The Admissibility of Differential Diagnosis Testimony to Prove Causation in Toxic Tort Cases: The Interplay of Adjective and Substantive Law[1]

by

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A. Introduction

In E.I. du Pont de Nemours & Co., Inc. v. Robinson,[2] the Texas Supreme Court adopted an interpretation of the rules concerning the admissibility of expert testimony that was nearly identical to those adopted two years earlier by the United States Supreme Court in Daubert v. Merrell Dow Pharmaceuticals, Inc.[3] The court affirmed the trial judge's exclusion of Dr. Whitcomb, the plaintiff's only causation expert who was prepared to testify that the defendant's contaminated fungicide damaged 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.[4]

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[1] Paper prepared for the Law and Contemporary Problems conference on Causation in Law and Science. November 10 and 11, 2000. Duke Law School, Durham, NC.

[2] 923 S.W.2d 549 (Tex. 1995).

[3] 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993).

[4] 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

In a prescient sentence, he objected to the exclusion of this testimony because it "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."[5] Indeed, it was. Like Dr. Whitcomb, physicians are frequently called upon to offer an opinion on the cause of an injury based on an 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.[6]

Justice Cornyn may simply 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

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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.

[5] Id.

[6] 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 Cyclopedic Medical Dictionary (14th ed.) p. 404 (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 in Cavallo v. Star Enter., 892 F.Supp. 756, 771 n. 31 (E.D.Va.1995), aff'd in part, rev'd in part, 100 F.3d 1150 (4th Cir.1996) as "[A] process whereby medical doctors experienced in diagnostic techniques provide testimony countering other possible causes ... of the injuries at issue." Some courts do recognize that this legal use is contrary to 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 (1998).

testimony had been employed in tort cases for many years without criticism from courts or commentators.[7] Perhaps, however, Justice Cornyn foresaw the opposite implication: If Dr. Whitcomb's testimony is inadmissible this might call into question the differential diagnosis testimony of many physicians. Had he investigated the law review literature more thoroughly, he would have discovered that in the late 1980s and early 1990s such questioning had already begun.[8]

A number of factors seem to have played a role in this change, among them the increasingly frequent use of scientific experts in court, the rise of toxic torts, and renewed interest in the criteria to be used to judge the admissibility of expert testimony. As the 90's progressed, courts were presented with more and more admissibility challenges to differential diagnosis testimony. There is now a considerable body of case law on point.[9]

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[7] A Westlaw search of the term "differential diagnosis" generates 415 cases, the earliest decided in 1948.

[8] Two of the earliest articles discussing differential diagnosis are Bert Black, A Unified Theory of Scientific Evidence, 56 Fordham L. Rev. 595 (1988); E. Donald Elliott, Toward Incentive-Based Procedure: Three Approaches to Regulating Scientific Evidence, 69 Boston Univ. L. Rev. 487 (1989).

[9] See for example, Hall v. Babcock & Wilcox, 69 F. Supp.2d 716 (W.D.Pa. 1999) (exposure to radiation and cancer);; Norfolk Southern Railway Co. v Baker, 514 S.E.2d 448 (Ga. App. 1999) (diesel exhaust and nasopharyngeal cancer); Berry v. CSX Transportation, Inc., 709 So.2d 552, 571 (Fla. App. 1998) (organic solvents and encephalopathy); Golod v. Hoffman La Roche, 964 F/Supp. 841 (S.D.N.Y. 1997) (Tegison and eye injury); Ambrosini v. LaBarraque, 191 F.3d. 129 (D.C.C. 1996) (Depo-Provera and birth defects); Pick v. American Medical Systems, 958 F. Supp. 1151, 1168 (E.D.La. 1997) (silicone penile implant and autoimmune disorder); Raynor v. Merrell Dow Pharmaceuticals, Inc., 104 F.3d 1371, 1376 (D.C.C. 1997) (Bendectin and fetal birth defects); Fadelalla v. Secretary of Health and Human Services, 1999 WL 270423, *5 (Fed.Cl.) (rubella vaccine and Guillain-Barre Syndrome); National Bank of Commerce v. Associated Milk Producers, 22 F.Supp.2d 942, 963 (E.D.Ark. 1998) (contaminated milk supplied to employer's cheese factory and laryngeal cancer); Mancuso v. Consolidated Edison, 56 F.Supp.2d 391 (S.D.N.Y. 1999), Aff'd in part, vacated in part, 2000 WL 730417 (2nd

Most would agree that the result is a body of evidence law that creates more barriers to the admissibility of this evidence than existed in the past.[10] However, there is nothing like a complete consensus as to what is required before such testimony should be admitted. On the contrary, as we discuss below, in some regards the case law is unsettled.[11] This lack of agreement is not surprising because differential diagnosis testimony attempts to address some very difficult causal questions, especially when it is offered in toxic tort cases.

In this paper we use the differential diagnosis opinions as a vehicle 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

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Cir.) (PCB exposure and a wide variety of injuries, including toxic burns, fatigue, loss of eyesight); Black v. Food Lion, Inc., 171 F.3d 308, 313 (5th cir. 1999) (fall in a grocery store and fibromyalgia); Zuchowicz v. United States, 140 F.3d 381 (2d Cir. 1998) overdose of drug Danocrine and primary pulmonary hypertension); Lakie v. Smithkline Beecham, 965 F.Supp. 49 (D.D.C. 1997) (benzene and myelodysplastic syndrome, a bone marrow disorder); Westberry v. Gislaved Gummi, 178 F.3d 257 (4th Cir. 1999) (airborne talc and severe sinus condition); Heller v. Shaw, 167 F.3d 146 (3d. Cir. 1999) (volatile organic compounds emitted from new carpet and respiratory illnesses); Kannankeril v. Terminix International, Inc., 128 F.3d 802 (3d Cir. 1997) Dursban and a variety of ailments, including memory loss concentration loss, sleeplessness, general anxiety, headaches, numbness, pain in joints, and skin rashes).

[10] Recent articles that discuss differential diagnosis include: Richard T. Stilwell, Kumho tire: The Battle of the Experts Continues, 19 Rev. Litig. 193 (2000); 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); Lars Noah, Pigeonholing Illness" Medical Diagnosis as a Legal Construct, 50 Hastings L.J. 241 (1999); Harvey Brown, Eight Gates for Expert Witnesses, 36 Hous. L. Rev. 743 (1999); Note, Navigating Uncertainty: Gatekeeping in the Absence of Hard Science, 113 Harv. L. Rev. 1467 (2000).

[11] See ---- infra for a discussion of areas of agreement and disagreement.

for the jury, causation is resolved in an in limine hearing before a jury is even empaneled.[12] Our goal is to shed some light on how admissibility decisions shape causal questions and in turn how causal principles to affect differential diagnosis admissibility decisions. Second, we are interested in the relationship between law and science. Specifically, we argue that the *Daubert* revolution in admissibility law has caused courts to be more "scientific" in their assessment of this type of testimony. The paper is divided into five sections. In the next section, we present the basic causal framework employed by most courts in toxic tort cases. In Section C we briefly sketch out the admissibility rules developed in *Daubert* and its progeny. Section D examines the differential diagnosis opinions in the context of light of both the causation analysis of section B and the admissibility rules presented in section C. In section E we attempt 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 interpretative conventions of science in assessing admissibility. The paper ends with a short conclusion.

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 in order to state a prima facie case in this evolving area of law. The final section offers a few thoughts as the proper balance between causal clarity and the role of juries in tort cases.

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[12] 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.

B. 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. The plaintiff must not only show that the substance causes the injury in question, but that it is more likely than not that the plaintiff's specific injury was caused by the substance.[14]

It would be a mistake to argue that the causal issues in toxic tort cases are fundamentally different from those presented in all tort cases. However, these cases do differ in degree in several significant ways.[15] First, all too often there is simply causal ambiguity. The level of

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[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. A very good note in the Harvard Law Review makes this point in distinguishing toxic tort cases from what it calls cases in the 'slip-and-fall paradigm," e.g. "cases of abrupt physical injury that nearly coincides with a discrete and dramatic eternal event." Note, Navigating Uncertainty: Gatekeeping in the Absence of Hard Science, 113 Harv. L. Rev. 1467, 1473 (2000).

[14]Ronald J. Allen, The Nature of Juridical Proof. 13 Cardozo L. Rev. 373 (1991).

[15] For useful discussions of the special causal problems arising in mass tort cases see David A. Fischer, Successive Causes and the Enigma of Duplicated Harm, 66 Tenn. L. Rev. 1127 (1999); Mark Parascandola, What is Wrong With The Probability of Causation? 39 Jurimetrics J. 29 (1998); Andrew A. Marino and Lawrence E. Marino, The Scientific Basis of Causality in Toxic Tort Cases, 21 U. Dayton L. Rev. 1 (1995); Gerald Boston, A Mass-Exposure Model of Toxic Causation: The Content of Scientific Proof and the Regulatory Experience, 18 Colum. J. Envtl. L. 181 (1993); 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); David Rosenberg, The Causal Connection in Mass Exposure Cases: A 'Public Law' Vision of the Tort System, 97 Harv. L. Rev. 849 (1984).

exposure to a substance or a drug (i.e. the dose rate) is often uncertain. The evidence of a relationship between the substance and the injury is sometimes sketchy.[16] The timing between exposure and disease may be suspect. These difficulties create both admissibility and sufficiency questions.

Second, there is the fundamental problem of multiple causation. Asbestos, the subject of the first great toxic tort, was atypical because it caused "signature" diseases. Asbestosis, and to a slightly less extent mesothelioma are diseases that are so strongly related to asbestos exposure that there is little doubt that a person who has been exposed to asbestos and contracts these illnesses did so because of the exposure.[17] However, other substances do not cause unique injuries. Even substances that do cause signature diseases may also cause other diseases. If an individual is exposed to asbestos and develops lung cancer, one cannot be certain the exposure caused the disease. It could be something else, for example cigarette smoking.[18]

Third, and related to the problem of multiple causation, is the fact that often there is limited evidence of specific causation, that is evidence that the substance caused the injury to this particular plaintiff.[19] Plaintiffs may find it difficult to prove that any particular injury was the

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[16] See Heidi Li Feldman, Science and Uncertainty in Mass Exposure Litigation, 74 Tex. L. Rev. 1 (1995).

[17] See Victor Roggli, Asbestos. In David Faigman, David Kaye, Michael Saks and Joseph Sanders (eds.) Modern Scientific Evidence, Vol. 3. pp. 285-325). St. Paul: West. (1999).

[18] See Piero Mustacchi. Lung Cancer Latency and Asbestos Liability, 17 J. Legal Medicine, 277 (1996).

[19] 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.

result of defendant's substance versus some other cause.

Courts have provided some solutions to these causal difficulties.. The most noteworthy is the use of general causation evidence such as the results of epidemiological studies to prove (or disprove) specific causation.[20] However, this solution is viable only where there is good evidence on general causation. In fact the quality of the general causation evidence varies from very good, e.g. the teratogenic effects of Bendectin,[21] to very poor, e.g. whether exposure to jet fuel can cause chronic conjunctivitis.[22] Courts have been less willing to entertain alternatives that would permit proportionate recoveries based on the probability that a specific injury was

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Abbott Laboratories, 607 P.2d 924 (Cal. 1980).

[20] Prior to the emergence of epidemiological evidence in the toxic tort context, some courts adopted what Judge Weinstein called a "strong version" of the preponderance of the evidence rule. See In re Agent Orange Products Liability Litigation, 611 F.Supp. 1223, 1261 (E.D.N.Y. 1985). In order to prove specific causation the plaintiff must offer more than statistical correlation. The plaintiff must also offer some "particularistic" proof of a causal connection. Other courts adopted a "weak version" of the rule. A plaintiff verdict may be supported solely on statistical., that is epidemiological evidence. 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 Eastern & Southern District Asbestos Litigation, 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 Pharmaceuticals, Inc., 911 F.2d 941, 958059 (3d Cir. 1990); Landrigan v. Celotex Corp., 127 N.J. 404 605 A.2d 1079, 1087 (1992).

[21] See Michael Green, Bendectin and Birth Defects. (1996).

[22] Cavallo v. Star Enterprise, 892 F.Supp. 756 (E.D.Va.1995).
The courts have also been willing to apply a substantial factor rather than a but-for test in these cases. The use of a substantial factor test has often been implicit. What is clear is that 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.

caused by a given exposure or collectivized, risk-based claims in mass exposure cases.[23] All of these solutions, accepted or not, tacitly recognize the difficulty of making a specific causation proof and some explicitly attempt to relieve the plaintiff of the burden of making such a proof.

Because courts have generally refused to adopt positions that relieve the plaintiff from the burden of proving specific causation, differential diagnosis evidence is often a crucial component of the plaintiff's case. Without some evidence that the substance in question caused this specific injury to this specific plaintiff, courts are likely to grant the defendant a summary judgment. And to get this evidence to the jury the plaintiff must first pass through the *Daubert* gate.

C. Daubert, Kumho Tire and the Admissibility of Expert Evidence

The question of when to trust an expert is as old as expert testimony itself.[24] Prior to Daubert, the most important admissibility opinion was Frye v. United States.[25] The defendant,

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[23] See Steve Gold, *Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence*, 96 Yale Law Journal 376 (1986); David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 851 (1984); David Rosenberg, Individual Justice and Collectivizing Risk-based Claims in Mass Exposure Cases, 71 New York University Law Review 211 (1996); Margaret Berger, *Eliminating General Causation: Notes Towards a New Theory of Justice and Toxic Torts*, 97 Colum. L. Rev. 2117 (1997).

[24] David L. Faigman, Elise Porter and Michael J. Saks, Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying About the Future of Scientific Evidence, 15 Cardozo L. Rev. 1799, 1800 (1994) report the first clear reference to an expert witness called by and on behalf of a part 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. & the Law 131 (1995).

[25] 293 F.1013 (D.D.Cir. 1923). My discussion here borrows heavily from David Faigman, David Kaye, Michael Saks and Joseph Sanders (eds.), Modern Scientific Evidence: The

accused of murder, offered the results of a precursor to a lie detector test to prove his innocence. The court refused to admit testimony based on the results of the test until the technique was "sufficiently established to have gained general acceptance in the particular field in which it belongs."[26]

With the adoption of the Federal Rules of Evidence the *Frye* test began a slow decline in the federal courts as a number of circuits abandoned the test.[27] Other circuits, however, concluded *Frye* did survive the adoption of the rules. The Ninth was among this latter group.[28] In Daubert v. Merrell Dow Pharmaceuticals, Inc.[29] Jason Daubert and Eric Schuler sued the defendant, the manufacturer of Bendectin. They claimed that the morning sickness drug, taken by their mothers during pregnancy, caused the plaintiff's limb reduction birth defects. The trial judge granted the defendant a summary judgment after concluding that the strongest inference a jury could draw from the evidence was "that Bendectin could possibly have caused plaintiff's

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Law and Science of Expert Testimony, Chapter 1 (1997).

[26] Frye, 293 F. at 1014.

[27] The most influential early circuit court opinions 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 in order to be admitted the evidence must survive the trial court's preliminary inquiry. In an in limine proceeding, the judge should balance: (1) the reliability of the scientific principles the expert employed; against (2) 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. Id. at 1226. Concern with reliability and fit have become cornerstones of post-*Daubert* jurisprudence. Another pre-Daubert case to reject *Frye* is Christophersen v. Allied-Signal Corp., 939 F.2d 1106 (5th Cir.1991) (en banc), cert. denied, 112 S.Ct. 1280 (1992).

[28] United States v. Solomon, 753 F.2d 1522, 1526 (9th Cir. 1985).

[29] Daubert v. Merrell Dow Pharmaceuticals, Inc., 727 F.Supp. 570 (S.D.Cal. 1989).

injuries," which was insufficient to avoid granting the defendant's motion.[30] On appeal, the Ninth Circuit affirmed.[31] It held the plaintiff's expert testimony inadmissible because its underlying methodology diverged substantially from the procedures and techniques generally accepted in the field.[32]

The Supreme Court granted certiorari, primarily to announce Frye's demise.[33] The Court held that although the Rules do not incorporate the Frye test, they do require more than relevance. Rule 702 requires reliability as well as relevance; testimony that is relevant but unreliable is inadmissible.[34] This raises the question; what constitutes reliability? In *Daubert*, where all the expert purported to be scientists, the Court turned to science for an answer. Reliable opinions are those that are arrived at using the "methods and procedures of science."[35] In footnote nine the court added that, "In a case involving scientific evidence, evidentiary reliability will be based upon scientific validity."[36]

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[30] Id. at 576.

[31] Daubert v. Merrell Dow Pharmaceuticals, Inc., 951 F.2d 1128 (9th Cir. 1991).

[32] Daubert v. Merrell Dow Pharmaceuticals, Inc., 951 F.2d 1128, 1129-30 (9th Cir. 1991).

[33] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 113 S.Ct. 2786, 2792-93, 125 L.Ed.2d 469 (1993).

[34] 113 S.Ct. at 2795.

[35] Id.

[36]113 S.Ct. at 2795 n. 9. For a discussion of the complex issue of scientific validity in the toxic tort context, see Bert Black, Francisco J. Ayala and Carol Saffran- Brinks,. Science and the Law in the Wake of Daubert: A New Search For Scientific Knowledge,72 *Texas Law Review* 715. (1994); Joseph Sanders, Scientific Validity, Admissibility, and Mass Torts After Daubert, 78 Minn. L. Rev. 1387 (1994).

Daubert did not offer a systematic presentation of what scientists mean when they inquire about validity, but it did offer up 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,[37] 2) the reliability of a procedure and its potential rate of error,[38] 3) whether the theory or technique has been subjected to peer review[39] and whether the results have been published,[40] 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.[41]

In addition, the Court noted that Rule 702 requires that the expert evidence "assist the trier of fact to understand the evidence or to determine a fact in issue." Justice Blackmun said that "This 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."[42] The "fit" requirement involves an assessment of whether the expert's chain of reasoning contains an inferential gap that is too wide.[43]

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[37] 113 S.Ct. at 2796.

[38] 113 S.Ct. at 2796-97.

[39] 113 S.Ct. at 2797.

[40] Id.

[41] Id.

[42] 113 S.Ct. at 2796. (citing United States v. Downing, 753 F.2d 1224,1242 (3d cir. 1985)).

[43] 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

In footnote eight of *Daubert,* the Court expressly limited the holding to scientific evidence.[44]In addition, the opinion made it clear that the four reliability factors: testability, error rate, peer review and publication, and general acceptance, are not exclusive.[45] 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

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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, 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 close 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." 113 S.Ct. at 2797.

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 717, 746 (3d Cir. 1994)

In *General Electric v. Joiner,* 118 S.Ct. 512 (1997), the Supreme Court ratified 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. That is what the District Court did here and we hold that it did not abuse its discretion in so doing." 118 S.Ct. at 518.

[44] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. at 590 n. 8.

[45] Daubert, 509 U.S. at 593, 594 n. 12.

could not agree about the proper role of the *Daubert* factors. Moore v. Ashland Chemical, Inc.[46] provides an instructive example. In *Moore*, the appellant was forced to clean up a spill of solvents inside the back of a truck. The trial judge excluded the causation testimony of one of his experts, a specialist in pulmonary, environmental, and internal medicine, that the one-hour exposure caused the plaintiff to suffer from reactive airways dysfunction syndrome (RADS).[47] The plaintiff appealed, and the Fifth Circuit reversed, ruling that the exclusion was in error.[48] It held that while *Daubert* 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.[49] These criteria should not be used to judge the admissibility of a clinical physician's expert testimony. Rather, that testimony should be judged by the principles and methodology of the field of clinical medicine.[50] After an en banc review, the full circuit

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[46] 126 F.3d 679 (5th Cir. 1997), rehearing en banc granted, opinion vacated, 151 F.3d 269 (5th Cir. 1998).

[47] 126 F.3d at 699.

[48] The appeal followed a trial on the merits. 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. The jury returned a verdict for the defendant, the plaintiff appealed, and the Fifth Circuit panel reversed and remanded. This determination resulted in an order granting a rehearing en banc.

[49] 126 F.3d at 682.

[50] Id. at 701. Some commentators share the view that clinical medical causation testimony should not be covered by the *Daubert* factors See for example, Ellen Relkin, Some Implications of Daubert and its Potential for Misuse: Misapplication to Environmental Tort Cases and Abouse 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

reversed and reinstated the judgement for the defendant.[51] 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.[52]

The proper role of the *Daubert* factors arose in other areas where the expert's testimony is said to rest on "experience." For example, the issue presented itself with respect to forensic testimony in the criminal context[53] and products liability design defect testimony.[54] The Supreme

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> 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."

[51] Moore v.Ashland Chemical, Inc., 151 F.3d 269, 279 (5th Cir. 1998).

[52] Id.

[53] See United States v. Starzecpyzel, 880 F.Supp 1027 (S.D.N.Y. 1995). (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. Because handwriting experts are not scientists, *Daubert's* reliability criteria do not apply.). United States v. Jones, 107 F.3d 1147 (6th Cir. 1997), cert. denied Jones v. United States, 521 U.S. 1127, 117 S.Ct. 2527, 138 L.Ed.2d 1027 (1997). (Agreeing that handwriting experts are not doing science 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.) 107 F.3d at 1160. In the aftermath of Kumho Tire, 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. United States v. Hines, 55 F.Supp.2d 62 (D. Mass, 1999).

[54] Compton v. Subaru of America, Inc., 82 F.3d. 1513 (10th Cir. 1996). is one of several *post-Daubert* opinions holding that the *Daubert* factors are inapplicable in a products liability design defect context. See also, See McKendall v. Crown Control Corp., 122 F.3d 803, 806 (9th Cir. 1997); Talkington v. Atria Reclamelucifers Fabrieken BV, 152 F.3d 254 (4th Cir. 1998). Not every court agreed, however. For example, the Fifth Circuit concluded that the *Daubert* factors

Court finally intervened in this debate in Kumho Tire Co. v. Carmichael.[55]

In July of 1993 eight members of the Carmichael family were involved in a serious automobile accident when the right rear tire of their minivan failed because the tire tread became separated from its inner steel-belted carcass. After the accident, the plaintiffs' expert examined the tire and concluded the failure was not the result of any abuse. He, therefore, concluded the failure was caused by a defect in either the tire's design or its manufacture. Prior to his testimony, the expert became ill and transferred the case to his employee, Dennis Carlson, who reviewed the file and confirmed the initial conclusion. Carlson did not personally examine the tire prior to rendering his opinion and inspected the tire for the first time approximately one hour prior to his deposition by the defendant.[56] The defendant moved to exclude Carlson's testimony because it

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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 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."

Watkins v. Telsmith, Inc., 121 F.3d 984, 990-91 (5th Cir. 1997) (citations and footnotes omitted.) See also Peitzmeier v. Hennessy Industries, Inc., 97 F.3d 293, 297 (8thCir. 1996).

[55] 526 U.S. 137, 119 S.Ct. 1167, 143 L.Ed.2d 238 (1999). Between *Daubert* and *Kumho* the Supreme Court decided General Electric Co. v. Joiner, 522 U.S. 136, 118 S.Ct. 512, 139 L.Ed.2d 508 (1997). In *Joiner* the court concluded that trial court 702 rulings should be reviewed under an abuse of discretion standard.

[56] Carmichael v. Samyang Tire, Inc., 131 F.3d 1433, 1434 (11th Cir. 1997).

could not satisfy *Daubert.* The trial judge agreed and found that, "none of the four admissibility criteria outlined by the *Daubert* court are satisfied in this case."[57] Because the expert testimony was the plaintiff's only evidence of defect, the district judge then granted the defendant a summary judgment.[58] Plaintiff appealed, arguing that the district court should not have applied *Daubert's* reliability framework because Carlson was not a "scientific" expert.[59]

The Eleventh Circuit undertook a *de novo* review of the trial court's decision to apply Daubert and also its decision to exclude the particular evidence under an abuse of discretion standard.[60] The court concluded *Daubert* applies only to scientific testimony, that the Carlsons' testimony was non-scientific, and therefore the district court erred as a matter of law in applying the *Daubert* criteria.[61]

The Eleventh Circuit did declare 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.[62] However, in another part of the opinion the appellate court said, "Thus, 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

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[57] Carmichael v. Samyang Tire, Inc. 923 F.Supp. 1414, 1521 (S.D.Ala. 1996).

[58] 923 F.Supp. at 1524.

[59] Carmichael v. Samyang Tire, Inc., 131 F.3d 1433, 1435 (11th Cir. 1997).

[60] 131 F.3d at 1435.

[61] 131 F.3d at 1435-36.

[62] 131 F.3d at 1436 n. 9.

expect a district court to allow a jury to evaluate)."[63] This sentence suggests a more lenient admissibility standard for non-science experts.

In the event, the trial court never got 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.[64] As to the role of the *Daubert* factors, the Court adopts 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.[65]

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[63] 131 F.3d at 1436.

[64] Kumho Tire Co. v. Carmichael, 526 U.S. 137, 119 S.Ct. 1167, 1179, 143 L.Ed.2d 238 (1999). Justice Stevens dissented to 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. 119 S.Ct. at 1179. (Stevens, concurring in part and dissenting in part.). In Wisgram v. Marley Co., — S.Ct. —, 2000 WL 196662 (U.S.)) the district court entered a judgment on a jury verdict for plaintiff and denied defendants motion for a judgment as a matter of law or a new trial. The Eighth Circuit vacated and directed entry of judgment as a matter of law for manufacturer after concluding the trial court had erred in admitting expert testimony. The plaintiff appealed, arguing the appellate court abused its discretion when it failed to remand the case to the trial court. The Supreme Court held that this was not an abuse of discretion and that appellate courts may direct entry of judgment as a matter of law for verdict loser, upon determining that after the exclusion there is no longer sufficient evidence to sustain the verdict.

[65] 119 S.Ct. at 1171.

Justice Breyer notes that all four of the *Daubert* factors do not necessarily apply even in situations where the reliability of scientific evidence is at issue.[66] A claim may have never been exposed to peer review because the particular issue may have never interested anyone. It would be a mistake, however, to read *Kumho* to say that the trial court may simply ignore the *Daubert* factors in non-science cases. The Court notes that, "a trial court should consider the specific factors identified in *Daubert* where they are reasonable measures of the reliability of expert testimony."[67] In a concurring opinion, Justices Scalia, O'Connor, and Thomas add that the discretion enjoyed by the trial court does not include the discretion to abandon the gatekeeping function or to perform it inadequately. "Though, 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."[68] A trial court that fails to justify its decision not to use *Daubert* factors risks reversal.[69]

The Kumho opinion offers a detailed analysis of the excluded expert testimony. Much of the proffered testimony was the engineering equivalent of a differential diagnosis. As the court noted, the issue is not whether it is ever possible for a tire expert to use visual and tactile inspection methods to determine whether a tire is defective. Rather, it is the specific causation

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[66] 119 S.Ct. at 1175.

[67] 119 S.Ct. at 1176.

[68] 119 S.Ct. at 1179 (Scalia, concurring)

[69] 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.")

question of whether this tire was defective and the reliability of Carlson's methods with respect to the Carmichael tire.[70]

Carlson's theory was that if the vehicle had been overloaded or the tire under inflated this would have led to a phenomenon called "overdeflection." Overdeflection can cause the tire to overheat which in turn can undo the bond that holds the tire tread to the carcass.[71] Carlson described four indicia of overdeflection and adopted the rule that if a tire exhibited two of the four he would say it had been abused.[72] He conceded that the tire did exhibit some of these indicia, but he testified that the symptoms were not significant.

For example, according to Carlson, one of the symptoms of overdeflection is tread wear on the tire's shoulder greater than tread wear along the tire's center. Carlson concluded that there was greater wear on the shoulders, but he also concluded that it was not evenly distributed on both shoulders. Rather, the wear appeared primarily on one shoulder whereas an overdeflected tire would show equal abnormal wear on both.[73] Therefore, this wear was not evidence of

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[70] 119 S.Ct. at 1177.

[71] 119 S.Ct at 1172.

[72] 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.

119 S.Ct. at 1172.

[73] 119 S.Ct at 1173.

overdeflection.

This process of reasoning is not unlike a physician's differential diagnosis testimony excluding other possible causes of a patient's illness. Why wasn't this analysis sufficiently reliable to gain admissibility? Another part of Carlson's testimony provides a partial answer. There he was asked how many miles the tire had traveled prior to the accident. According to the Supreme Court, he "could not say whether the tire had traveled more than 10, or 20, or 30, or 40, or 50 thousand miles, adding that 6,000 miles was 'about how far' he could 'say with any certainty.'"[74] To this, the Supreme Court responds,

> 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.[75]

Although the Supreme Court does not specifically tie its analysis to the *Daubert* factors, the reference to subjectivity suggests that it is questioning the falsifiability and perhaps the error rate

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[74] 119 S.Ct. at 1177.

[75] 119 S.Ct at 1177.

of Carlson's theory. The Court also notes that lack of general acceptance of his specific test, of his decision rule that a tire has not been abused unless it exhibits two of his four overdeflection symptoms, or of an expert's ability to make the very fine distinctions made by Carlson.[76] According to the Supreme 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."[77] In the eyes of the court, Carlson's testimony did not measure up to this standard.[78]

If *Kumho Tire* removed uncertainty about whether the *Daubert* factors *might* apply to differential diagnosis testimony, it settled little else. The *Kumho Tire* opinion self is unclear on some points.[79] Moreover, because both the decision to admit expert testimony and the criteria

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[76] 119 S.Ct. at 1178.

[77] 119 S.Ct. 1176. The "same intellectual rigor" standard first appears in a pair of Seventh Circuit opinions authored by Judge Posner. Rosen v. Ciba-Geigy Corp., 78 F.3d 316, 318 (7th Cir. 1996); Braun v. Lorillard Inc., 84 F.3d 230, 234 (7th Cir. 1996). Post-*Kumho* appellate opinions have been quick to incorporate this standard in their opinions. See e.g. Black v. Food Lion, Inc., 171 F.3d 308, 311 (5th Cir. 1999).

[78] "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, 119 S.Ct. at 1179.

[79] 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

used to make an admissibility decision are to by judged by an abuse of discretion standard on appeal,[80].it is possible we will witness contrary trial court admissibility decisions on similar facts. This is all the more likely because the circuits have themselves taken varying positions about what is required before clinical medical testimony on causation is admissible. In the next section, we review the criteria used by the courts in making their judgments.

D. 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,[81] the court excluded the expert testimony of a physician who claimed he could tell whether the plaintiff's posterior subcapsular cataract was caused by radiation just by looking at it.[82]

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concurring opinion suggests this might be the case, but the court's opinion is ambiguous. If a court does not chose 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. __ Law and Contemporary Problems __ (2000).

[80] General Electric Co. v. Joiner, 522 U.S. 136, 118 S.Ct. 512, 139 L.Ed.2d 508 (1997;. Kumho Tire Co. v. Carmichael, 526 U.S. 137, 119 S.Ct. 1167, 143 L.Ed.2d 238 (1999).

[81] 807 F.Supp. 1376, 1397 (C.D.Ill. 1992).

[82] See also In re Paoli Railroad Yard PCB Litigation, 35 F.3 717, 759 (3d Cir. 1994) ("where a defendant points to a plausible alternative cause and the doctor offers no explanation for why he or she has concluded that was not the sole cause, that doctor's methodology is unreliable."); Heller v. Shaw, 67 F.3d 146, 156 (3d. Cir. 1999); Valente v. Sofamor,48 F.Supp.2d 862, 870 (E.D. Wisc. 1999); Aldridge v. Goodyear Tire and Rubber Co., 34 F.Supp.2d

Moreover, no opinion of which we are aware has concluded that differential etiology, when properly performed, is inadmissible.[83] Here it is useful to follow Professor 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."[84] This formulation is repeated by Judge Becker in *United States v. Downing*.[85] Courts accept the general validity of the technique of differential diagnosis.

It is not sufficient, however for an expert simply to assert 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, i.e., 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 Weinstein excluded the testimony of a doctor who based his diagnosis of the cause of plaintiffs' injury on form statements signed by the plaintiffs in which they indicated that they had been exposed to Agent Orange and then checked off their symptoms.[86] And in Viterbo v. Dow Chemical Co.,[87] the court excluded a doctor's

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1010, 1024 (D.Md. 1999).

[83] See cases discussed in Westberry v. Gislaved Gummi AB, 178 F.3d 257, 263 (4th Cir. 1999).

[84] Paul Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half–Century Later*, 80 COLUM. L. REV. 1197 at 1201 (1980).

[85] 753 F.2d at 1234 (1985).

[86] 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 Hospital Medical Center, 811 F.2d 18, 25 (1st Cir. 1987). (expert cannot rely on consulting doctor's handwritten note when performing a

testimony that the defendant had caused plaintiff's illness because the doctor had relied on a medical history that omitted important information. 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 expert. Without more than credentials and a subjective opinion, an expert's testimony that 'it is so' is not admissible."[88]

This position has continued among post-*Daubert* cases. In In re Paoli,[89] the court affirmed the district court 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."[90] Similar statements can be found in a number of cases up to the present time.[91] For example, in Wooley v.

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differential diagnosis as to the cause of the plaintiff's neurological difficulties following surgery).

[87] 826 F.2d 420 (5th Cir.1987)

[88] Id. at 424.

[89] 35 F.3d 717 (3rd Cir. 1993).

[90] Id. at 762.

[91] 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

Smith & Nephew Richard, Inc.,[92] the court refused to admit the expert's opinion that a pedicle screw implant caused plaintiff's chronic pain in part because the expert failed to interview or examine the patient or considered all of the patient's medical records.[93]

The flip side of this position is that 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: "However, 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."[94] Moreover, most courts would agree with the *Paoli* opinion that a failure to account for all possible causes does not render expert opinion

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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.'"); Pick v. American Medical systems, 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.")

[92] 67 F.Supp.2d 703 (S.D.Tex. 1999).

[93] Wooley, 67 F.Supp.2d 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 Lawson v. Smith and nephew Richards, Inc., 1999 WL 1129677 (N.D.Ga.); Baker v. Smith and Nephew Richards, Inc., 1999 WL 1129650 (N.D.Ga.); Alexander v. Smith & Nephew, P.L.C., 90 F.Supp.2d 1225 (N.D.Okla. 2000); Coleman v. Danek Medical, Inc., 43 F.Supp.2d 637 (S.D.Miss. 1999); Wheat v. Sofamor, 46 F.Supp.2d 1351 (N.D.Ga. 1999); Valente v. Sofamor, 48 F.Supp.2d 862 (E.D.Wisc. 1999); Uribe v. Sofamor, S.N.C., 1999 WL 1129703 (D.Neb.); Schmerling v. Danek Medical, Inc., 1999 WL 712591 (E.D.Pa.). But see Sita v. Danek Medical, Inc., 43 F.Supp.2d 245, 254 (E.D.N.Y. 1999)(expert testimony admissible. Even though report was of dubious reliability; information that screw broke was type of information that physicians would use or believe to be relevant for diagnostic and treating purposes, and case did not involve complex question of medical causation.)

[94] Paoli, 35 F.3d at 717, 758 (3rd Cir. 1993). In many cases, of course, the parties may disagree as to whether standard diagnostic techniques were in fact employed.

based on differential diagnosis inadmissible.[95]

There remains, however, substantial disagreement about what constitutes a reliable differential diagnosis.[96] Two dimensions highlight this disagreement: whether one must "rule in" the putative cause before "ruling out" other causes, and whether temporal order alone (the cause preceded the effect) is sufficient to support the causal attribution.

1. Ruling in before ruling out

In Cavello v. Star Enterprise,[97] 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"

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[95] In re Paoli R.R. Yard PCB Litig., 35 F.3d at 764-65. See Westberry v. Gislaved Gummi AB, 178 F.3d 257, 265-66 (4th Cir. 1999); Heller v. Shaw, 167 F.3d 146, 156 (3d Cir. 1999). Occasionally courts summarily assert that a differential diagnosis is admissible with little discussion of the particular analysis performed by the expert. See for example Wilson v. Petroleum Wholesale, Inc., 904 F.Supp. 1188, 1190 (D.Colo.1995) (two minute exposure to air horn allegedly led to permanent hearing loss and tinnitus. Expert's opinion "is based not only on his extensive training and career in the field of otolaryngology, but also on the time-honored and well-accepted method of differential diagnosis, which is a process whereby practitioners of medical arts elicit symptoms by examination and history and rule out causes until the most probable cause is determined.");

[96] See, for example Glazer v. Thompson Medical Co., Inc. 32 F.3d 969 (6th Cir. 1994).

[97] 892 F.Supp.756 (E.D.Va. 1995, aff'd in part, rev'd in part, 100 F.3d 1150 (4th Cir. 1996).

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.[98]

The "rule in before ruling out" position of *Cavello* presumes that at least in toxic tort cases a differential diagnosis, no matter how well done, can rarely, by itself, prove general causation. The *Cavello* position has been repeated in numerous cases. For example, in Raynor v. Merrell Dow Pharmaceuticals, Inc.,[99] a Bendectin case, the D.C. Circuit compared the present case to its earlier opinion in Ambrosini v. Labarraque.[100] It argued that in the Ambrosini case the, "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."[101] Similar holdings are to be found in Kelley v. American Heyer-Schulte Corp.,[102] Grimes v. Hoffmann-

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[98] 892 F.Supp. 756, 771 (E.D.Va.1995), aff'd in part, rev'd in part, 100 F.3d 1150 (4th Cir.1996).

[99] 104 F.3d 1371, 1376 (D.C.C. 1997).

[100] 101 F.3d 129, 138-39 (D.C. Cir. 1996).

[101] Raynor, 104 F.3d at 1376 (D.C.C. 1997).

[102] 957 F.Supp. 873 (W.D.Tex. 1997) ("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. See Brock v. Merrell Dow, 874 F.2d at 312-13. In the absence of any evidence regarding general causation, the Court will not permit Dr. Espinoza to testify as to specific causation.) Id. at 882.

LaRoche, Inc., [103] Rutigliano v. Valley Business Forms,[104] Hall v. Baxter Healthcare Corp.,[105] In re Breast Implant Litigation,[106] and National Bank of Commerce v. Associated Milk Producers, Inc.[107]

The "rule in" requirement sometimes is presented as a question of dosage. Assuming that

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[103] 907 F.Supp. 33 (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.") Id. at 38.

[104] 929 F.Supp. 779, 783 (D.N.J. 1996).

[105] 947 F.Supp. 1387 (D.Ore. 1996) ("Testimony regarding specific causation in a given patient is irrelevant unless general causation is established.") Id. at 1413.

[106] 11 F.Supp.2d 1217, 1230 (D.Colo 1998) ("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.")

[107] 22 F.Supp.2d 942, 963 (E.D.Ark. 1998), aff'd 191 F.3d 858 (8th Cir. 1999). See also Fadelalla v. Secretary of Health and Human Services, 1999 WL 270423, *5 (Fed.Cl.) (Expert cannot testify as to specific causation between rubella vaccine and Guillain-Barre Syndrome. " Millions of people receive rubella vaccine and yet, although the Centers for Disease Control (CDC) receives vaccine adverse event (VAERs) reports, there has not been a higher incidence of GBS reported among rubella vaccinees than among baseline."); Minnesota Mining & Mfg. Co. v. Atterbury, 978 S.W.2d 183, 193 (Tex.App.1998) (a physician's causation testimony though a differential diagnosis is not sufficient proof of causation unless the physician is able reliably both to rule in certain potential causes and to rule out other potential causes. A treating physician's testimony on specific causation is insufficient "in the absence of any evidence of general causation."); Snyder v. Upjohn Co, 172 F.3d 58 (Table) (9th Cir. 1999)(Text at 1999 WL 77975 (9th cir. Feb. 12, 1999)); Nelson V. American Home Products Corporation, 92 F.Supp.2d 954, 969 (W.D.Mo. 2000).

some dose of the substance in question might cause harm, 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[108] makes this point in the following passage:

> 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.[109]

The Mancuso court rejected the testimony of plaintiff's expert who was prepared to testify that exposure to PCB's caused a variety of injuries. 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. See Federal Judicial Center: Reference Manual on Scientific Evidence, 'Reference Guide on Toxicology,' at 185."[110] As the court noted later in the opinion, the methodology,

> is a three-step procedure: First, the level of exposure of plaintiff to the toxin in question

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[108] 56 F.Supp.2d 391, 403 (S.D.N.Y. 1999).

[109] Id. at 403. Mancuso's expert apparently found that the concentration of PCBs at the plaintiff's marina was four parts in ten billion, lest than one ten-thousandths as high as the level which the EPA has found to be safe. Id. at 404.

[110] 56 F.Supp.2d 391, 394-95 (S.D.N.Y. 1999).

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 this particular plaintiff's illness, which involves weighing the possibility of other causes of the illness--a so-called 'differential diagnosis.'"[111]

Similar positions can be found in Mitchell v. Gencorp Inc.,[112] Moore v. Ashland Chemical Inc.,[113] Cuevas v. E.I. DuPont de Nemours & Co.,[114] Cartwright v. Home Depot U.S.A., Inc.,[115] and

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[111] Id. at 399.

[112] 165 F.3d 778, 781 (10th Cir. 1999) (It is well established that a plaintiff in a toxic tort case must prove that he or she was exposed to and injured by a harmful substance manufactured by the defendant. In order to carry this burden, a plaintiff must demonstrate "the levels of exposure that are hazardous to human beings generally as well as the plaintiff's actual level of exposure to the defendant's toxic substance before he or she may recover." Wright v. Willamette Industries, Inc., 91 F.3d 1105, 1106 (8th Cir.1996)

[113] 151 F.3d 269, 278 (5th Cir. 1998) ("Dr. Jenkins offered no scientific support for his general theory that exposure to Toluene solution at any level would cause RADS.") Compare Curtis v. M & S Petroleum, Inc., 174 F.3d 661, 670 (5th Cir. 1999) ("We conclude that the district court correctly determined that Dr. Stevens had adequate support for his general causation opinion that exposure to benzene at levels of 200-300 ppm would cause the injuries suffered by Plaintiffs.")

[114] 956 F.Supp. 1306, 1312 (S.D.Miss 1997).

[115] 936 F.Supp. 900, 904 (M.D.Fla. 1996).

Savage v. Union Pacific Railroad Co.[116] In Lakie v. Smithkline Beecham,[117] on the other hand, the court concluded that the plaintiff's expert's estimate of her level of exposure to benzene was grounded on verifiable information regarding the benzene content in the defendant's product and, therefore, the expert's opinion was admissible.

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*, the district court in Becker v. National Health Products, Inc.,[118] permitted physicians to testify that Hot Stuff "anabolic activator" caused diverticulosis and diverticulitis, based primarily on differential diagnosis even though the court noted 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."[119]

If other evidence proving general causation is a perquisite for differential diagnosis

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[116] 67 F.Supp.2d 1021, 1033-34 (E.D.Ark, 1999)("[P]laintiff has produced no scientific data showing the nature of creosote exposure required to initiate or promote the development of basal cell carcinoma. Nor has he shown the level of such exposure needed to cause such skin cancer in humans generally. Nor does he show with any degree of scientific reliability the level of his own exposure.")

[117] 965 F.Supp. 49, 58 (D.C. 1997)

[118] 896 F.Supp. 100, 102 (N.D.N.Y.1995)

[119] Id. at 102. See also McCullock 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").

testimony, the appellate court in Kannankeril v. Terminix International, Inc.,[120] 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. The plaintiff claimed to be suffering from a wide range of ailments due to exposure to Dursban, including memory loss concentration loss, sleeplessness, general anxiety, headaches, numbness, muscle twitching, pain in joints, nausea, and skin rashes. Her expert was a toxicologist who concluded her injuries were caused by Dursban even though the evidence on the dosage received by the plaintiff was quite limited, the expert performed no clinical tests to support his causal opinion, and the only blood test conducted on the plaintiff was negative for Dursban..

In Westberry v. Gislaved Gummi,[121] the plaintiff's expert testified that his exposure to airborne talc in the workplace caused the aggravation of his pre-existing sinus condition. 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."[122] 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.

Finally, in Heller v. Shaw,[123] the plaintiff claimed her respiratory illnesses were caused by

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[120] 128 F.3d 802 (3d Cir. 1997),.

[121] 178 F.3d 257 (4th Cir. 1999) .

[122] Id. at 264.

[123] 167 F.3d 146 (3d. Cir. 1999).

volatile organic compounds emitted from new carpet installed in her home. Judge Becker specifically rejected the requirement that plaintiff's expert must always cite published studies on general causation to reliably conclude that a particular object caused a particular illness.[124] In Heller, the court seems to assume that there was no research at all on the general causation question.

2. Temporal Order

The question of general causation aside, there remains the difficult question of what differential diagnosis evidence the expert must present in order to present an admissible specific causation argument. Disagreements on this question are most evident in cases that discuss whether temporal order alone, i.e. the injury followed the exposure, is sufficient to rule out other possible causes.[125]

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[124] 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 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.

[125] 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 most well 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? Because experiments randomly assign people to treatments, they control for many unknown systematic threats to validity. Ceteris paribus, experimental data is more persuasive than other types of data.
3. Is the association a strong one? The stronger the association the more likely the relationship is causal.
4. Is the association consistent from study to study?
5. Is there a dose-response gradient? In animal studies, especially, the causal argument is strengthened if higher doses of a substance produce more injury.
6. Is the association specific? For example, exposure to asbestos produces the specific disease asbestosis.

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.[126] Statements to this effect may be found in a number of swine flu cases from the early 1980s: Hasler v. United States,[127] In re Swine Flu Immunization Products Liability Litigation (Bean) v. United States.[128]

Post-*Daubert* opinions that apply the *Daubert* factors to the case frequently take the

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7. Does the association make biological sense? For example, if a drug such as Bendectin is to cause harm to the fetus it must be shown that it can cross the placental barrier, which in fact it can.
8. Is there appropriate analogy to other known causal relationships?

Andrew C. Harper and Laurie J. Lambert, The Health of Populations: An Introduction. pp 92-95. New York: Springer (1994).

[126] This is not to say that temporal order is irrelevant to a causal analysis. See for example, In re Swine Flu Immunization Products Liability Litigation (Unthank) v. United States, 533 F.Supp. 703, 714 (D.Utah 1982) ("There are two reasons for our conclusion that plaintiff's transverse myelitis was caused by the swine flu vaccine. First, the process of reasoning by which Drs. Poser and Petajan supported their opinions persuades us that their opinions are entitled to greater weight. Both conducted a neurological examination of plaintiff as well as taking independent medical histories. They arrived at the swine flu vaccine as the cause of her transverse myelitis after ruling out all other possible etiologies. Second, 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).")

In Heller v. Shaw, 167 F.3d 146 (3d. Cir. 1999), 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 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.

[127] 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 despite close temporal connection)

[128] 533 F.Supp. 567, 581 (D.Colo. 1980) (temporal relationship insufficient to establish a relationship between Swine Flu vaccine and drop foot).

position that such testimony should be excluded for lack of reliability, Porter v. Whitehall Laboratories, Inc.,[129] Conde v. Velsicol Chemical Corp.[130] The following passages are typical of the reason given for exclusion.

> "Dr. Winters (and Dr. Shalat) propound the argument that because [acute lymphocytic leukemia] 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."[131]

> "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

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[129] 9 F.3d 607, 611 (7th Cir.1993) (expert testimony of two doctors excluded where their opinions were based solely on the temporal relationship between the ingestion of ibuprofen and injury).

[130] 804 F.Supp. 972, 1023 (S.D.Ohio 1992), aff'd., 24 F.3d 809 (6th Cir.1994) (expert testimony based solely on a temporal relationship between exposure to insecticide and injury excluded where there was no medical evidence of causation).

[131] Whiting v. Boston Edison Co., 891 F.Supp. 12, 23 n. 52 (D. Mass. 1995).

FED.R.EVID. 702."[132]

"[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."[133]

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.[134]

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[132] Schmaltz v. Norfolk & Western Railway Co., 878 F.Supp. 1119, 1122 (N.D.Ill (1995).

[133] Kelly v. American Heyer-Schulte Corp., 957 F.Supp. 873, 882 (W.D. Tex. 1997)

[134] Nelson v. American Home Products Corp., 92 F.Supp.2d 954, 971 (W.D.Mo. 2000). See also Cuevas v. E.I DuPont de Nemours & Co., 956 F.Supp. 1306, 1312 (S.D.Miss. 1997). ("Many times in his report and in his deposition 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,

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.

In Kannankeril v. Terminix International, Inc,[135] homeowners sued pest exterminator for a wide ranging set of cognitive impairment injuries to Dr. Mary Kannankeril[136] allegedly arising out of application of the pesticide Dursban at their residence. The plaintiff's symptoms began approximately one year after the beginning of the Terminix service. After an application that

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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."); In re Breast Implant Litigation, 11 F.Supp.2d 1217, 1232 (D.Colo. 1998). ("Plaintiffs' experts assert that causation may be inferred based upon the temporal sequence of implantation and the onset of illness. A temporal relationship by itself, provides no evidence of causation.... Even as to specific causation, temporality cannot withstand Daubert scrutiny.");Valente v. Sofamor, S.N.C., 48 F.Supp.2d 862, 872 (E.D. Wisc. 1999) ("Certainly, Dr. Trobiani does not have to consider every factor within the realm of possibility that might have caused the plaintiff's pain to increase, but some statement regarding why the pedicle screw likely caused the plaintiff's pain is necessary to establish the reliability of his opinion. Instead, Dr. Trobiani's simply assumes that if A occurred before B, then A must have caused B. Such reasoning cannot qualify as expert testimony."); Willert v. Ortho Pharm. Corp., 995 F.Supp. 979, 981-82 (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.").

[135] 128 F.3d 802 (3d Cir. 1997).

[136] These include memory loss, concentration loss, sleeplessness, headaches, insomnia, numbness, muscle twitching, pain in muscles and joints, nausea, skin rashes, and depigmentation patches throughout her body. Id. At 805, n. 3.

produced objectionable odors, the defendant sent a company to clean the residence. Some nine months later the plaintiffs asked the New Jersey Department of Environmental Protection to test their home. An analysis of air samples taken at that time failed to find detectable levels of pesticides. Apparently, the plaintiff's symptoms did not abate after applications ceased. [137] Plaintiff's expert, Dr. Benjamin Gearson testified that, "The 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 1989 to 1990."[138]

The trial judge excluded the plaintiffs' medical expert and granted defendant a summary judgment. The Third Circuit vacated and remanded. Dr. Gearson did not rule out other possible causes of the plaintiff's illness, but the appellate court noted that the defendant did not point to another plausible cause. Although the court notes that the defendant is not obligated to offer alternative theories of causation, its failure to do so seemingly relieved the expert from doing so on his own. Temporal order seems to have been the primary reason for the expert's opinion.

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[137] "Dr. Kannankeril allegedly developed chronic toxicity related to exposure to chlorpyrifos and became sensitized to multiple other chemicals so that further exposure to organophosphates would result in disabling physical problems. As a result of her ill health, she gave up her hospital position in March, 1993, and now sees patients only in an office at home." Id. at 805.

[138] Id. at 805/ According to the Third Circuit, Dr. Grearson based his opinion on 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. Id. at 806. The report by the neuropsychologist, Dr. Grober, included the results of a blood test, the chloinesterase blood test, that is the most accepted test for determining exposure to Dursban. The test did not produce abnormal results. Id. at 807.

In Westberry v. Gislaved Gummi AB,[139] the Fourth Circuit affirmed the trial judge's decision to permit an expert to testify that exposure to airborne talc caused the aggravation of his the plaintiff's pre-existing sinus condition. 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 nearly entirely on the temporal order of events. The court replied that "depending on the circumstances, a temporal relationship between exposure to a substance an the onset of a disease or worsening of symptoms can provide compelling evidence of causation."[140] It believed that this was such a case partly because the expert testified that when the plaintiff stayed home from work his sinus condition improved.[141]

In Curtis v. M&S Petroleum, Inc.,[142] refinery workers brought an action against defendants for health problems caused by exposure to excessive amounts of benzene. There was little doubt that exposure to benzene at levels present in the plant can cause injuries similar to those suffered by the plaintiffs. Id. at 669. In addition to this general causation evidence, the

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[139]178 F.3d 257 (3d Cir. 1999).

[140] Id. at 265.

[141] "Here, Dr. Isenhower testified that Westberry's sinus disease began shortly after Westberry began working as a gasket cutter. Furthermore, during the time he was treating Westberry, Dr. Isenhower experimented with keeping Westberry out of work and noticed that his sinus condition improved when he was not working but worsened when he returned. Under these circumstances, we conclude that the temporal relationship between Westberry's exposure and the onset and worsening of his sinus disease provided support for Dr. Isenhower's opinion that talc was the source of the problem." Id. at 265.

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 proximatedly caused the aggravation of his pre-existing sinus condition." Id at 260.

[142] 174 F.3d. 661 (5th Cir. 1999).

expert pointed to the strong temporal connection between the workers' exposure to benzene and the onset of their symptoms. However, he did not undertake a differential diagnosis. For this reason, the trial judge refused to admit his testimony. The Fifth Circuit reversed on this point. On the question of specific causation the court said,

> 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.[143]

Recently, in Cooper v. Nelson,[144] the Seventh Circuit reversed a district court judge's exclusion of plaintiff's experts who were prepared to testify that the plaintiff's fall at a construction site caused his chronic pain syndrome. The trial judge refused to admit the testimony because each physician relied on the plaintiff's statements about his past medical history as the basis for a diagnosis that the fall caused his CPS. It concluded the experts had no

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[143] Id at 670.

[144] 211 F.3d 1008 (7th Cir. 2000).

scientific basis for their testimony.[145]

One expert, "said that, based on Mr. Cooper's statement that he had been free of pain before the fall, the pain was caused by the fall. Dr. Richardson also explained that the cause of Mr. Cooper's trauma was irrelevant to him in prescribing a course of treatment and that, therefore, he did not inquire further as to the cause of Mr. Cooper's CPS."[146] On cross examination the defendant elicited testimony that Dr. Richardson had really done no investigation into the cause of the plaintiff's pain. Nevertheless, with respect to the defendant's argument that the expert's post hoc, propter hoc determination of causation was not an acceptable methodology in cases where the mechanism of injury ins not understood, the appellate court concluded that this goes to the weight of the medical testimony and not its admissibility.[147]

E. Understanding the Differences

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

1. Non-causal considerations

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[145] Id. at 1019.

[146] 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, i.e. chronic musculoskeletal pain. He was much less interested in differential etiology, i.e. the cause of the pain.

[147] Id. at 1020-21.

Part of the different results in these cases should be laid to the feet of non-causal considerations. 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.[148] With respect to the admissibility of expert testimony, this has meant that judge have been more willing to limit party control of the evidence that gets to the jury.[149] 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 described the *Daubert* criteria as more in tune with the liberal admissibility thrust of the Federal Rules.[150] The higher threshold reflects this trend. Not every court is equally committed to a less adversarial style, however. The Third and Fourth Circuits have been more solicitous toward jury decision making and adversarial processes than have some other Circuits, notably the Fifth. This non-causal consideration undoubtedly plays some role in explaining the differences we observe in differential diagnosis admissibility decisions.

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[148]On this point 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).

[149] A number of recent law review articles have discussed this shift in the balance between judge and jury. See 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); 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); Harvey Brown, Procedural Issues Under Daubert, 36 Hous. L. Rev. 1133 (1999).

[150] Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 588, 113 S.Ct. 2786, 2794, 125 L.Ed.2d 469 (1993).

2. 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 causal information available. The opinions that require the expert to "rule in before ruling out" are, in our opinion, correct. However, some of the courts that have used language which appears to retreated from this requirement have addressed fact patterns where there is some evidence of general causation. This is clearer in cases such as *Westberry* where the issue was one of dosage as much as whether even very heavy concentrations of talc might cause injury.

Other cases appear to relax plaintiff's burden on this issue when the court believes there is little or no information either way as to whether a substance causes injury. Thus in *Heller*, Judge Becker does not say that the plaintiff must not rule in the alleged cause, only that the expert is not required to cite published studies addressing general causation.[151] In this regard,

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[151]167 F.3d at 155. 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." Cavallo v. Star Enter., 892 F.Supp. 756, 774 (E.D.Va.1995), aff'd in relevant part, 100 F.3d 1150, 1159 (4th Cir.1996), cert. denied, --- U.S. ----, 118 S.Ct. 684, 139 L.Ed.2d 631 (1998).

"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.

Unfortunately, Judge Becker leaves us with the suggestion that what distinguishes these

Judge Calabresi's opinion in Zuchowicz v. United States[152] is instructive. In *Zuchowicz*, the plaintiff's wife died from a fatal lung condition allegedly caused by the drug Danocrine. Mrs. Zuchowicz was negligently prescribed an overdose of the drug which she took daily for over a month. She continued taking the correct dosage of the medication for another two months, when due to adverse symptoms she as advised to cease. According to the plaintiff's experts, because of the rareness of primary pulmonary hypertension and the lack of any formal research on the effects of the drug at this dose rates, they could not point to specific research supporting their differential diagnosis that the drug caused the decedent's illness. However, they could point to studies showing other agents such as birth control pills, some appetite suppressants, and chemotherapy drugs that cause this illness. In support of the decision to affirm the trial court's decision to admit the testimony, Judge Calabresi noted the experts were able to provide a biologically plausible reason why the drug could cause this effect.[153]

If the plaintiff were always required to present substantial epidemiological or animal study data indicating adverse health effects from a given dose of a substance, in many situations this would constitute an insurmountable burden. In both *Heller* and *Zuchowicz*, the court has implicitly recognized this fact and allowed the plaintiff to proceed with relatively less evidence

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two cases is the strength of the temporal order. However, this alone 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 the both cases is a lack of proof of general causation. If Judge Becker were to be told that the chemical X the plaintiff was doused with in the second situation was a very very weak solution, presumably temporal order alone would not suffice.

[152] 140 F.3d 381 (2d Cir. 1998).

[153] Id. at 387.

than would be required if there were a substantial body of research. In this respect, they conform to Gerald Boston's observation that courts have frequently relaxed plaintiff's obligation to produce hard science on general causation for injuries that may be placed in the "sporadic accident model of tort law."[154] In these cases, where only a single plaintiff or a few plaintiffs have allegedly suffered an injury due to some exposure, a medical doctor will be permitted to render an opinion as to general causation with little or no epidemiological evidence, and sometimes with very little toxicological evidence.[155] Examples of such cases include, specific medical treatments such as was the case in *Zuchowicz*, and nonrecurring occupational diseases that affect a limited number of individuals such as *Heller*.[156] However, courts have not been willing to go further than this and adopt the proposals of some commentators that argue in situations of irreducible causal uncertainty the plaintiff should be relieved of the burden of persuasion on the causal question or should be permitted some percentage recovery even in the absence of causal

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[154] 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).

[155] Lakie v. Smithkline Beecham, 965 F.Supp. 49, 56 (D.C. 1997) (benzene in denture adhesive allegedly 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. For one, MDS 5 q-minus has not been included in any of the epidemiological studies on benzene exposure. Furthermore, MDS and MDS 5-q minus have only recently been identified as separate medical conditions.")

[156] See McCullock v. H.B. Fuller Co., 61 F.3d 1038 (2d Cir.1995)(glue fumes allegedly causing throat polyps); Kennedy v. Collagen Corp., 974 F.2d 1342 (9th Cir.1992), cert. denied, 509 U.S. 923, 113 S.Ct. 3037, 125 L.Ed.2d 724 (1993) (collagen allegedly causing systemic immunological injuries); Becker v. National Health Prod., Inc., 896 F.Supp.100 (N.D.N.Y.1995) (Hot Stuff "anabolic activator" allegedly caused diverticulosis and diverticulitis).

evidence.[157] 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 proof. Even under a relaxed standard it is difficult to square the opinions in *Becker*[158] and *Kannankeril*[159] with the requirement that the plaintiff must rule in the alleged cause before ruling out other potential causes.

Assuming 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.[160] Here multiple defendants simultaneously developed similar health problems after exposure to levels of benzene known capable of producing these types of injuries. The very existence of multiple defendants tends to rule out other causes that are not job related. Moreover, the similar to those a substantial workers. Moreover, the injuries were contemporaneous with the introduction of benzene into the workplace and abated within two weeks after the defendants left the refinery.[161] The inference to be drawn from "mere" temporal order is much stronger here than in other situations and is closer to the classic slip-and-fall scenario where temporal order alone frequently suffices.[162]

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[157] See Heidi Li Feldman, Science and Uncertainty in Mass Exposure Litigation, 74 Tex. L. Rev. 1 (1995)

[158] 896 F. Supp. 100 (N.D.N.Y. 1995)

[159] 128 F.3d. 802 (3d Cir. 1997).

[160] 174 F.3d 661 (5th Cir. 1999).

[161] 174 F.3d at 670.

[162] 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.

Black v. Food Lion, Inc.,[163] an actual slip-and-fall case, ironically presents a fact pattern at the other end of the spectrum. Black slipped on mayonnaise in defendant's store. She immediately complained of lower back and arm pain, a headache and dizziness. Over several months she underwent numerous tests but her treating physician could not identify a physical basis for plaintiffs continued complaints of pain.[164] She was referred to another physician who specializes in treating patients with persistent pain. After several weeks of treatment this physician, Dr. Reyna, diagnosed the plaintiff with a condition known as fibromyalgia syndrome, which is characterized by complaints of generalized pain, poor sleep, an inability to concentrate, and chronic fatigue.[165] The condition is most common among women between 30 and 50 and is often associated with hormonal problems. According to the Fifth Circuit, "Dr. Reyna hypothesized that the fall at Food Lion caused physical trauma to Black, which caused 'hormonal changes,' which caused Black's fibromyalgia."[166] The case was removed to a federal court and tried to a magistrate who, over defense objections, permitted Dr. Reyna to testify and based on the testimony awarded a judgment to the plaintiff.[167]

In reversing with respect to the fibromyalgia damages, the Fifth Circuit acknowledged the utility of the differential diagnosis process but noted that under *Daubert, Kumho Tire,* and *Moore*

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[163] 171 F.3d 308 (5th Cir. 1999).

[164] Id. at 309.

[165] Id. at 309.

[166] Id. at 309.

[167] Id at 310.

it must be applied fact-specifically in each case.[168] With respect to this specific differential diagnosis, the Fifth Circuit made the following observation:

> [The magistrate judge] 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. This is not an exercise in scientific logic but in the fallacy of post-hoc propter-hoc reasoning, which is as unacceptable in science as in law. By the same "logic," Dr. Reyna could have concluded that if Black had gone on a trip to Disney World and been jostled in a ride, that event could have contributed to the onset of fibromyalgia....
>
> 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.[169]

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[168] 171 F.3d at 314.

[169] Black, at 313-314.

In sum, although the expert purported to perform most of the steps required of a differential diagnosis, the Fifth Circuit found that her actual analysis was little more than generalities.[170] Although falls may be a cause of fibromyalgia, it is not clear that they are a typical or frequent cause. This becomes particularly important when, as is the case here, we cannot assume that most causes of an ailment are known. Otherwise, as Susan Poulter notes,[171] the elimination of other risk factors would not significantly increase the likelihood that the exposure was the cause of the plaintiff's injury.[172] In such situations, one cannot make a Sherlock

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[170] "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.

[171] Susan R. Poulter, Science and Toxic Torts: Is There A Rational Solution to the Problem of Causation? 7 High Tech. L. J. 189, 233 n. 209 (1993)

[172] A similar point is made by Judge Boggs in dissent in Glazer v. Thompson Medical Co., Inc., 32 F.3d 969 (6th Cir. 1994) (reversing a district court decision to grant defendant a 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 (that is, not just Dexatrim, but also such medications as Contac and Dimetapp) and have no other strong organic reason for a faint...
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> 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 random havoc. This belief is not supported by the scientific studies he refers to. Nevertheless, he believes and is willing to testify that an adverse effect following the condition is caused by the condition, and he minimizes very obvious alternative explanations.
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> 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. The trial judge in this case did exactly what he should have done in his 'gatekeeping role' by taking such a hard look. His actions warrant praise, not reversal.

Id. at 982.

Holmes-like logical deduction that once all other causes have been eliminated, whatever is left, no matter how improbable, must be the cause. From this perspective, the outcome in *Cooper v. Nelson*[173] is more difficult to justify. Perhaps it should be understood as an opinion reflecting a stronger commitment to jury decision making.

3. Style of reasoning adopted by the expert.

The district court in Sanderson v. International Flavors and Fragrances, Inc.,[174] makes explicit a point that is often implicit in other opinions. 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.[175]

The court rejected this argument. In a case that requires expert testimony on causation, neither the plaintiff nor the plaintiff's experts[176] may rely exclusively on the common-sense causal

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[173] 211 F.3d 1007 (7th Cir. 2000).

[174] 950 F.Supp. 981 (C.D.Cal. 1996). Sanderson claimed that exposure to defendants' fragrance products caused her toxic encelopathy, chronic nasal problems, or small airways disease. Id. at 988.

[175] Id at 985.

[176] 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.

conclusion that arises from temporal order. 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 plaintiff's injuries."[177] The court concluded that this is not a 'scientific connection' and the expert's testimony does not meet the *Daubert* standard.[178]

What, from the court's perspective, is wrong with "common sense" in this context? The answer it seems is that approach is not "scientific." In *Sanderson* as in other cases discussed above the court criticize experts for failing to take a "scientific approach." Of course, the line between scientific and other opinions is not a bright. Dual-process theory in social psychology gives us some insights as what the courts have in mind. This body of research argues that individuals have two systems for processing information.[179] Experiential processing is more holistic, tends to be outcome oriented and tends to represent events as concrete exemplars. Rational processing, on the other hand, is more analytic, relies more on abstract symbols, is process oriented.[180] By and large, science is more committed to rational than experiential

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[177] Id at 999-1000.

[178] Id.

[179] These types go by a number of different names: experiential vs. rational; associative vs rule based; heuristic vs. systematic. See Shelly Chaiken and Yaacof Trope (eds.) Dual Process Theories in Social Psychology. New York: The Guilford Press (1999).

[180] See Seymour Epstein and Rosemary Pacini, some Basic Issues Regarding Dual-Process Theories from the Perspective of Cognitive-Experiential Self- Theory. p. 466 in Shelly Chaiken and Yaacof Trope (eds.) Dual Process Theories in Social Psychology. New York: The

processing of information. When courts object that an approach is insufficiently scientific they often seem to be suggesting it is insufficiently rational in this sense. Judges find less acceptable those expert judgments that rely to a greater extent on the expert's intuition[181] and professional judgment,[182] i.e. those judgements that reflect a greater degree of experiential processing.[183]

Guilford Press (1999). For a fuller discussion of expert testimony from the point of view of dual process theories see Joseph Sanders, Kumho and How We Know. (unpublished ms. 2000).

[181] Cartwright v .Home Depot U.S.A., Inc., 936 F.Supp. 900, 907 (M.D.Fla. 1996) ("Plaintiffs' claim that they suffer from asthma caused by exposure to latex paints. The conclusionary opinions supporting this contention proffered from their expert witnesses are based on post hoc reasoning, intuition and speculation.")

[182] In re Breast Implant Litigation, 11 F.Supp.2d 1217, 1230 (D.Colo. 1998) ("Plaintiffs' experts rely on their individual clinical experience of seeing many patients with silicone breast implants and their review of the medical literature to opine that silicone breast implants cause disease. Such experience is the equivalent or a series of case reports, or observations made about a particular patient. Case reports can give rise to a question about causation; epidemiology answers the question.")

[183] 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).There, the court said of plaintiff's engineer, "In the case at hand, Willis was prepared to testify that the corn head was unreasonably dangerous because it lacked awareness barriers. However, Willis has not attempted to construct or even draw the suggested device, much less test its utility as a safety device or its compatibility with the corn head's proper function. . . We therefore hold that the district court did not abuse its broad discretion in concluding that the proffered testimony regarding the lack of awareness barriers flunked the reliability prong of *Daubert*.." Id. at 1083–84. From the perspective taken here, one could say that what was wrong with the expert's testimony is that it was too holistic, associational, and subjective. It looked at a single facet of the product and a single outcome without examining the many other variables that may play a role in deciding whether this was a superior alternative feasible design.

Interestingly, in a recent article Henderson and Twerski, the reporters for the Restatement (Third) of Torts: Products Liability argue for the superiority of a risk utility test of design defect because the alternative consumer expectation test relies too heavily on intuitive analysis to resolve the causal question. James A. Henderson and Aaron D. Twerski, Intuition and Technology in Product Design Litigation: An Essay on Proximate Causation. 80 Geo. L.J. 659 (2000).

Here we see the impact of *Daubert*, *Kumho Tire*, and a decade and more of post-*Frye* jurisprudence. At bottom, the *Daubert* revolution is about the relationship between law and science. *Frye* asked judges to acquiesce to 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. *Daubert* on the other hand, invites the trial court to make an independent inquiry. The judge should determine whether the proffered evidence is reliable by examining the reasoning and methodology underlying the expert's testimony.[184] As Michael 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."[185] In figuring it out for themselves, judges have moved steadily toward the interpretative practices of science.[186] Those practices, that is the generally accepted types of arguments and data interpretation that define the

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[184] 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.

[185] Michael J. Saks, Merlin and Solomon: Lessons from the Law's Formative Encounters with Forensic Identification Science, 49 Hastings L. J. 1069, 1139 (1998).

[186] 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.

Goldman, Alvin I. *Knowledge in a Social World*. p. 250. Oxford: Clarendon Press (1999).

interpretative community of science, typically involve rational processing.[187] In this area at least, the interpretative communities of science and law have tended to converge.[188] By its refusal to distinguish between scientific experts and other experts, *Kumho Tire* has reinforced this movement in areas such as differential diagnosis.

For an example of a case where style of reasoning arguably made a difference in an otherwise difficult causal argument might consider the testimony of the experts in *Zuchowicz.*[189]

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[187] We do not mean to suggest that there is only one scientific interpretative community. At a philosophical and sociological level, there is much disagreement about how scientists know. Moreover, there is variation in normal practice across disciplines. 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 Martin Curd and J.A. Cover (eds.) Philosophy of Science: The Central Issues. New York: W.W. Norton & Co. (1998); David Papineau (ed.) *The Philosophy of Science*. Oxford: Oxford University Press. (1996); Stephen Cole, *Making Science: Between Nature and Society.* Cambridge, MA: Harvard University Press (1992).

[188] The idea of interpretative 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. Durham, NC: Duke U. Press (1989).

[189] 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.
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> 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

Their conclusion is to a very substantial degree based on temporal order. But it also is fully within the rational processing style. It is analytic, it relies more on abstract symbols, and it is process oriented. Both the trial court and the Second Circuit found it to be admissible.

If our argument is correct, then testimony that is both in a rational processing style and is also 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

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> hypertension.
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> 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.
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> 2. Dr. Tackett
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> 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.

Zuchowicz, 140 F.3d at 385-86

contingent on the existence of research done and presented in this way. In this sense style and substance are inevitably intertwined.

F. Conclusion

This essay has focused on one of the more difficult causal issues in tort today, the proof of specific causation in toxic tort suits. Typically, plaintiffs experts attempt this proof through a process 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 that are 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 expert presented the evidence.

We believe 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. But we believe it is also because courts have become more demanding in the sense that they require better science before admitting the testimony. Justice Cornyn was right to be concerned in *Robinson*. With respect to harm to both plants and people, plaintiffs are held to a more rigorous standard.

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 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 and 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.