expert’s] opinion is founded primarily on the temporal connection between the spill and the development of Ms. Cavallo’s symptoms, as well as on his subjective, unverified, belief that AvJet can cause the types of injuries from which Ms. Cavallo suffers. This is not the method of science.

As is the case with ruling in before ruling out, however, a number of courts have permitted experts to testify as to specific causation based on little more than temporal order. Not surprisingly, perhaps, many of these cases are the same ones adopting the minority position on ruling in before ruling out. For example, in *Westberry v. Gislaved Gummi AB*,¹⁵² in addition to objecting that the expert failed to rule in talc before ruling out other causes, the defendant also objected that the expert's causal analysis rested almost entirely on the temporal order of events. The court replied that "depending on the circumstances, a temporal relationship between exposure to a substance and the onset of a disease or a worsening of symptoms can provide compelling evidence of causation."¹⁵³ The court found the temporal evidence here compelling partly because the plaintiff's sinus condition improved when he stayed home from work.¹⁵⁴

A similar outcome occurred in the facts of *Kannankeril v. Terminix International, Inc.*¹⁵⁵ In this case, homeowners sued a pest exterminator for a wide-ranging set of cognitive impairment injuries to Dr. Mary Kannankeril from application of the pesticide Dursban at their residence.¹⁵⁶ Dr. Kannankeril's symptoms began approximately one year after the beginning of the Terminix service. After an application that produced objectionable odors, the defendant sent a company to clean the residence. Nine months later, the plaintiffs asked the New Jersey Department of Environmental Protection to test their home.¹⁵⁷ An analysis of air samples taken at that time failed to find detectable levels of pesticides.¹⁵⁸ Apparently, Dr. Kannankeril's symptoms did not abate after the pesticide applications ceased.¹⁵⁹ The plaintiffs' expert, Dr. Benjamin Gerson, testified that "[t]he temporal relationship and the nature of her complaints lead me to conclude that with reasonable medical certainty, the cause of Dr. Kannankeril's Central Nervous System manifestations of toxicity is exposure to Dursban in [sic] 1989 to 1990."¹⁶⁰ The trial judge had excluded this expert's testimony and granted summary judgment for the defendant.¹⁶¹ The Third Circuit

152. 178 F.3d 257 (4th Cir. 1999).

153. *Id.* at 265.

154. *See id.* Neither the court nor the expert appears to distinguish between the cause of an injury and the aggravation of a previous injury. The point appears to be relevant because earlier in the opinion, the court states that Westberry brought the present action claiming that his "breathing airborne talc proximately caused the aggravation of his pre-existing sinus condition." *Id.* at 260.

155. 128 F.3d 802 (3d Cir. 1997).

156. *See id.* at 805.

157. *See id.*

158. *See id.*

159. *See id.*

160. *Id.* According to the Third Circuit, Dr. Gerson based his opinion on the plaintiff's account of her symptoms, a report prepared by a neuropsychologist who examined Dr. Kannankeril, a summary report of the times and amounts of pesticide applications to the Kannankeril home, and his general experience and readings, general medical knowledge, standard textbooks, and standard references. *See id.* at 806. The report by the neuropsychologist, Dr. Grober, included the results of a cholinesterase blood test, which is the most accepted test for determining exposure to Dursban. The test did not produce abnormal results. *See id.* at 807.

161. *Kannankeril v. Terminix Int'l, Inc.*, 128 F.3d 802, 804 (3d Cir. 1997).

vacated and remanded.¹⁶² Dr. Gerson did not rule out other possible causes of the plaintiff's illness, but the court noted that the defendant had not pointed to any other plausible cause. Although the court noted that the defendant is not obligated to offer alternative theories of causation, its failure to do so seemingly relieved the expert from offering his own.¹⁶³ Temporal order seems to have been the primary basis of the expert's opinion.

In *Curtis v. M&S Petroleum, Inc.*, refinery workers brought an action against the defendants for health problems caused by exposure to excessive amounts of benzene.¹⁶⁴ There appeared to be little doubt that exposure to benzene at levels present in the plant could cause injuries similar to those suffered by the plaintiffs.¹⁶⁵ In addition to this general causation evidence, the plaintiffs' expert pointed to the strong temporal connection between the workers' exposure to benzene and the onset of their symptoms.¹⁶⁶ However, he did not undertake a differential diagnosis.¹⁶⁷ For this reason, the trial judge refused to admit his testimony.¹⁶⁸ The Fifth Circuit reversed on this point.¹⁶⁹ On the question of specific causation the court said that

Dr. Stevens pointed to the strong temporal connection between the refinery workers' exposure to benzene and the onset of their symptoms. The refinery workers developed their symptoms contemporaneously with the first attempts to process HAD, and their symptoms subsided within two weeks after they left the refinery. A temporal connection standing alone is entitled to little weight in determining causation. However, a temporal connection is entitled to greater weight when there is an established scientific connection between exposure and illness or other circumstantial evidence supporting the causal link. In the present case, both scientific literature and strong circumstantial evidence support the causal connection.¹⁷⁰

Recently, in *Cooper v. Carl A. Nelson & Co.*, the Seventh Circuit reversed the trial court judge's exclusion of the plaintiff's experts who were prepared to testify that the plaintiff's fall at a construction site caused his chronic pain syndrome ("CPS").¹⁷¹ The trial judge had refused to admit the testimony because he concluded that the experts had no scientific basis for their testimony. Each physician had relied on the plaintiff's statements about his past medical history as the basis for the diagnosis that the fall caused his CPS.¹⁷² Dr. Richardson, one of the experts, said that, based on Mr. Cooper's statement that he had been without pain before the fall, the pain was caused by the fall.¹⁷³ He also explained that the cause of Mr. Cooper's trauma was irrelevant to him in prescribing a

162. 128 F.3d at 805.

163. *See id.* at 808 n.7.

164. 174 F.3d 661 (5th Cir. 1999).

165. *See id.* at 669.

166. *See id.* at 670.

167. *See id.*

168. *See id.* at 670-71.

169. *See id.* at 661.

170. *Id.* at 670.

171. 211 F.3d 1008 (7th Cir. 2000).

172. *See id.* at 1019.

173. *See id.* at 1012.

course of treatment and that, therefore, he did not inquire further as to the cause of Mr. Cooper's CPS.¹⁷⁴ On cross examination, the defendant elicited testimony that Dr. Richardson had really not investigated into the cause of the plaintiff's pain.¹⁷⁵ Nevertheless, the Seventh Circuit held that the defendant's argument, that the expert's *post hoc ergo propter hoc* determination of causation was not an acceptable methodology in cases where the mechanism of injury is not understood, went to the weight of the medical testimony, not its admissibility.¹⁷⁶

V

UNDERSTANDING THE DIFFERENCES

How might we understand this set of admissibility opinions? In this final section, we note three factors that seem to affect the outcome in these cases: the commitment to jury decisionmaking, the quality of the available causal information, and the type of reasoning employed by the expert.

A. Commitment to Jury Decisionmaking

The different results in these cases are partly attributable to a non-causal consideration: a commitment to jury decisionmaking. In the face of increasing trial complexity and the growth of scientific testimony, many courts have been more willing to take steps that erode traditional adversary processes and adopt a more inquisitorial style of adjudication.¹⁷⁷ With respect to the admissibility of expert testimony, this has meant that judges have been more willing to limit party control of the evidence that reaches the jury.¹⁷⁸ Almost everyone agrees that the admissibility threshold under *Daubert* is higher than it was under *Frye*, even though when it was decided, the Supreme Court implied that the *Daubert* criteria were more in tune with the liberal admissibility thrust of the Federal Rules.¹⁷⁹ *Daubert's* higher threshold reflects this trend. Not every court, however, is equally committed to a less adversarial style. The Third and Fourth Circuits have been more solicitous toward jury decisionmaking and adversarial

174. See *id.* at 1019. This passage highlights the difference between differential diagnosis and differential etiology. Dr. Richardson's statement makes clear the fact that he was primarily concerned with a differential diagnosis, that is, chronic musculoskeletal pain. He was much less interested in differential etiology, or the cause of the pain.

175. See *id.*

176. See *id.* at 1020-21.

177. See Howard M. Erichson, *Mass Tort Litigation and Inquisitorial Justice*, 87 GEO. L.J. 1983 (1999); Joseph Sanders, *Scientifically Complex Cases, Trial by Jury, and the Erosion of Adversarial Processes*, 48 DEPAUL L. REV. 355 (1998).

178. A number of recent law review articles have discussed this shift in the balance between judge and jury. See Harvey Brown, *Procedural Issues Under Daubert*, 36 HOUS. L. REV. 1133 (1999); Lucinda M. Finley, *Guarding the Gate to the Courthouse: How Trial Judges are Using Their Evidentiary Screening Role to Remake Tort Causation Rules*, 49 DEPAUL L. REV. 335 (1999); Richard Collin Mangrum, *Kumho Tire Company: The Expansion of the Court's Role in Screening Every Aspect of Every Expert's Testimony at Every Stage of the Proceedings*, 33 CREIGHTON L. REV. 525 (2000).

179. See *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 588 (1993).

processes than other circuits, notably the Fifth. This non-causal consideration undoubtedly plays some role in explaining the differences we observe regarding differential diagnosis admissibility decisions.

B. Quality of the Available Causal Information

Some of the differences in the admissibility opinions may be understood as a function of the underlying quality of the available causal information. The opinions that require the expert to “rule in before ruling out” are, in our view, correct. However, some of the courts that appear to have retreated from this requirement have addressed fact patterns where there was some evidence of general causation. This is most clear in cases like *Westberry v. Gislaved Gummi AB*, where the issue was one of dosage as much as whether even very heavy concentrations of talc could cause injury.¹⁸⁰

Other cases appear to relax the plaintiff’s burden on this issue when the court believes that there is little or no information on whether a substance causes injury. Thus in *Heller v. Shaw Industrial, Inc.*, Judge Becker did not say that the plaintiff need not rule in the alleged cause, but only that the expert is not required to cite published studies addressing general causation.¹⁸¹ In this regard, Judge Calabresi’s opinion in *Zuchowicz v. United States* is instructive.¹⁸² In *Zuchowicz*, the plaintiff’s wife died from a fatal lung condition allegedly caused by the drug Danocrine.¹⁸³ Mrs. Zuchowicz was negligently prescribed an overdose of the drug, which she took daily for over a month.¹⁸⁴ She continued taking

180. 178 F.3d 257 (4th Cir. 1999).

181. See 167 F.3d 146, 155 (3d Cir. 1999). Judge Becker distinguishes the facts in *Heller* from both more and less extreme cases:

The temporal relationship will often be (only) one factor, and how much weight it provides for the overall determination of whether an expert has “good grounds” for his or her conclusion will differ depending on the strength of that relationship. For example, if there was a minor oil spill on the Hudson River on the same day that Heller began experiencing her symptoms in West Chester, Pennsylvania, and she recovered around the time the oil was cleaned up, a proper differential diagnosis and temporal analysis by a well-qualified physician such as Dr. Papano could not possibly lead to the conclusion that the oil spill caused Heller’s illness. Conversely, “if a person were doused with chemical X and immediately thereafter developed symptom Y, the need for published literature showing a correlation between the two may be lessened.”

The present case falls between these two hypotheticals. In this middle area, we do not believe that *Daubert* and *Paoli* require a physician to rely on definitive published studies before concluding that exposure to a particular object or chemical was the most likely cause of a plaintiff’s illness.

Id. at 154 (citations omitted).

Unfortunately, Judge Becker leaves us with the suggestion that what distinguishes these two cases is the strength of the temporal order. This alone, however, cannot be the determining factor. The temporal relationship between exposure and illness might be identical in the two hypotheticals, but we presume Judge Becker would exclude the testimony in the Hudson River spill case. What is missing in both cases is a lack of proof of general causation. If Judge Becker were to be told that the chemical X with which the plaintiff was doused in the second situation was an incredibly weak solution, presumably temporal order alone would not suffice.

182. See 140 F.3d 381 (2d Cir. 1998).

183. See *id.* at 383.

184. See *id.* at 384.

the correct dosage of the medication for another two months, when she was advised to cease due to adverse symptoms.¹⁸⁵ Because of the rareness of primary pulmonary hypertension and the lack of any formal research on the effects of Danocrine at the higher dosage, the experts could not point to specific research supporting their differential diagnosis that the drug caused the decedent's illness.¹⁸⁶ They could, however, point to studies identifying other agents, such as birth control pills, some appetite suppressants, and chemotherapy drugs, that cause this illness.¹⁸⁷ Affirming the trial court's decision to admit the testimony, Judge Calabresi noted that the experts were able to provide a biologically plausible reason why the drug could cause this effect.¹⁸⁸

In many situations it would be an insurmountable burden for the plaintiff to present substantial epidemiological or animal study data indicating adverse health effects from a given dose of a substance. In both *Heller* and *Zuchowicz*, the court implicitly recognized this fact and allowed the plaintiff to proceed with relatively less evidence than would be required if there were a substantial body of research. In this respect, these decisions conform to Gerald Boston's observation that courts have frequently relaxed the plaintiff's obligation to produce hard science on general causation for injuries that may be placed in the "sporadic accident model" of tort law.¹⁸⁹ In these cases, where only a single plaintiff or a few plaintiffs have allegedly suffered an injury due to exposure, a medical doctor will be permitted to render an opinion on general causation with little or no epidemiological evidence and sometimes with very little toxicological evidence.¹⁹⁰ Examples of such cases include specific medical treatments, as in *Zuchowicz*, and nonrecurring occupational diseases that affect a limited number of individuals, as in *Heller*.¹⁹¹ However, courts have not been willing to go beyond this and adopt the proposals of some commentators who argue that, in situations of irreducible causal uncertainty, the plaintiff should either be relieved of the burden of persuasion on the causal question or should be permitted some percentage recovery, as long as the plaintiff could establish strong un-

185. *See id.*

186. *See id.* at 385.

187. *See id.* at 385-86.

188. *See id.* at 387.

189. Gerald W. Boston, *A Mass-Exposure Model of Toxic Causation: The Content of Scientific Proof and the Regulatory Experience*, 18 COLUM. J. ENVTL. L. 181, 188 (1993); *see also* Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 NW. U. L. REV. 643, 680-82 (1992).

190. *See* *Lakie v. Smithkline Beecham*, 965 F. Supp. 49, 56 (D.D.C. 1997) (alleging that benzene in denture adhesive caused rare form of leukemia) ("The absence of epidemiological studies, however, while important, is not dispositive as long as the methodology employed by the expert is sound This is especially true when the disease is an extremely rare disorder like MDS 5 q-minus.").

191. *See, e.g.,* *McCulloch v. H.B. Fuller Co.*, 61 F.3d 1038 (2d Cir. 1995) (glue fumes allegedly causing throat polyps); *Kennedy v. Collagen Corp.*, No. 91-15597, 1992 WL 217803 (9th Cir. Sept. 8, 1992) (collagen allegedly causing systemic immunological injuries); *Becker v. National Health Prods., Inc.*, 896 F. Supp. 100 (N.D.N.Y. 1995) (alleging that Hot Stuff "anabolic activator" caused diverticulosis and diverticulitis).

certainty about causation.¹⁹² Here, as in other areas of causal uncertainty, we are left with the question of how far the courts should go in easing the plaintiff's burden of proof. Even under a relaxed standard, it is difficult to square the opinions in *Becker v. National Health Products*¹⁹³ and *Kannankeril v. Terminix International, Inc.*¹⁹⁴ with the requirement that the plaintiff must rule in the alleged cause before ruling out other potential causes.

Assuming that the general causation "rule in" hurdle is surmounted, there remains the specific causation question of when a differential diagnosis is adequate. Once again, some differences in language can be explained by the facts presented in the case. A case in point is *Curtis v. M&S Petroleum, Inc.*¹⁹⁵ In that case, multiple defendants simultaneously developed similar health problems after occupational exposure to levels of benzene known to be capable of producing these types of injuries.¹⁹⁶ The very existence of multiple co-worker defendants tends to rule out other causes not job-related. Moreover, the injuries were contemporaneous with the introduction of benzene into the workplace and abated within two weeks after the defendants left the refinery.¹⁹⁷ The inference to be drawn from "mere" temporal order was much stronger here than in most situations and was closer to the classic slip-and-fall scenario where temporal order alone frequently suffices.¹⁹⁸

Black v. Food Lion, Inc., an actual slip-and-fall case, ironically presents a fact pattern at the other end of the spectrum.¹⁹⁹ Black slipped on spilled mayonnaise in the defendant's store.²⁰⁰ She immediately complained of lower back and arm pain, a headache, and dizziness.²⁰¹ She underwent numerous tests for several months, but her treating physician could not identify a physical basis for the plaintiff's continued complaints of pain.²⁰² She was referred to another physician specializing in treating patients with persistent pain.²⁰³ After several weeks of treatment, this physician, Dr. Reyna, diagnosed the plaintiff with a condition known as fibromyalgia syndrome.²⁰⁴ According to the Fifth Circuit, "Dr. Reyna

192. See Heidi Li Feldman, *Science and Uncertainty in Mass Exposure Litigation*, 74 TEX. L. REV. 1, 45 (1995).

193. 896 F. Supp. 100 (N.D.N.Y. 1995).

194. 128 F.3d 802 (3d Cir. 1997).

195. 174 F.3d 661 (5th Cir. 1999).

196. See *id.* at 664.

197. See *id.* at 670.

198. An example of the classic slip-and-fall scenario would be where a grocery store patron slips on a banana peel and breaks his leg. Proof that the leg was not broken before the fall settles the causal question. Insofar as *Westberry* is a case about talc aggravating rather than causing the plaintiff's sinus condition, perhaps a similar argument may be made in that case as well.

199. 171 F.3d 308 (5th Cir. 1999).

200. See *id.* at 309.

201. See *id.*

202. See *id.*

203. See *id.*

204. See *id.* Fibromyalgia is characterized by complaints of generalized pain, poor sleep, an inability to concentrate, and chronic fatigue. The condition is most common among women between 30 and 50 and is often associated with hormonal problems.

hypothesized that the fall at Food Lion caused physical trauma to Black, which caused ‘hormonal changes,’ which caused Black’s fibromyalgia.’²⁰⁵ The case was removed to a federal court and tried before a magistrate who, over defense objections, permitted Dr. Reyna to testify and awarded a judgment to the plaintiff based on the testimony.²⁰⁶

In reversing the fibromyalgia damages, the Fifth Circuit acknowledged the utility of the differential diagnosis process but noted that, under *Daubert*, *Kumho*, and *Moore*, it must be applied fact-specifically in each case.²⁰⁷ With respect to this fact-specific differential diagnosis, the Fifth Circuit made the following observation:

[The magistrate judge] then found that Dr. Reyna followed [an appropriate] protocol by (a) taking a medical history from Black, (b) ruling out prior or subsequent “causes” of fibromyalgia, (c) performing or reviewing physical tests [which all turned up negative], and (d) deducing that the Food Lion fall was the only possible remaining cause of fibromyalgia that appeared nine months later.

This analysis amounts to saying that because Dr. Reyna thought she had eliminated other possible causes of fibromyalgia, even though she does not know the real “cause,” it had to be the fall at Food Lion.

In this case, neither Dr. Reyna nor medical science knows the exact process that results in fibromyalgia or the factors that trigger the process. Absent these critical scientific predicates, for which there is no proof in the record, no scientifically reliable conclusion on causation can be drawn. Dr. Reyna’s use of a general methodology cannot vindicate a conclusion for which there is no underlying medical support.²⁰⁸

Although the expert purported to perform most of the steps required of a differential diagnosis, the Fifth Circuit found that her analysis only loosely linked some generalities.²⁰⁹ Although falls may cause fibromyalgia, it is not clear that they are a typical or frequent cause.²¹⁰ This becomes particularly important when, as in this case, one cannot assume that most causes of any given ailment are known. Otherwise, as Susan R. Poulter has noted,²¹¹ the elimination of other risk factors would not significantly increase the likelihood that the exposure was the cause of the plaintiff’s injury.²¹² In such situations, one cannot make a

205. *Id.*

206. *See id.*

207. *See id.* at 314.

208. *Id.* at 313-14.

209. “If the magistrate judge thought he was applying *Daubert*, however, he fatally erred by applying its criteria at a standard of meaninglessly high generality rather than boring in on the precise state of scientific knowledge in this case.” *Id.* at 314.

210. *See id.* at 313.

211. *See* Susan R. Poulter, *Science and Toxic Torts: Is there a Rational Solution to the Problem of Causation?*, 7 HIGH TECH. L.J. 189, 233 (1993).

212. A similar point is made by Judge Boggs in his dissent in *Glaser v. Thompson Medical Co., Inc.*, 32 F.3d 969 (6th Cir. 1994) (reversing a district court decision granting defendant summary judgment):

The fallacy of the court’s conclusion may be underscored by the implication that follows. Every day, many Americans faint and fall. By Dr. Zaloga’s analysis, every one of them can get to a jury if they happen to have taken any of the 125-plus over-the-counter common-cold remedies or diet aids that provide doses of 75 mg of PPA . . . and have no other strong organic reason for a faint . . . In short, all that we have is a witness’s personal belief that an environmental condition to which tens of millions are exposed annually is capable of wreaking ran-

Sherlock Holmes-like deduction that simply because all other known causes have been eliminated, the only known cause left, no matter how improbable, must be the actual cause. From this perspective, the outcome in *Cooper v. Carl A. Nelson & Co.*²¹³ is more difficult to justify. Perhaps it should instead be understood as an opinion reflecting a stronger commitment to jury decision-making.

C. Style of Reasoning Adopted by the Expert

A court's decision whether or not to admit an expert's testimony may be affected by the style of reasoning employed by the expert. The district court in *Sanderson v. International Flavors and Fragrances, Inc.*, explicitly states a point that is often implicit in other opinions.²¹⁴ The plaintiff argued that

the Court should adopt a "common-sense," lay interpretation of causation. She contends that because her injuries are of the type caused by defendants' products, she was exposed to same, and there is a temporal connection between such exposures and her experience of symptoms, a jury could find that defendants' products caused her injuries.²¹⁵

The court rejected this argument.²¹⁶ In a case requiring expert testimony on causation, neither the plaintiff nor the plaintiff's experts may rely exclusively on the common-sense causal conclusion that arises from temporal order.²¹⁷ Sanderson's expert

could not identify anything other than pure temporal coincidence to support his probability estimate, and based it upon what he knows about people with similar health problems, "not necessarily with fragrances but from other chemicals." He also admitted that there are no published statistics that would allow him to calculate or quantify the relative risk of any of the plaintiff's injuries.²¹⁸

The court concluded that this was not a "scientific connection" and that the expert's testimony did not meet the *Daubert* standard.²¹⁹

What, from the court's perspective, is wrong with "common sense" in this context? The answer, it seems, is that the approach is not "scientific." In *Sanderson*, as in other cases discussed above, the court criticized experts for

dom havoc. This belief is not supported by the scientific studies he refers to . . . This is *post hoc propter hoc* reasoning at its rankest, and is contrary to the "hard look" encouraged and even required by our case law.

Id. at 982.

213. 211 F.3d 1008 (7th Cir. 2000) (holding that fact that medical experts relied on worker's statement about his past medical history as basis for diagnosis that his fall caused chronic pain syndrome did not render such expert testimony unreliable).

214. 950 F. Supp. 981 (C.D. Cal. 1996). Sanderson claimed that exposure to the defendants' fragrance products caused her toxic encephalopathy, chronic nasal problems, and small airways disease. *See id.* at 988.

215. *Id.* at 985.

216. *See id.* at 985-86.

217. The court cites *Viterbo v. Dow Chemical Co.*, 826 F.2d 420, 424 (5th Cir. 1987), for the point that an expert's testimony that merely repeats a layperson's oral history "is no more than [lay] testimony dressed up and sanctified as the opinion of an expert." *Sanderson*, 950 F. Supp. at 987 n.4.

218. *See Sanderson*, 950 F. Supp. at 999-1000.

219. *See id.*

failing to take a “scientific approach.” There is, of course, no bright-line test for distinguishing between scientific and non-scientific opinions. However, dual-process theory in social psychology offers some insights as to what the courts have in mind. This body of research argues that individuals have two systems for processing information.²²⁰ Experiential processing is more holistic, tends to be outcome-oriented, and tends to represent events as concrete exemplars.²²¹ Rational processing, on the other hand, is more analytic, relies more on abstract symbols, and is process-oriented.²²² By and large, science is more committed to rational, rather than experiential, processing of information.²²³ When courts object that an approach is insufficiently scientific, they often seem to be suggesting that it is insufficiently rational in this sense. Judges find less acceptable those expert judgments relying primarily on the expert’s intuition²²⁴ and professional judgment,²²⁵—judgments that reflect a greater degree of experiential processing.²²⁶

Here we see the impact of *Daubert*, *Kumho*, and more than a decade of post-*Frye* jurisprudence. At bottom, the *Daubert* revolution is about the relationship between law and science. *Frye* asked judges to acquiesce in the judgment of the relevant scientific community. It invited judges to accept an expert’s judgment as long as it appeared to be within the mainstream of scientific opinion.²²⁷ *Daubert*, on the other hand, invites the trial court to make an independent inquiry.²²⁸ The judge should determine whether the proffered evidence is reliable by examining the reasoning and methodology underlying the expert’s testimony.²²⁹ As Michael J. Saks recently noted, “perhaps the purpose of the rules is simply to hold up a target to the courts; call one the *Frye* target and the other the *Daubert* target. The *Frye* ideal says: Do whatever the experts tell you to do. The *Daubert* ideal says: Figure out the science yourself.”²³⁰ In figuring it out for themselves, judges have moved steadily toward the interpretive prac-

220. These types go by a number of different names: experiential vs. rational; associative vs. rule based; heuristic vs. systematic. See DUAL PROCESS THEORIES IN SOCIAL PSYCHOLOGY 73, 323, 627 (Shelly Chaiken & Yaacov Trope eds., 1999).

221. See Seymour Epstein & Rosemary Pacini, *Some Basic Issues Regarding Dual-Process Theories from the Perspective of Cognitive-Experiential Self-Theory*, in DUAL PROCESS THEORIES IN SOCIAL PSYCHOLOGY, *supra* note 220, at 466.

222. For a fuller discussion of expert testimony from the point of view of dual process theories, see Sanders, *supra* note 104.

223. See Epstein & Pacini, *supra* note 221, at 466.

224. See, e.g., *Cartwright v. Home Depot U.S.A., Inc.*, 936 F. Supp. 900, 907 (M.D. Fla. 1996).

225. See *In re Breast Implant Litig.*, 11 F. Supp. 2d 1217, 1230 (D. Colo. 1998).

226. A similar trend may be occurring in products liability design defect litigation. See *Jaurequi v. Carter Mfg. Co., Inc.*, 173 F.3d 1076 (8th Cir. 1999).

227. See Michael J. Saks, *Merlin and Solomon: Lessons from the Law’s Formative Encounters with Forensic Identification Science*, 49 HASTINGS L.J. 1069, 1075 (1998).

228. See *id.* at 1077.

229. To be sure, the opinion allows judges to make use of surrogate indicia of reliability. Peer review and publication and general acceptance in the scientific community are factors judges may consider, but they are secondary to a direct assessment of the testimony’s scientific validity.

230. Saks, *supra* note 227, at 1139.

tices of science.²³¹ Those interpretive practices—the generally accepted types of arguments and data interpretation that define the interpretive community of science—typically involve rational processing.²³² In this area at least, the interpretive communities of science and law have tended to converge.²³³ By its refusal to distinguish between scientific experts and other experts, *Kumho* has reinforced this movement in areas such as differential diagnosis.

Zuchowicz v. United States is an example of a case where the style of reasoning in the expert testimony arguably made a difference in an otherwise difficult causal argument.²³⁴ The experts' conclusion was primarily based on tempo-

231. Alvin Goldman provides one list of the dimensions of scientific practice. They include:

- (1) An emphasis on precise measurement, controlled test, and observation, including a philosophy, organon, and technology for more and more powerful observation.
- (2) A systematic and sophisticated set of inferential principles for drawing conclusions about hypotheses from observations of experimental results.

ALVIN I. GOLDMAN, *KNOWLEDGE IN A SOCIAL WORLD* 250 (1999).

232. We do not mean to suggest that there is only one scientific interpretive community. At a philosophical and sociological level, there is much disagreement about how scientists know. We make the more modest point that appeals to professional judgment or intuition based on experiential processing of information are generally outside the boundaries of legitimate scientific epistemology. See STEPHEN COLE, *MAKING SCIENCE: BETWEEN NATURE AND SOCIETY* (1992); *PHILOSOPHY OF SCIENCE: THE CENTRAL ISSUES* (Martin Curd & J.A. Cover eds., 1998); *THE PHILOSOPHY OF SCIENCE* (David Papineau ed., 1996).

233. The idea of interpretive communities in law is usually associated with Stanley Fish. See STANLEY FISH, *DOING WHAT COMES NATURALLY: CHANGE, RHETORIC, AND THE PRACTICE OF THEORY IN LITERARY AND LEGAL STUDIES* (1989).

234. The following description of their testimony is taken from the opinion:

1. Dr. Matthay

Dr. Richard Matthay is a full professor of medicine at Yale and Associate Director and Training Director of Yale's Pulmonary and Critical Care Section. He is a nationally recognized expert in the field of pulmonary medicine, with extensive experience in the area of drug-induced pulmonary diseases. Dr. Matthay examined and treated Mrs. Zuchowicz. His examination included taking a detailed history of the progression of her disease, her medical history, and the timing of her Danocrine overdose and the onset of her symptoms.

Dr. Matthay testified that he was confident to a reasonable medical certainty that the Danocrine caused Mrs. Zuchowicz's PPH. When pressed, he added that he believed the overdose of Danocrine to have been responsible for the disease. His conclusion was based on the temporal relationship between the overdose and the start of the disease and the differential etiology method of excluding other possible causes. While Dr. Matthay did not rule out all other possible causes of pulmonary hypertension, he did exclude all the causes of secondary pulmonary hypertension. On the basis of Mrs. Zuchowicz's history, he also ruled out all previously known drug-related causes of primary pulmonary hypertension.

Dr. Matthay further testified that the progression and timing of Mrs. Zuchowicz's disease in relation to her overdose supported a finding of drug-induced PPH. Dr. Matthay emphasized that, prior to the overdose, Mrs. Zuchowicz was a healthy, active young woman with no history of cardiovascular problems, and that, shortly after the overdose, she began experiencing symptoms of PPH such as weight gain, swelling of hands and feet, fatigue, and shortness of breath. He described the similarities between the course of Mrs. Zuchowicz's illness and that of accepted cases of drug-induced PPH, and he went on to discuss cases involving classes of drugs that are known to cause other pulmonary diseases (mainly anti-cancer drugs). He noted that the onset of these diseases, which are recognized to be caused by the particular drugs, was very similar in timing and course to the development of Mrs. Zuchowicz's illness.

2. Dr. Tackett

ral order. But their testimony also was fully within the rational processing style. It was analytic, it relied more on abstract symbols, and it was process-oriented. Both the trial court and the Second Circuit found it to be admissible.²³⁵

If our argument is correct, then testimony that is both in a rational-processing style and is supported by higher quality causal information is more likely to be admitted. One should note, however, that these are not entirely separate criteria. The definition of what constitutes higher-quality causal information is greatly affected by whether the information itself is presented in this style. The very ability to construct a plausible rational processing style argument is in part contingent on the existence of research done and presented in this way. In this sense, style and substance are inevitably intertwined.

VI

CONCLUSION

This article has focused on one of the more difficult causal issues in torts today, the proof of specific causation in toxic tort suits. Typically, plaintiffs' experts attempt to prove specific causation through a process that the courts have called differential diagnosis. Given the difficulty of the question, it is not surprising that courts have made inconsistent pronouncements on issues such as ruling-in before ruling-out and the sufficiency of temporal order evidence. What is surprising is the fair degree of consensus that has been achieved on these questions. Moreover, a number of the opinions in the minority on these issues can be reconciled with the majority view based on the strength of the causal information available and the way in which the experts presented the evidence.

We believe that it is fair to say that differential diagnosis testimony generally is looked upon with greater skepticism than was the case prior to the *Daubert* revolution. Courts are less likely to admit the testimony. In part, this is because in the toxic tort arena plaintiffs are attempting more difficult causal arguments. We believe it is also because courts have become more demanding by requiring better science before admitting testimony. Justice Cornyn was right to be concerned in *Robinson*. With respect to harm to both the plants in *Robinson* and the people in the differential diagnosis cases, plaintiffs are held to a more rigorous standard.

Dr. Randall Tackett is a tenured, full professor of pharmacology and former department chair from the University of Georgia. He has published widely in the field of the effects of drugs on vascular tissues. Dr. Tackett testified that, to a reasonable degree of scientific certainty, he believed that the overdose of Danocrine, more likely than not, caused PPH in the plaintiff by producing: 1) a decrease in estrogen; 2) hyperinsulinemia, in which abnormally high levels of insulin circulate in the body; and 3) increases in free testosterone and progesterone. Dr. Tackett testified that these hormonal factors, taken together, likely caused a dysfunction of the endothelium leading to PPH. Dr. Tackett relied on a variety of published and unpublished studies that indicated that these hormones could cause endothelial dysfunction and an imbalance of vasoconstrictor effects.

140 F.3d 381, 385-86 (2d Cir. 1998).

235. See *Zuchowicz*, 140 F.3d at 387.

A lesson to be drawn from this discussion is that the adjective law of evidence and the substantive law of causation are also intertwined. If all that an expert could say in support of her opinion is that it is widely shared by other experts who have considered the question, most courts would refuse to let her take the stand. In this sense, *Frye* has been banished from federal courts. Its departure has altered not only evidentiary law on admissibility of expert testimony, but also the substantive tort law of what is necessary to prove a causal connection based on a differential diagnosis.