

Expert Information and Expert Evidence: A Preliminary Taxonomy

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I. INTRODUCTION

Federal Rule of Evidence 702 speaks in very general terms. It governs every situation in which “scientific, technical or other specialized knowledge will *assist* the trier of fact,” and provides that, in that situation, “a witness *qualified* as an expert by knowledge, skill, experience, or education, may testify thereto in the form of an opinion or otherwise”¹ In 2000, following a trio of Supreme Court cases interpreting Rule 702, the Rule was amended to include a third requirement, in addition to the helpfulness of the testimony and the qualifications of the witness: *reliability*. Under Rule 702 as amended, a qualified witness may only provide expert testimony “if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of *reliable* principles and methods, and (3) the witness has applied the principles and methods *reliably* to the facts of the case.”²

In the wake of that trio—*Daubert v. Merrell Dow Pharmaceuticals, Inc.*,³ *General Electric Co. v. Joiner*,⁴ and *Kumho Tire Co. v. Carmichael*⁵—

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¹ FED. R. EVID. 702 (emphasis added).

² *Id.* (emphasis added).

³ 509 U.S. 579 (1993).

⁴ 522 U.S. 136 (1997).

⁵ 526 U.S. 137 (1999).

we have all tended to focus our attention on the third and most recent of these requirements for expert evidence: reliability. Literally thousands of pages have been written about both the proper criteria for evaluating the reliability of expert evidence and the institutional competence of judges to evaluate scientific reliability.⁶ Moreover, since Rule 702 is a rule of admissibility, commentators write and talk about reliability primarily as a threshold question: is the evidence reliable enough to be admissible? That question, naturally, is only interesting in cases in which the expert evidence seems to be comparatively unreliable—as that term is understood and applied—and therefore potentially inadmissible. In each of this trilogy of leading cases, for example, the expert evidence at issue was excluded at trial as unreliable, and in each case the exclusion was affirmed.⁷

Many have suggested that the problem of assessing reliability is especially acute with respect to non-scientific expert evidence.⁸ At

⁶ A number of commentators have addressed this issue. See, e.g., Erica Beecher-Monas, *A Ray of Light for Judges Blinded by Science: Triers of Science and Intellectual Due Process*, 33 GA. L. REV. 1047 (1999); Scott Brewer, *Scientific Expert Testimony and Intellectual Due Process*, 107 YALE L.J. 1535 (1998); Judge Harvey Brown, *Eight Gates for Expert Witnesses*, 36 HOUS. L. REV. 743 (1999); Daniel J. Capra, *The Daubert Puzzle*, 32 GA. L. REV. 699 (1998); David L. Faigman et al., *Check Your Crystal Ball at The Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying About the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799 (1994) [hereinafter Faigman et al., *Check Your Crystal Ball*]; David L. Faigman et al., *How Good is Good Enough?: Expert Evidence under Daubert and Kumho*, 50 CASE W. RES. L. REV. 645 (2000) [hereinafter Faigman et al., *How Good is Good Enough*]; Edward J. Imwinkelried, *Should the Courts Incorporate a Best Evidence Ruling into the Standard Determining the Admissibility of Scientific Testimony?: Enough Is Enough Even When It Is Not the Best*, 50 CASE W. RES. L. REV. 19 (1999); *Developments in the Law—Confronting the New Challenges of Scientific Evidence*, 108 HARV. L. REV. 1481 (1994).

⁷ See *Kumho Tire*, 526 U.S. at 158 (upholding trial court's exclusion of plaintiff's tire safety expert as unreliable); *Joiner*, 522 U.S. at 143 (finding trial court's exclusion of plaintiff's expert evidence on causation within judge's discretion); *Daubert*, 509 U.S. at 583-84 (vacating the lower court's exclusion of plaintiff's expert evidence and establishing that "general acceptance" is no longer the proper standard for admissibility); *Daubert v. Merrell Dow Pharm., Inc.*, 43 F.3d 1311, 1322 (9th Cir. 1995) (excluding plaintiff's expert testimony on causation on remand from Supreme Court).

⁸ *Daubert* offers a flexible set of guidelines for judges to examine when assessing the reliability of scientific expert evidence—testability, error rate, the existence of standards, peer review—and general acceptance. *Daubert*, 509 U.S. at 593-95. *Kumho Tire* holds that a judge *may* consider these criteria when evaluating nonscientific expert evidence, but emphasizes that this "list of specific factors neither necessarily nor exclusively applies to all experts or in every case." *Kumho*, 526 U.S. at 141. While granting the trial judge "considerable leeway in deciding in a particular case how to go about determining whether particular expert testimony is reliable," the opinion offers no concrete guidance on how to do this apart from using the *Daubert* factors beyond noting that in some cases, "the relevant reliability concerns may focus upon personal knowledge or experience." *Id.* at 150, 152. A number of commentators have begun to address the issue of how to evaluate non-scientific expert evidence.

least compared to alternative forms of knowledge-production, research science involves formalized methodological norms, articulated standards, and conscious research design. By contrast, many forms of potential expert knowledge—from the clinical doctor’s diagnosis to the historian’s description to the tire safety expert’s analysis—are based on experience, tacit knowledge, even hunch.⁹ Evaluating the reliability of knowledge not produced through formal methods thus raises especially difficult questions. As important as an examination of method, however, and much less noted, is another dimension: the degree of certainty that the expert posits in what she offers. One of the central problems with much expert testimony introduced in court—both scientific and non-scientific alike—is that experts claim as matters of fact or probability opinions that should be couched in more cautious terms, as possibilities or hypotheses.

We believe that the monocular focus on issues of scientific method and reliability has obscured some broader points; therefore, in this Article we try to step back (gingerly) and take a broader view. Instead of beginning with the problems of reliability, we start by briefly detailing the array of informational issues facing a consumer of expert evidence, thereby putting the attention-getting problems of reliability into a broader context. We then attempt to review and classify the full range of expert testimony, much of which is unproblematic, AND some of which *is* problematic but routinely admissible nonetheless. We offer first a brief taxonomy, an outline with examples. We then develop our classification scheme by exploring each kind of expert statement in more detail. In these discussions, we purposefully do not distinguish between scientific knowledge and other forms of knowledge, instead framing our

See, e.g., Edward J. Imwinkelried, *Evaluating the Reliability of Nonscientific Expert Testimony: A Partial Answer to the Questions Left Unresolved by Kumho Tire Co. v. Carmichael*, 52 ME. L. REV. 19 (2000); Edward J. Imwinkelried, *The Next Step After Daubert: Developing a Similarly Epistemological Approach to Ensuring the Reliability of Non-Scientific Testimony*, 15 CARDOZO L. REV. 2271, 2292-94 (1994); D. Michael Risinger, *Defining the “Task at Hand”: Non-Science Forensic Science After Kumho Tire Co. v. Carmichael*, 57 WASH. & LEE L. REV. 767 (2000); D. Michael Risinger, *Preliminary Thoughts on a Functional Taxonomy of Expertise for the Post-Kumho World*, 31 SETON HALL L. REV. 508 (2000) [hereinafter Risinger, *Preliminary Thoughts*].

⁹ Tacit knowledge and experience matter within science as well. *See, e.g.,* H.M. Collins, *The TEA Set: Tacit Knowledge and Scientific Networks*, in THE SCIENCE STUDIES READER 95 (Mario Biagioli ed., 1999). In addition, some have argued that *Daubert’s* conception of science is unrealistic and idealized. *See, e.g.,* David S. Caudill, *Ethnography and the Idealized Accounts of Science in Law*, 39 SAN DIEGO L. REV. 269 (2002). Even granting both of these points, developing criteria for evaluating reliability remains at least as difficult for nonscientific expert evidence as it is for scientific expert evidence, and perhaps more so.

taxonomy around specific kinds of statements and their functions.

Our taxonomy has four purposes. First, we want to emphasize the extraordinary range of information that is presented in court by expert witnesses. Some of this information is ‘scientific’ and some of it is ‘non-scientific’; but often, whichever categories it falls in, it is wholly unproblematic. Many if not most expert witnesses testify without objection and present information that may be critical for the factfinder but is not in dispute. Second, for many categories of expert evidence, even when there may be some degree of controversy or disagreement, there really is no *Daubert* or *Kumho Tire* problem. For certain categories of expert information, a focus on the credentials of the expert is generally sufficient, and courts need not (and typically do not) make any additional elaborate inquiry into validity. Third, our taxonomy reminds us of the continuing importance within the evaluation of expert testimony of more mundane credibility issues than ‘reliability’ in the *Daubert* sense: specifically, bias, competence, and lack of clarity. Finally, our discussion reveals the sometimes overlooked importance of paying attention not only to what the expert says, but to how she says it. Often, whether testimony is based on scientific study or more casual forms of observation, what makes an expert’s conclusion unreliable is that it is expressed with a confidence not warranted by the evidence. The clinical observations of a physician or an engineer or a mechanic or a fingerprint examiner may be quite appropriate as the basis for testimony, but the degree of certainty expressed by the witness should reflect both knowledge and its limits, both what is known and what is not.

II. THE GENERAL NATURE OF EXPERT EVIDENCE

A. *The Task of Providing Expert Information: Doing and Telling*

“Expert evidence” is a species of the genus “expert information.” In everyday life, we rely on experts constantly—doctors, lawyers, carpenters, mechanics. Most of the time we want them to do things—set bones, write wills, build walls, fix brakes—not talk about them. Most of us have learned the hard way that mechanics and contractors (if not doctors) may have pleasing personalities and give clear, plausible explanations, but do lousy work. Still, we usually want these experts to tell us what they are doing, even if that is not their main task, and sometimes that information is crucial since we, the non-expert consumers, must make critical decisions. It is that informative function that interests us here, since expert *witnesses* only provide information, evidence; what they *do* in court is *tell*.

Sometimes an expert might be able to answer a question immediately, from existing knowledge: “Anthrax is a life-threatening bacterial disease that cannot be transmitted directly from one infected person to another.” For other questions, she may need to collect additional information, in one or both of two categories: (1) *data about the particular case*, ranging from the minimal (“let me take a quick look”) to the extensive (collecting archival data on hiring and compensation in a large company and then running a set of statistical analyses); (2) *general knowledge on the topic*, which can mean anything from checking a standard reference to an original scientific study that adds to the body of general knowledge in the field and may have value beyond the lawsuit. Whatever the scope of the work, the structural significance is the same: The *telling* part of an expert’s task—for an expert *witness*, this is the only job—often requires some preliminary *doing*: study.¹⁰

Testimony based on deliberate study is not the exclusive preserve of expert witnesses. Lay investigators who set out to discover what happened on a particular occasion may also testify to some of what they find out. This category includes not only the prototypical police and private investigators, but also any other witnesses—most often, parties or their employees—who deliberately collect information about significant past events. What makes studies by expert witnesses different is the permissible scope of testimony describing those studies. The lay investigator who “solves” a murder may testify about the tracks he saw in the dust and the shell casings he found in the defendant’s car, but he may not relate most of the hearsay statements he heard when conducting interviews, and he may not give his own interpretation of the evidence. By contrast, the pathologist who testifies to the cause of death may freely rely on a wide range of second-hand information in making up her mind, may testify in detail to her opinions, and may be permitted to describe a wide range of otherwise inadmissible evidence along the way.¹¹

¹⁰ In-court experiments provide the limiting case. While it may look like a form of “doing,” such an experiment is really a form of “telling” that is gussied up to look like “doing.” No experienced attorney would want an expert to perform an “experiment” in court without being quite certain in advance about the outcome. Strictly speaking, this sort of performance is not an experiment but a “demonstration.” Its purpose is not to teach the expert anything at all, but to display to the factfinder what the expert already knows.

¹¹ See FED. R. EVID. 703. Rule 703 permits experts to base their opinions on facts and data not admissible in evidence, so long as they are “of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject” An amendment to the Rule in 2000 restricts the extent to which the expert may testify to the bases for her conclusions when those bases are inadmissible. Such disclosure is permitted only when its probative value “substantially outweighs”

Unlike a lay investigator, an expert may generate and testify to new information that did not exist before by conducting tests (or occasionally even studies) herself.

B. Issues for Consumers of Expert Information: Validity, Competence, Clarity, and Bias

1. Validity

The most basic question about expert information is whether it is within a valid category of expertise: Is there a field of knowledge that has credible tools to produce valid answers to questions such as this? Can astrologers determine personality characteristics from the time and place of a person's birth? Can forensic scientists determine a person's identity from bite marks? Can biologists determine identity from analysis of DNA? In each case, the issue is not the competence of the particular analysis but the legitimacy of the discipline's claim to be able to provide this sort of information. This aspect of validity—*field validity*—is fundamental but usually uncontroversial. It is important in court because it defines the boundaries of permissible expert testimony—biologists will be allowed to testify but astrologers will not—but most evidence that is offered is well within the recognized borders. The debates preceding and following *Daubert* have highlighted the importance of field validity, and several accepted forms of expert testimony—from psychiatric evaluations to handwriting identification—have been challenged on this basis.¹²

its prejudicial effect. *Id.* However, given the existence of hearsay exceptions for statements made for the purpose of medical diagnosis or treatment in Rule 803(4), and for statements in learned treatises in Rule 803(18), it is clear that quite apart from the limited admissibility now available under Rule 703, experts may still inform the jury about a great many hearsay sources for their judgments.

¹² See, e.g., *United States v. Vallejo*, No. 99-50762, 2001 U.S. App. LEXIS 7367, at *29 (9th Cir. Jan. 16, 2001) (reversing the district court on its admission of expert testimony on drug trafficking and its exclusion of expert testimony by defendant's school psychologist); *Jenson v. Eveleth Taconite Co.*, 130 F.3d 1287, 1295 (8th Cir. 1997) (reversing a successful trial level *Daubert* challenge to plaintiff's psychiatric testimony); *United States v. Powers*, 59 F.3d 1460 (4th Cir. 1995) (affirming district court's exclusion of expert testimony that defendant did not exhibit characteristics of fixated pedophilia); *United States v. Falcon*, 245 F. Supp. 1239 (D. Fla. 2003) (excluding defendant's proffer of psychological expert testimony on the personality disorders of a key government witness). The first case to scrutinize handwriting identification evidence with care was *United States v. Starzeczpyzal*, 880 F. Supp. 1027 (S.D.N.Y. 1995), in which the court thought the expertise failed *Daubert* but admitted it anyway as nonscientific expert evidence (a move now prohibited by *Kumho Tire*). Some recent cases have rejected handwriting identification expertise. See, e.g., *United States v. Brewer*, No. 01 CR 892, 2002 WL 596365 (N.D. Ill. Apr. 16, 2002); *United States v. Lewis*, 220 F. Supp. 2d 548 (S.D.W. Va. 2002); *United States v.*

Moving down a level of abstraction takes us to a second aspect of validity: *method validity*. Given that a discipline is accepted as a legitimate category of expertise on a particular topic, are the methods that were used in this instance capable of producing valid answers? The present version of Rule 702, codifying *Daubert* and *Kumho Tire*, makes method validity a prerequisite for expert evidence: expert testimony is only admissible if it is “the product of reliable principles and methods.”¹³ In *Daubert* itself, for example, no one doubted the *field* validity of epidemiology, but the lower courts went on to hold nonetheless that the particular *method* used by the plaintiff’s experts—reanalysis of data from published studies—was not a valid basis for testimony by qualified epidemiologists.¹⁴ Method validity addresses the specific techniques deployed by the expert: Is PCR a valid procedure for comparing samples of DNA? Is differential diagnosis a valid method to determine the cause of a disease? *Daubert*, *Kumho Tire*, and *Joiner* all concern method validity.¹⁵ In their wake, objections on this basis have become more common and more successful, particularly so in civil cases.¹⁶ In run-of-the-mill cases, however, expert evidence continues to follow well-worn and well-

Saelee, 162 F. Supp. 2d 1097 (D. Alaska 2001). Academic debate about handwriting identification evidence has been similarly vigorous. See, e.g., D. Michael Risinger et al., *Brave New ‘Post-Daubert World’—A Reply to Professor Moenssens*, 29 SETON HALL L. REV. 405 (1998); D. Michael Risinger et al., *Exorcism of Ignorance as a Proxy for Rational Knowledge: The Lessons of Handwriting Identification ‘Expertise’*, 137 U. PA. L. REV. 731 (1989); D. Michael Risinger & Michael J. Saks, *Science and Nonscience in the Courts: Daubert Meets Handwriting Identification Expertise*, 82 IOWA L. REV. 21 (1996); see also Andre A. Moenssens, *Handwriting Identification Evidence in a Post-Daubert World*, 66 UMKC L. REV. 251 (1997). See generally Jennifer L. Mnookin, *Scripting Expertise: The History of Handwriting Identification Evidence and the Judicial Construction of Reliability*, 87 VA. L. REV. 1723 (2001) (providing a history of handwriting identification).

¹³ FED. R. EVID. 702 (emphasis added).

¹⁴ *Daubert v. Merrell Dow Pharm., Inc.*, 727 F. Supp. 570, 576 (S.D. Cal. 1989), *aff’d*, 951 F.2d 1128 (9th Cir. 1991).

¹⁵ *Kumho Tire*, 526 U.S. 137 (1999); *Joiner*, 522 U.S. 136 (1997); *Daubert*, 509 U.S. 579 (1993).

¹⁶ See MOLLY TREADWAY JOHNSON ET AL., EXPERT TESTIMONY IN FEDERAL CIVIL TRIALS: A PRELIMINARY ANALYSIS (2000) (finding in a 1998 survey of federal judges that fewer judges permitted all proffered expert evidence in their last civil trial than had done so in 1991); Lloyd Dixon & Brian Gill, *Changes in the Standards for Admitting Expert Evidence in Federal Civil Cases since the Daubert Decision*, 8 PSYCHOL., PUB. POL’Y & L. 251, 269 (2000) (finding on the basis of an empirical study of district court decisions that “since *Daubert*, judges have examined the reliability of expert evidence more closely and have found more evidence unreliable as a result”); see also 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); Steve Leben, *In Practice, Daubert Raised the Bar*, 37 COURT REV. 37 (Fall 2000); Joseph Sanders & Julie Machal-Fulks, *The Admissibility of Differential Diagnosis Testimony to Prove Causation in Toxic Tort Cases: The Interplay of Adjective and Substantive Law*, 64 LAW & CONTEMP. PROBS. 107 (2001).

accepted paths.¹⁷

Method validity and field validity are obviously linked—a field is invalid to the extent that its methods fail to do what they claim—but the distinction is important. Field invalidity implies method invalidity, but the converse is not the case. Few question the value of medicine as a field, and few doubt that some medical doctors make foolish medical claims, based on unsound, if not specious, methods. One of the most difficult tasks for lay judges in evaluating expert evidence is to distinguish between acceptable and unacceptable practices by qualified members of a legitimate discipline. One solution is to pass the buck back to the expert field itself, and accept the standards it imposes on itself; this is the logic behind the *Frye* standard of “general acceptance” for novel scientific techniques.¹⁸ However (ignoring for the moment other difficulties with *Frye*), this dodge does not work when the validity of the field itself is in question.¹⁹

2. Competence

Assuming that expert information reflects sufficiently valid methods within a legitimate field, we need to know whether a particular statement is a competent example of its genre. This issue has two components: (1) *Qualifications*: Does the expert at hand have the knowledge and skill that are necessary to produce the information? Rule 702 makes this a requirement: to testify as an expert, a witness must be “*qualified . . . by knowledge, skill, experience, training, or education . . .*”;²⁰ and (2) *Execution*: Did the expert (assuming she can ever do so) perform competently on this occasion? Even a qualified expert working in a recognized and valid

¹⁷ The empirical data on the effects of *Daubert* are limited, but some findings about how judges perceive *Daubert* are suggestive. See JOHNSON ET AL., *supra* note 16 (stating that though the number decreased between the years 1991 to 1998, in 1998, 59 percent of judges still allowed all of the expert evidence proffered in their last civil trial); Sophia I. Gatowski et al., *Asking the Gatekeepers: A National Survey of Judges on Judging Expert Evidence in a Post-Daubert World*, 25 LAW & HUM. BEHAV. 433 (finding in a 1998 survey of state trial court judges that 59 percent thought that the intent of *Daubert* was either not to change the threshold for admissibility for expert testimony, or to lower it).

¹⁸ *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

¹⁹ On *Frye* in general, see Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 COLUM. L. REV. 1197 (1980) (describing some of the problems with the *Frye* test). For analysis of the problems with a general acceptance test when the field itself may be invalid, see Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 BROOK. L. REV. 13, 63 (2001). See also Michael J. Saks, *Merlin and Solomon: Lessons from the Law's Formative Encounters with Forensic Identification Science*, 49 HASTINGS L.J. 1069, 1078-79 (1998).

²⁰ FED. R. EVID. 702 (emphasis added).

methodology can do an incompetent job in a particular case. Rule 702, following *Kumho Tire*,²¹ requires that expert testimony be “based upon sufficient facts or data,” and that the expert have “*applied* the principles and methods [she used] *reliably* to the facts of the case.”²² Until recently, American courts were notoriously forgiving on qualifications, and probably almost equally so on execution, as preconditions for admissibility. The operating theory was that in most cases these are issues that go to the weight of the evidence. There are some indications that courts have become more exacting in recent years, though the cases are by no means consistent on this point.

3. Clarity

You can only make use of information to the extent that you understand it. When the informant is an expert—someone whose career is devoted to arcane information—the problem can be acute, as most of us know from common experiences with builders, accountants and computer technicians. Clarity is not generally an important factor in determining the admissibility of expert testimony in court. In theory, lack of clarity could be a basis for an objection to expert evidence under Rule 403 because its “tendency to confuse” substantially outweighs its probative value,²³ or under Rule 702 on the ground that the evidence is too confusing to “assist” the trier of fact.²⁴ In practice, these objections are unlikely to succeed—or even to be made. Because clarity seems to have great influence on the evaluation of experts by juries and judges, we are generally willing to rely on the self-interest of the parties to produce clear expert evidence in court. In fact, a special danger associated with expert testimony is that the parties and their experts will sacrifice accuracy for the sake of appealingly clear but erroneous or over-simplified presentations.²⁵

4. Bias

If we understand what an expert tells us, and know that she has correctly applied a valid method to the pertinent facts, our problems are at an end. In most situations, however, we cannot know these things directly for the simple and obvious reason that we ourselves are not experts in the relevant field. Instead, we use various indirect

²¹ 526 U.S. at 141.

²² FED. R. EVID. 702 (emphasis added).

²³ FED. R. EVID. 403.

²⁴ FED. R. EVID. 702.

²⁵ See Samuel R. Gross, *Expert Evidence*, 1991 WIS. L. REV. 1113, 1163-65.

measures of the quality of expert information, of which the most pervasive, in court and out, is bias. What is the first question that comes to mind when a mechanic at a highway road stop tells you that you need two new tires, immediately? As with clarity, bias is not a common basis for excluding expert testimony. In our system, the evaluation of bias is a core function and special prerogative of juries as triers of fact; therefore we do not exclude witnesses who may be biased, but allow juries to weigh that factor in judging their evidence. Our practice for experts is, in this respect, basically the same as for lay witnesses. We systematically neglect well-considered plans for the use of unbiased (or at least, non-partisan) expert testimony as a supplement to potentially biased party-sponsored expert evidence.²⁶

Conceptually, bias has three components: (1) Is the *field* biased? Do chiropractors, *as a group*, always say that the problem is a misalignment of the spinal column? This is not a common issue. In an extreme case, evidence of this sort could conceivably be the basis for an objection that evidence from such an expert is invalid—in the terminology of this Article, that the area of knowledge lacks field validity—or that experts trained in that discipline are unqualified to testify. (2) Is this *person* biased across a range of cases? Is she an expert who always says that the plaintiff had a pre-existing condition, or that toxic exposure caused the disease? In extreme cases, this could be an argument against admissibility on the theory that the expert is unqualified; in practice this argument almost always “goes to the weight” of the expert’s evidence. (3) Is the expert’s *performance* biased? Does the expert have a grudge against this defendant, or, more likely, was she paid a handsome fee to say what she said in this case? That too is a type of bias that is considered appropriate as a basis for discounting an expert’s evidence, but not for excluding it.

* * *

At this point, a note about vocabulary is in order. *Daubert* and Rule 702 talk extensively about “reliability.”²⁷ In the sciences, *reliability* is often used to mean “consistency” or “repeatability.”²⁸ A test that produces the same result on successive applications is said to be *reliable*, while a test that produces accurate results is said to be *valid*.²⁹ The Court in *Daubert* uses “reliability” instead to mean

²⁶ *Id.* at 1187-1208 (describing both benefits and obstacles to use of neutral experts).

²⁷ See *supra* notes 2-7 and accompanying text.

²⁸ David H. Kaye & David A. Freedman, *Reference Guide on Statistics*, in REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 83, 102 (2d ed. 2000).

²⁹ *Id.*

something closer to “validity” or “trustworthiness.”³⁰ What the *Daubert* Court calls “reliability” blends our categories of *validity* and *competence*, focusing especially on method validity and competence of execution. To be consistent with *Daubert* and Rule 702, in this Article we too use *reliability* to mean “trustworthiness”: If evidence is *reliable*, we can trust it, we can rely on it.

III. A TAXONOMY OF EXPERT INFORMATION

When an expert’s job is to inform, what sort of information do we want? The scheme that follows is a first cut. The categories we list are not entirely analytically distinct, and a single expert will typically do more than one of these tasks in a given project. We do not divide expert testimony by field, or even by methodological approach. Our point, rather, is to note that there are several different *types* of information that we commonly seek from experts—in court and out—and to try to describe that range. In the scheme that follows, categories of expert information are arranged, more or less, along a rough continuum from specific “factual” bricks that the consumer may use to build a wall, to comprehensive general “conclusions” that the lay listener must accept or reject as a whole. We start with a capsule form of the taxonomy—an outline with examples—and proceed to a more detailed discussion in which we try apply the general issues we have touched on—validity, competence, clarity, and bias—and consider the factors that bear on the admissibility of such expert information in court.

³⁰ *Daubert*, 509 U.S. at 590 n.9 (“We note that scientists typically distinguish between ‘validity’ (does the principle support what it purports to show?) and ‘reliability’ (does application of the principle produce consistent results?) [O]ur reference here is to *evidentiary* reliability—that is, trustworthiness.”) (emphasis in original) (citations omitted).

A. Capsule Form

1. Description:

- (a) Observation: “The brake shoes are worn to within 1 mm of the bracket.”
“This x-ray shows multiple fractures of the tibia.”
- (b) Translation: “In English, that means ‘I agree.’”
“As used in this stock exchange, ‘5p@36’ means ‘I offer to sell 5000 shares of preferred stock at \$36 per share.’”
“The term ‘nick’ refers to a five dollar bag of cocaine or crack.”
- (c) Calculation: “The total payments over the 10 year term of the loan, with compound interest at 7% per annum, will come to \$789,566.”
“A racial disparity this large or larger would occur by chance alone less often than 1 time in 100,000.”
“Total indebtedness, as of 9/10/2001, was \$2,896,755.”

2. Instruction:

- (a) Facts: “Blood has a pH value of 7.4.”
“Mitochondrial DNA is transmitted entirely from a mother to her offspring.”
“Most of the loss of eyewitness memory occurs in the first few hours after an observation.”
“Bendectin is not a teratogen.”

- (b) Norms: “The customary treatment for premature labor is bed rest and a tocolytic agent.”
“Epidemiological study is the most persuasive way to establish a correlation between ingestion of a substance and a disease.”
3. Assessment:
- (a) Condition:
(diagnosis) “Your chimney is unsafe.”
“The patient is suffering from rheumatoid arthritis.”
- (b) Causation: “The skull fracture may have been caused by a blow from a heavy object.”
“Tire failure was probably caused by a defect in the fabrication of the tire.”
“The tumor was caused by exposure to dioxin.”
- (c) Consequences:
(prognosis) “The patient will be permanently paralyzed from the fifth lumbar vertebra down.”
“If current levels of phosphates are maintained, all frog populations in the basin will be extinct within ten years.”
“You need a new chimney.”
- (d) Identity:
(common source) “The latent fingerprints on the knife came from the defendant’s right hand.”
“It’s a forgery.”
- (e) Value:
(or quality) “The present value of the plaintiff’s expected lifetime earnings before the accident was approximately \$1.6 million.”
“This house has market value between \$375,000 and \$405,000.”
“This play has literary merit.”

B. Fuller Discussion

1. Description

Much information from experts is primarily descriptive rather than evaluative. Expert testimony focuses heavily on opinions, sometimes elaborate opinions, but, as Rule 702 recognizes, experts may testify “otherwise.”³¹ The boundary between description and assessment is fuzzy, and expert opinions are frequently, perhaps invariably, built into the foundations of their descriptive statements. All the same, the distinction is meaningful and useful. In this Article we discuss three types of descriptive statements: observation, translation, and calculation.

Field validity is not a major concern for evaluating expert information that is primarily descriptive, although it could be. A specialty that claims to be able to observe people’s thoughts would run into deep trouble. Questions of method validity frequently figure in the background—in decisions on what to look for, for example (X-ray the neck, or the entire spine?), or what to calculate (Is chi-square an appropriate statistic test of the independence of the distributions of two variables?), or how to calculate it (Can one use the SAS statistical package to compute chi-squares?). And competence, of course, is crucial.

(a) Observation

Much of what experts learn to do is see and hear things that the rest of us miss. The degree and nature of the skill involved varies greatly from one type of expertise to another, but the advantages that many experts have in perception are well known, from umpires (good ones) and coaches, to orchestra conductors, to optometrists. An expert’s observation may be uncontroversial—the expertise involved may consist entirely of identifying the right object (brake shoe) and measuring it with the right tool (a caliper)—or it might depend on an exercise of judgment that other experts might dispute (“Strike!”). One way or another, the question that this sort of expertise answers is: “What did you perceive—see, hear, feel or smell?” In court, expert observations—describing pathologies or injuries to people for example, or damage to structures—are often crucial, either as the crux of expert testimony or as part of the foundation for evaluative opinions. And these observations are sometimes controversial since experts, like everybody else, may disagree about what they see.

³¹ FED. R. EVID. 702.

The distinction between observation and assessment is one of degree. The nurse who says that a patient's blood pressure was 135/85 is *interpreting* sensory information—what she saw on the pressure gauge and heard on her stethoscope—not reporting it. Moreover, her interpretation incorporates a host of unstated assumptions about the tools she used and the procedure she followed. A doctor who says that a patient is suffering from rheumatoid arthritis is also interpreting information, but the range of information is likely to be greater (multiple tests, reported and observed symptoms, family history) and much of it probably consists of second- and third-hand accounts. We classify the first statement (blood pressure) as an expert *observation*, the second (arthritis) as an *assessment*. Some cases may be harder to call, but the dividing line is less important than the underlying issue: To what extent does the expert integrate information about the particular case from a variety of sources, rely on reports from others, and make complex analytic judgments?

In general, the first thing we want to know about an expert observation is the competence of the observer: How good is she at this task? Since we do not usually have direct measures of skill, we tend to rely on proxies: How good was her training? Does she use accepted techniques in an apparently competent manner? Out of court, we try to use experts who have, in our own experience, provided accurate information in the past; failing that, we look for those who are said to be accurate by friends and acquaintances, or who are reputed to be accurate. In court, we count on testimony on qualifications and on cross-examination to provide evidence on the expert's training and experience.³²

Bias, of course, may be as important as competence. The chimney sweeper who tells you (as they all do) that there are ten-inch cracks in your chimney, is probably also a contractor who rebuilds chimneys. The key to minimizing bias, out of court, is to remove the incentives to distort—for example, by consulting a diagnostician who knows he will have no role in the treatment. In court, we neglect the most effective method of minimizing bias—using non-partisan experts—and rely instead on cross-examination and rebuttal to expose it.³³

The primary foundational requirement for the admission of observational expertise under existing rules is evidence that the expert is “qualified,” which bears on her competence. On this issue,

³² See generally Gross, *supra* note 25, at 1158-62.

³³ See *id.* at 1165-76, 1187-1211.

the treatment of different sorts of experts is likely to diverge. If the field has elaborate formal qualifications—in particular, if it requires graduate or professional education, and/or certification—courts typically accept these formal qualifications as sufficient evidence of competence.³⁴ Most, perhaps all scientists fall into this category, along with many non-scientists. On the other hand, if the skill is based primarily or exclusively on “experience”—the harbor pilot or the chicken sexer—courts may demand concrete evidence from past practice that the expert can perform this task accurately.³⁵

By far the most effective way to minimize the danger of error in observational evidence of any sort is to reproduce the observation. For lay witnesses, we rarely have that luxury; for experts, we can often ask another expert to do it again. If it matters enough, we have a second doctor examine the X-rays, or a second lab repeat the test. In litigation, this task may be performed by an expert for the side opposed to the party that called the first expert. When this is possible, the adversarial system probably performs quite well, on the whole, in producing high quality evidence—provided that the advocates for both sides have sufficient resources and motivation to do a good job. This is a significant qualification.³⁶

The worst problems with expert descriptions occur in criminal prosecutions. Most experts in criminal cases are state employees who are called by prosecutors: police officers, medical examiners, technicians at state crime laboratories, and so forth. Many of them are inadequately trained, and some are unscrupulous. Their testimony is rarely subjected to review by defense experts; in many

³⁴ See *id.* at 1158 n.139 (citing sources).

³⁵ Some scholars have suggested that courts have implicitly used a ‘marketplace test,’ inquiring whether the expert could make a living selling his professed expertise. See Faigman et al., *Check Your Crystal Ball*, *supra* note 6, at 1803-05; Saks, *supra* note 19, at 1073-74.

³⁶ Thus, for example, there are reports of widespread expert fraud in comparatively small personal injury cases that settle on the basis of written reports from plaintiffs’ experts, with minimal review from the defendants’ insurance companies, and very likely none from their lawyers. See, e.g., William K. Rashbaum, *Three Officers Faked Reports, Police Say*, N.Y. TIMES, Oct. 23, 2002, at B1 (recounting that three police officers were charged with falsifying accident reports along with several other members of a fraud ring including individuals making false medical and insurance claims); Jerry Urban, *Metro Officials Say Fraudulent Injury Claims are Problem*, HOUS. CHRON., Aug. 11, 1997, at A15. We suspect that such fraud is far more difficult and less common in cases that stand any chance of going to trial. *But see Husband, Wife Get 7 Years for Fake-Injury Schemes*, ORLANDO SENTINEL TRIB., July 17, 1992, at B5. A husband and wife were sentenced after managing to win a \$2.5 million malpractice settlement and \$900,000 in workers’ compensation for a fraudulent injury allegedly arising from a back surgery. *Id.* The scam was revealed when the “injured” husband was video taped by a private investigator walking his dog and climbing stairs. *Id.*

cases, they are hardly even cross-examined by the inexperienced, overworked, and underpaid court-appointed defense attorneys. Any witness can make avoidable mistakes or lie, but an expert can make a career of it. In recent years we have seen examples of this repeatedly in criminal prosecutions across the United States: a pathologist who testified to conducting hundreds of autopsies on bodies he never touched,³⁷ forensic scientists who made up findings in hundreds of cases to suit the police and prosecutors,³⁸ and crime labs that were riddled with incompetence.³⁹ We have no way of knowing how

³⁷ Texas pathologist Ralph Erdmann was eventually convicted of felonies relating to autopsies that he botched and falsified. *See, e.g.*, Richard L. Fricker, *Grave Mistakes*, 79 A.B.A. J., Dec. 1993, at 46 (describing Erdmann's incompetence and quoting a police sergeant as stating that Erdman treated autopsies as if they were "kindergarten classes or show and tell"); Richard L. Fricker, *Pathologist's Plea Adds to Turmoil: Discovery of Possibly Hundreds of Faked Autopsies Helps Defense Challenges*, 79 A.B.A. J., Mar. 1993, at 24 (describing Erdmann's conviction and quoting attorney appointed to investigate him as saying, "[i]f the prosecution theory was that death was caused by a Martian death ray, then that was what Dr. Erdmann reported"); Roberto Suro, *Ripples of a Pathologist's Misconduct in Graves and Courts of West Texas*, N.Y. TIMES, Nov. 22, 1992, at 22 (describing intimations of a police cover-up of wrongdoing and quoting investigator of Erdmann as saying, "We started digging up bodies and when we were seven for seven we decided that in the interests of judicial economy we didn't have to go further to prove that this guy was a liar").

³⁸ The most notorious example is West Virginia serologist Fred Zain, who even testified to tests his laboratory laced the equipment to perform. *See generally In re Investigation of the W. Va. State Police Crime Lab., Serology Div., 738 S.E.2d 501, 503-04 (W. Va. 1993)* (describing Zain's misconduct and developing procedures and standards for evaluating cases in which Zain's testimony helped procure conviction); JIM DWYER ET AL., ACTUAL INNOCENCE: FIVE DAYS TO EXECUTION, AND OTHER DISPATCHES FROM THE WRONGLY CONVICTED 109-17 (2000) (describing in detail Zain's mishandling and creation of scientific evidence); Stephanie Martz, *Judge's Report Closes Investigation of Zain*, CHARLESTON GAZETTE, Feb. 25, 1994, at 1D (reporting that Zain was found to have fabricated blood test results in at least thirty-six cases); Sarah Webster, *Officials Revive Case Against Zain: Another Special Prosecutor Appointed to Pursue Case*, CHARLESTON DAILY MAIL, Oct. 4, 1996, at 1C (describing incriminating evidence against Zain said to include two coworkers who saw Zain fake data in nearly 100 cases).

³⁹ *See, e.g.*, Robert Tanner, *Standards, Autonomy Sought for Crime Labs Mishandling of Evidence; Mismanagement Cited*, SEATTLE TIMES, July 7, 2003, at A1 (summarizing recent problems with crime labs). Oklahoma City forensic scientist Joyce Gilchrist presents another recent example. *See, e.g.*, *Memo Says Police Lab Manager Botched Evidence*, TULSA WORLD, May 2, 2001, at A8; Ed Timms & Diane Jennings, *Concern Grows Over Use of Flawed Evidence; Chemist's Case Raises Fears of Problem's Scope*, DALLAS MORNING NEWS, May 13, 2001, at A43; Jim Yardley, *Inquiry Focuses on Scientist Employed by Prosecutors: Chemist Handled 5,000 Oklahoma Cases*, N.Y. TIMES, May 2, 2001, at A14 (reporting that the Governor of Oklahoma ordered all felony cases in which Gilchrist was involved to be re-examined); *see also* McCarty v. State, 765 P.2d 1215, 1218, 1222 (Okla. Crim. App. 1988) (reversing and remanding capital conviction on account of Gilchrist's poor lab work). There was also a year-and-a-half long investigation into problems at the FBI crime lab. *See, e.g.*, U.S. DEP'T OF JUSTICE, OFFICE OF THE INSPECTOR GENERAL, THE FBI LABORATORY: AN INVESTIGATION INTO LABORATORY PRACTICES AND ALLEGED MISCONDUCT IN EXPLOSIVES-RELATED AND OTHER CASES

frequently similar problems go undetected, but by any accounting they are by far the worst misuse of expertise in American courts.⁴⁰ This is an avoidable scandal. If we are going to rely on the adversary system to guarantee competence and honesty in expert evidence we must actually have an adversary process. When one side is absent, the result may be disastrous.

(b) Translation

Almost all expert information involves some form of “interpretation.” A radiologist who describes an X-ray as showing a bone fracture is “interpreting” the X-ray; for that matter, a layperson who says that the defendant “agreed” with the policeman is “interpreting” the words the defendant spoke, or the nod of his head. We use “translation” in a narrower sense, to refer to the restatement in one system of symbolic communication (in American courts, everyday English) of a message that was conveyed in a different system of communication.⁴¹ In this case, the question for the expert is some version of “What did she say?”

The archetypal “translation” is from one common language into another. This is no doubt the common type of expert translation in American courts, but other sorts of translation are also used with some regularity. Perhaps the most controversial is expert evidence, generally from a police officer, about the meaning of particular words and phrases in some esoteric underworld community, typically the world of drug dealers.⁴² Similar interpretive tasks, however, occur in any context in which a comparatively small group of insiders in a

(1997); Richard A. Serrano, *Misconduct Allegations Arise in FBI Lab Probe*, L.A. TIMES, Jan. 30, 1997, at A1. Most recently, a major scandal has been uncovered at the Houston Police Department crime lab. See, e.g., James Kimberly, *Independent Lab Probe Given Push; City, County Officials Say Inquiry Would Help Rebuild Faith in System*, HOUS. CHRON., Apr. 30, 2003, at 21, available at <http://www.chron.com/cs/CDA/ssistory.mpl/special/crimelab/188958>.

⁴⁰ See generally DWYER ET AL., *supra* note 38; Gary Taylor, *Fake Evidence Becomes Real Problem*, NAT'L L. J., Oct. 9, 1995, at A1. An even more widespread problem may be the biases that result from the close relationship between forensic experts and the police and prosecution, and the fact that forensic experts frequently know in advance what it is that the investigators hope that they will find. For a general discussion of this issue, see D. Michael Risinger et al., *The Daubert/Kumho Implications of Observer Effects in Forensic Science: Hidden Problems of Expectation and Suggestion*, 90 Cal. L. Rev. 1 (2002).

⁴¹ By contrast, Risinger uses “translation” in a broader sense to describe almost all expert evaluations about the facts of the particular case that the trier of fact is asked to accept on the basis of the expert’s authority. See Risinger, *Preliminary Thoughts*, *supra* note 8 at 518-25.

⁴² See Phylis Skloot Bamberger, *The Dangerous Expert Witness*, 52 BROOK. L. REV. 855, 867 (1986).

profession or trade develops a specialized jargon for the issues they deal with on a regular, repetitive basis: You may need an expert in the diamond trade to tell you what a sentence from a diamond trader means,⁴³ or a pharmacist to interpret what your internist wrote on a prescription form.⁴⁴ As with expert observation, translation (by the expert herself, or by another expert) is frequently a foundational element of more evaluative expert testimony even when translation is not a central or explicit task.

The main question for a translator is the same as for an expert observer, competence: How good is she at her job? Other than common intelligence, the main requirements for competence are proficiency in the two systems of communication that need to be made mutually intelligible; a Russian language interpreter in an American court must be able to understand and communicate effectively in both Russian and English. In addition, of course, a biased translator can distort the message he transmits. As with expert observers, the best check on mistranslation is replication by a second translator who is not likely to share the weaknesses and biases of the first.

The Federal Rules of Evidence recognize that translation is a form of expert testimony, but nonetheless have a special provision for interpreters who perform this function, Rule 604: “An interpreter is subject to the provisions of these rules relating to qualification as an expert and the administration of an oath or affirmation to make a true translation.”⁴⁵ In practice, this means that interpreters who provide evidence (as opposed to those who translate proceedings for the benefit of non-English speaking participants) are treated schizophrenically, depending on the context. Live testimony cannot proceed if there is a dispute about the meaning of the spoken words. Therefore, an interpreter who translates testimony from the witness stand—unlike almost every other expert witness in an American court—is selected by the judge, preferably from an official list of pre-

⁴³ On the internally-created dispute resolution mechanisms within the diamond industry, see Lisa Bernstein, *Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry*, 21 J. LEGAL STUD. 115 (1992).

⁴⁴ Sometimes obscure shorthand is used by insiders for the specific purpose of making their views obscure to outsiders. For example, in a public defender's office where one of us worked as a student, “WPD” meant “white punk on dope,”—a shorthand that facilitated messages, on the *outside* of file folders, such as: “D—WPD V—WPD Will settle.” Similarly, we're told that in some car dealerships the code “ESO” on a form sent back from a mechanic to a “service representative” means “Equipment Superior to Operator”—i.e., “The idiot customer is complaining because he's too stupid to operate the machine.”

⁴⁵ FED. R. EVID. 604.

qualified experts, takes the special oath provided by Rule 604 (if they are in federal court) and provides (at least prima facie) authoritative evidence on the meaning of the spoken words.⁴⁶ The use of official interpreters no doubt greatly reduces the danger of biased translation. If the official certification program works as intended, it may also help guarantee competence.

A different set of rules applies to an interpreter who translates words that were spoken or written at some earlier time, as memorialized in a document or an electronic recording. In that situation, the translator is treated as an ordinary “language expert [under Rule 702] who [takes] the stand under oath, and subject[s] himself to cross-examination. Rule 604 is inapplicable.”⁴⁷ Since immediate, authoritative translation is not a functional necessity when the words are recorded, the usual rules for expert witnesses apply, and competing experts may offer different interpretations of statements in a foreign language.⁴⁸ It is not clear to us how disputes over the accuracy of translations of *live* testimony are handled, except that the paucity of cases and commentary suggest that this is not a problem that is frequently litigated.

The distinctive feature of the use of this type of expertise is the emphasis on clarity. Because testimonial interpreters are imperative to the ongoing functioning of the system of oral testimony in the face of a language barrier, it is essential that they be comprehensible to the participants as they perform their function. As a result, the Court Interpreters Act includes a specific provision for the replacement of an interpreter who does not “communicate effectively”⁴⁹—a problem that in other expert contexts we let the adversaries sort out.

Translation from less well-organized systems of specialized communication presents a different type of problem. When the question is “What signs and words do drug dealers use to convey their meaning without being understood by outsiders?” it is much harder to find well-informed disinterested experts than when the question is “What does this German sentence mean in English?” This can make it harder to find unbiased interpreters, and harder to check on the accuracy of a translation. The classic troublesome case is the police

⁴⁶ Court Interpreters Act, 28 U.S.C. § 1827(d)(1) (2003); *United States v. Armijo*, 5 F.3d 1229, 1234-35 (9th Cir. 1993); *United States v. Taren-Palma*, 997 F.2d 525, 531-32 (9th Cir. 1993).

⁴⁷ *Taren-Palma*, 977 F.2d. at 532.

⁴⁸ *See, e.g.*, *United States v. Ben-Shimon*, 249 F.3d 98, 101 (2d Cir. 2001) (“If the accuracy of the transcript is contested, competing transcripts may be submitted to the jury.”); *United States v. Chalarca*, 95 F.3d 239 (2d Cir. 1996).

⁴⁹ 28 U.S.C. § 1827(e)(1).

officer who qualifies as an expert in some variety of underworld jargon.⁵⁰ In that situation, the problem is frequently magnified by the fact that the officer-expert, who has an obvious interest in the outcome of the case, also testifies as a lay witness to critical acts by the criminal defendant or by others. When that happens, the process of qualifying the officer as an expert—both the imprimatur given by the court and the character evidence on which it is based—may improperly bolster the officer’s *lay* testimony.⁵¹ And, of course, this takes place in the presentation of the prosecution’s case in a criminal trial, where our concern for accuracy ought to be at its highest.

(c) Calculation

For this type of expertise, the question to the expert is some variant of “What does it add up to?” Totaling up the grocery bill, even if you have to add sales tax, hardly requires an expert, but some tasks that involve nothing more than a complex set of arithmetic calculations (preparing a tax return) may benefit from an expert’s help. If the job is big enough and complicated enough (calculating the indebtedness of a substantial company), or involves more sophisticated and difficult mathematical operations (calculating inferential statistics, or the force generated by a falling object) expert help is essential for most of us in any context, and always in court where the trier of fact is a lay jury or judge. In that situation, an expert who testifies to calculations will usually also explain what this type of calculation *means*, a separate task that we discuss under the heading “instruction.”

Calculation, like translation, is a task of making sense of information that is already available. It can be done by any qualified expert once the data exist. As with observation and translation, the central issue is the competence of the calculator—a question that

⁵⁰ See *United States v. Barnett*, Nos. 02-4561, 02-4732, 2003 U.S. App. LEXIS 6953, at *3-5 (4th Cir. Apr. 11, 2003) (describing how a special agent was permitted to testify as an expert witness with regard to drug code); *United States v. Ceballos*, 302 F.3d 679, 685 (7th Cir. 2002) (recounting that the government presented two agents as experts on drug code language who testified as to the content of several taped conversations played for the jury); *United States v. Dukagjini*, 326 F.3d 45, 53 (2d Cir. 2001) (allowing an agent to serve as a dual witness testifying as a case agent and as an expert on drug code); *United States v. Evans*, 272 F.3d 1069, 1096 (8th Cir. 2001) (upholding the admittance of a sergeant’s testimony regarding prostitution, including jargon); Bamberger, *supra* note 42.

⁵¹ See *Dukagjini*, 326 F.3d at 53-56; Bamberger, *supra* note 42, at 866-69 (discussing *United States v. Young*, 745 F.2d 733 (2d Cir. 1984)). Though courts express concern about expert evidence bolstering the lay evidence, the inverse is also possible: if the factfinder believes the lay witness’s eyewitness account, she may be more inclined to trust her expert judgment as well.

usually can be routinely answered by reference to her training and experience. In court, the qualifications of the expert are the only requirement for admissibility of this sort of expertise; mathematics itself is correctly considered to be universally reliable.

Strictly speaking, calculation itself is absolutely predictable; mathematical operations leave no room for ambiguity. Experts do disagree, however, on antecedent questions: *what* to count and *how* to do so. As the assumptions that are built into the process become more complex and debatable, the task may slip from “calculation” to “assessment.” As we have drawn the line in this Article, determining the indebtedness of a company is near the borderline. We classify it, perhaps arbitrarily, as a “calculation,” although, as we all learned from the Enron and Arthur Andersen scandals, there are more ways than one to make the many underlying judgments on how to categorize various possible liabilities and assets. On the other hand, we describe the task of estimating the present value of a person’s lifetime earnings if he had survived an accident as an “assessment.” The difference is not so much that this task is more complex or controversial than calculating indebtedness, but that it requires integrating information on, and making assumptions about, more disparate issues—productive life span, possible career paths, future employment trends and wage rates, productivity and inflation in the economy, and so forth. As with observation, the location of the boundary line between the more descriptive task of “calculation” and the more analytic task of “assessment” is not crucial, as long as we realize that some calculations are based in part on controversial assumptions; that many assessments have calculations embedded in them; and that there are close cases that are hard to call.

As calculation shades into assessment, questions of method and bias become increasingly salient. The question may be not so much what the indebtedness of Enron adds up to, but what the expert *means* by “indebtedness.” If both sides have access to competent experts, legal disputes that involve calculations are likely to focus on these choices and on the expert assessments on which they are based, or on the accuracy of the underlying data, rather than on the mathematical calculations themselves. Since the results of the mathematical operations are determinate, there should be no more room to dispute the *calculation* that produces an estimate of the expected lifetime earning of a deceased plaintiff than to dispute the arithmetic (as opposed to the items) on a tab in a restaurant. If there is a dispute, replication (in a restaurant or in court) is a perfect check on mathematical accuracy. In theory, calculations and their underlying assumptions can always be teased apart, the assumptions

spelled out and separated from the calculations that follow. In practice this may make the information too dense to absorb—we do not really want to know how and why our accountant calculated the tax as she did—and in any case it often is not done.

2. Instruction

Experts, to state the obvious, educate—they provide lay people with useful information. In court, the only function of an expert witness (or for that matter, any witness) is to educate, in this very general sense: to supply information that helps the trier of fact make decisions.⁵² We focus here on a particular kind of education—“instruction”—by which we mean general information about some common issue or phenomenon (“Inadequate drainage can cause ground water to undermine a foundation”) rather than specific information about a particular problem or case (“The wall collapsed because of inadequate drainage at its base”). Instruction answers such questions as “What do experts know about that topic?” and “How do things like that work?”

Instruction provides background knowledge but not the case-specific answers.⁵³ An expert witness who gives purely instructional testimony in a trial can literally repeat the same performance in a different courtroom with a different cast of characters, in another case that raises a parallel issue with different specific facts. Instructional testimony may lead to an inference that suggests or even requires a specific decision in a given case, but it is not itself information about any particular case. The statement “Bendectin is not a teratogen”—once controversial, now no longer so—is an example of instruction: it is a general empirical claim. By contrast, the statement, “Ingestion of Bendectin by the plaintiff mother did not cause this limb defect in her offspring,” is no longer instruction. It follows logically from the general instructional statement, if true; but it also may be true even if that general statement is not. In any case, the second assertion is a claim about the specific events involved

⁵² For a detailed analysis of experts as educators, see Ronald J. Allen & Joseph S. Miller, *The Common Law Theory of Experts: Deference or Education*, 87 NW. U. L. REV. 1131 (1993).

⁵³ Edward Imwinkelried has made a similar distinction between what he terms the expert’s major and minor premises: “The major premise is a principle, procedure, or explanatory theory derived by the inductive, scientific technique. The [expert] applies that major premise to the facts of the case” and these specific facts are the witness’s minor premise. Edward J. Imwinkelried, *The “Bases” of Expert Testimony: The Syllogistic Structure of Scientific Testimony*, 67 N.C. L. REV. 1, 2-3 (1988); see also Edward J. Imwinkelried, *The Educational Significance of the Syllogistic Structure of Expert Testimony*, 87 NW. U. L. REV. 1148 (1993).

in the litigation—a type of statement that we classify and discuss as an *assessment* of causation.

As usual, effort can make the boundaries fuzzy. Consider, for example, the archetypal early twentieth-century hypothetical question in which the lawyer would ask an expert for his opinion about the cause of death of a “hypothetical person.” In form, the lawyer would ask for an opinion on the cause of death of *anybody* in like circumstances, but the actual question (which sometimes went on for pages) would incorporate a whole series of *particular* facts that happened to be in evidence in the case at hand, and the expert would provide an opinion assuming these many ostensibly hypothetical facts to be true.⁵⁴ Strictly speaking, the testimony is framed in general non-case-specific terms and, therefore, fits our definition of “instruction.” But the effect, of course, if we look past the formal structure of the testimony to its substance, is an extremely fact-specific opinion that is best described as an “assessment.”

Whatever the dividing line between instruction and assessment, most experts—and certainly most expert witnesses—go back and forth across it and provide both types of information. This need not be the case. Eyewitness identification experts, for example, if permitted at all, are typically allowed to provide instruction only. They may testify, for example, that in general cross-racial identification is more likely to be erroneous than intra-racial identifications, or that eyewitness confidence is not generally a good predictor of eyewitness accuracy. But case-specific testimony evaluating the merits of a particular eyewitness’s identification, if offered, would typically be excluded as an invasion of the province of the jury.⁵⁵ Most experts, however, do provide case-specific assessments, and usually incorporate instruction into that testimony, to make their conclusions both more comprehensible and more persuasive.

In this Article we discuss two different kinds of instructional statements: claims about matters of fact in the physical world, and

⁵⁴ The case of *Treadwell v. Nickel*, 228 P. 25 (Cal. 1924), describes an extreme example: an eighty-three page hypothetical question, followed by a fourteen page objection.

⁵⁵ Some judges believe that even permitting expert testimony on the lack of relationship between confidence and accuracy invades the province of the jury. In *Garden v. State*, 815 A.2d 327, 338 (Del. 2003), the trial court rejected the portion of the eyewitness identification expert’s testimony dealing with the confidence/accuracy relationship “because such opinion would amount to a comment on the veracity of the witnesses who testified and thus would invade the province of the jury.” The Delaware Supreme Court found the exclusion to be error, albeit harmless. *Id.*

statements about social norms—customs, common practices, ethical and professional standards, research methodologies. In both contexts the expert gives her views on the state of the world—instruction on norms, in this sense, is factual rather than normative—but the purposes to which each kind of instruction are put in court are quite different. Much (though by no means all) factual instruction is uncontested, and typically, even when controversial, it is not a central issue in a case but rather serves as the background for an assessment. Occasionally, however, a disputed general factual proposition—in the classic case, “Bendectin is a human teratogen”—is an essential element of a claim. By contrast, in malpractice claims against professionals—lawyers, accountants, psychotherapists, and especially doctors—instructional opinions about norms—the professional standard of care for the conduct at issue—are often at the heart of the case. As we shall see, these differences in nature and purpose have implications for the admissibility of these two types of instructional testimony.

(a) Facts

If you want to know an esoteric fact, you ask an expert, or—much the same thing—check a book or an article written by one. Most of the time we can rely on the information we get in this manner because the answer, although news to us, is well-known and uncontroversial among those who specialize in the area. This can be true for information at any level of generality, from the universal (“the speed of light in vacuum is 299,792,458 meters per second”) to the highly particular (“73% of the respondents on this survey did not know the name of either of their United States senators”).

In court, much expert information of this sort could be presented without testimony by any witness. Frequently, the statements at issue—that human blood has a pH of 7.4, for example, or that every person (except an identical twin or a clone) has a unique DNA sequence—are suitable subjects for judicial notice because they are not open to reasonable dispute and are “capable of accurate and ready determination by resort to sources whose accuracy cannot reasonably be questioned.”⁵⁶ In practice, such information is generally introduced in the course of expert testimony, in part because the statements accompany other information provided by the expert that could not properly be judicially noticed, and in part because a well-prepared expert witness is more likely than the judge to present the information in a manner that is helpful to the side that

⁵⁶ FED R. EVID. 201.

called her.

A layperson cannot know in advance which propositions are not in dispute in medicine or physics or genetics. Out of court, we can guard against being misled (as usual) by asking more than one expert, or consulting more than one reference, or relying on a source—the United States Census Bureau, for example—whose authority we do not doubt. In court, the adversarial process defines what is in dispute, and undeniable expert facts are likely to form part of the uncontested background for the assessments that are contested. The parties may fight about whether a substance found in the defendant's possession was cocaine, but they are not likely to fight about the chemical make-up of cocaine itself. They might disagree about whether a DNA-typing test was done correctly in the particular case, or about how to interpret the evidentiary significance of finding the defendant's DNA at the crime scene, but they are unlikely to do battle over the general premise that apart from identical twins, a person's DNA genome is unique. On background issues of that sort, there is no debate about factual accuracy, and hence no question of reliability or admissibility. There is still room for bias, of course, in the selection and organization of the material. A testifying expert (like any teacher) chooses what to present from a large array of possible pieces of information; she may select the background facts most useful to her party's case and omit other information that is less helpful to her client. This form of bias is almost invariably addressed by cross-examination and rebuttal testimony rather than exclusion. Assuming the opposing party is motivated and prepared, these may well be adequate mechanisms for checking partisan impulses to provide partial information.

As we move away from well known facts about which there is little or no disagreement, matters become more complicated. In theory, this is a problem that can be addressed: after more tests, more study, and more examination, we might someday reach answers that, if not wholly conclusive, may at least achieve widespread consensus. For a straightforward issue—the population of Detroit in 2000—a single, well-executed study (the decennial census), despite its imperfections, may provide as good an answer as we will ever have. But for difficult and complex questions (the origin of HIV; the structure of quarks) the process is likely to be complicated and uncertain, and even many comparatively easy issues are never addressed, or the studies are not complete when we need them. Whether because of the complexity of the issue or the paucity of the data (or both), at any point in time, a general factual question may have no clear answer. Knowledgeable people may disagree on what

the answer is, or whether it is known, or even whether the question is answerable. And even if there is a reasonably clear answer out there somewhere, it may be no mean feat to find it. None of us can absorb even a tiny fraction of the general knowledge that exists in our extremely complex culture. We have no choice but to rely on experts, those who know the issue best—which merely pushes the problem back a step, to the identification of the most knowledgeable experts to rely on.

How do we determine matters of instructional fact outside of the courtroom? On routine issues, even debatable ones—and often on big ones as well—we do not invest a lot of energy in screening expert instruction. We look in well-known sources or ones we are familiar with (the Internet, the New York Times), we ask experts we have used before who are referred to us by friends and acquaintances, or we see what highly-credentialed experts have to say. If it *really* matters, however—if a lot of money, or the future of an institution, or someone's life or health is at stake—we increase our search costs. We spend time and energy to identify leading experts and to learn what they think about the matter.

What exactly are we searching for? Since we cannot identify accurate expert instruction directly, we look for the best available proxy: the consensus of well-informed experts in the field. Of course there may not be a consensus, and if there is, it may be out-of-date or just plain wrong. But figuring out the consensus viewpoint, if there is one, is the starting point of any well-conducted inquiry into general facts outside of litigation; more often than not, it is the ending point as well.

In the context of litigation, identifying a consensus among experts in court can be very hard. The expert's credentials are not much help. An imperfect proxy for knowledge in the best of circumstances, credentials lose nearly all of whatever value they may have when expert witnesses are chosen by the parties, from among those who will say what the parties want to hear, in part precisely because of their seemingly impressive credentials.⁵⁷ Worse, the

⁵⁷ See Gross, *supra* note 25, at 1134. With most witnesses, parties are constrained by circumstances: they have no choice but to use those who, because of their physical relationship to the facts, have uniquely valuable information. (The personal knowledge rule operates as a proxy for information quality, supplemented by extensive (though not necessarily effective) mechanisms for testing witness credibility to weed out percipient but unreliable observers.) In the context of factual instruction, where the issues are ones of general knowledge, parties are not limited by the happenstance of percipient witnesses. Since they can call any qualified expert who is willing to cooperate, they can, in principle, get the best available evidence in every case. In practice, their dominant incentive is to get the most useful expert

parties who call expert witnesses have no common interest in identifying a consensus among experts. On the contrary, if there is any room at all for a dispute among experts, one side or both may have an interest in obscuring the extent of general agreement within the field and creating the appearance of an active dispute when there is none. The experts the parties call may take positions that are at best outliers within their own specialties but sound perfectly plausible to outsiders. If the factfinder is a jury, it may not even have the power to put questions to the party experts, much less seek another opinion or investigate another source.⁵⁸ If the plaintiff calls an expert who testifies that silicone gel breast implants are known to cause autoimmune diseases, and the defendant calls an expert who testifies that there is no evidence that these devices produce that effect, the factfinder is in no position to judge which statement reflects a consensus in the field, if one exists, and which statement is considered unlikely or simply false. In any other contexts, the answer would be to check with experts who are not chosen by and identified with those parties whose interests are directly at stake—a panel assembled by the NIH rather than researchers hired by the pharmaceutical company whose product is being studied. That procedure is available in court under Federal Rule of Evidence 706, but, as we have mentioned, it is rarely used, and almost never in routine cases.

If credentials do not help much, and unbiased expertise is not sought, what legal tools are left to address conflicting expert claims about general factual propositions? We can exclude the evidence, or we can do our best to make use of what we get. In practice, we rely on the second sort of remedy more often than the first.

Daubert and its progeny—including the post-*Daubert* version of Rule 702—require courts to assess the validity of this sort of expert evidence. But how? By what standard? If we are not concerned about the validity of the field (if we are dealing with medicine, for example, and not astrology), a consensus of informed experts about the matter of general fact should certainly be sufficient to justify admission, but is probably too much to require. On one hand, if the cause of a phenomenon is unknown—and generally agreed to be unknown—this requirement would prevent the jury from getting any meaningful expert assistance on causation, since the only thing an expert witness could testify to is the consensus that experts do not

testimony to support their position, not the most accurate.

⁵⁸ Some courts permit jurors to ask questions of witnesses through the judge, but this varies by jurisdiction and the temperament of the judge. Judges can, of course, question witnesses.

know. On the other hand, for the large array of issues on which experts disagree on whether there is a consensus, or on what the consensus is, this rule would be impossible to administer. Could judges possibly determine the existence of an expert consensus, item for item, as a precondition to permitting any expert witness to make general factual claims? The difficulties of applying *Frye* pale by comparison.

A judge could demand a lesser degree of agreement as condition for expert instruction. A mild version of this inquiry into the consensus of the field seems to us to be a reasonable requirement for expert instruction. Because the judge's role is merely to decide whether the information may be considered at all, the test should be whether other experts in the field generally agree that the factual claim is plausible. This is a different kind of agreement than that demanded by *Frye* ("general acceptance" of the method or technique), and it does not require any level of agreement on the ultimate truth of any asserted fact. The focus, rather, is on the legitimacy of the factual claim: is it (at a minimum) considered a debatable point among those who know best?

Rule 702 speaks to the issue of instructional testimony only obliquely.⁵⁹ This category of testimony does not fit neatly into the Rule's structure, which assumes that expert testimony will apply "to the facts of the case."⁶⁰ Nonetheless, Rule 702 can be interpreted to impose a reliability requirement on general factual instruction, as for all expert testimony. To the extent that courts do scrutinize scientific testimony about general facts, we suspect that their inquiry focuses on the kind of consensus we have described: the degree of plausibility of the factual proposition within the witness's field. In general, however, the courts make no such inquiry. They simply require that an expert be "qualified," and then—except in a small group of unusual but important cases—allow them to make a wide range of general factual claims within their fields of expertise. Once a witness has been permitted to testify as an expert under Rule 702, judges usually leave the task of correcting and explaining their instructional statements to the opposing parties and the expert witnesses they call.

Occasionally, a party may call an expert witness who says things that are simply bizarre. This seems to happen most often in criminal cases, where resources and standards of practice—especially on the defense side—are sometimes abysmally low. In the 1980s, for

⁵⁹ FED. R. EVID. 702. Rule 702 was revised in 2000 in the wake of *Daubert* and *Kumho Tire* to emphasize the reliability requirement for expert testimony.

⁶⁰ *Id.*

example, an anthropologist named Louise Robbins was allowed to testify for the prosecution in several cases that it is possible to identify a person from nothing more than a shoe print—the *wearer*, not the shoe.⁶¹ The only explanation is incompetence by the judges, the defense attorneys, or both. (Her testimony was also excluded several times. Even so, the fact that she did testify repeatedly—indeed, that prosecutors even considered using her—is some measure of what’s *not* considered a problem.) Usually, however, it is not the statement itself that is implausible but the confidence with which it is uttered. The problem is not the assertion that exposure to asbestos *might* cause colon cancer, but the claim that it *does*.

On reflection, it appears that the level of certainty that a witness attaches to a statement is likely to be the dominant problem for this type of expert testimony. If an expert testifies, for example, that a scientific study published in a peer-reviewed journal found that ephedra had a teratogenic effect on mice when ingested at a certain dose, this is as unproblematic as instructional testimony can be; the expert is reporting a fact that can easily be checked. The expert might then go on to testify, however, on the basis of that study (perhaps in conjunction with other information, perhaps not), that in her opinion ephedra *is* a human teratogen. Although phrased as an “opinion” this second claim is still “instruction” rather than “assessment,” since the conclusion remains general rather than case-specific. But there is much more reason to be concerned about reliability at this higher level of generality. The study might be biased or poorly-conceived, and even if it is flawless, it might not be a sufficient basis for the expert’s general conclusion. Even so, the issue is not so much the possible causal link the expert draws between ephedra and birth defects, but her confidence in the existence of that link. Few would quarrel with the witness if she had said that ephedra “might” be a human teratogen, or even perhaps that “there is a substantial risk” that it causes birth defects. The problem emerges as she moves up the ladder from *possible* to *probable*, to *very likely*, to *is*.

In the usual case, however, testimony is not excluded because a witness is too certain or too uncertain. Normally, a witness’s level of confidence is grist for the adversarial mill: the jury considers it in evaluating the witness’s credibility, taking into account any in-roads made in cross-examination, inconsistent evidence on rebuttal, and arguments by counsel. Lots of witnesses are excessively self-assured;

⁶¹ See Paul C. Giannelli, *The Abuse of Scientific Evidence in Criminal Cases: The Need for Independent Crime Laboratories*, 4 VA. J. SOC. POL’Y & L. 439, 457-62 (1997) (discussing Louise Robbins’s so-called expertise).

many are simply wrong. We do not exclude an eyewitness who says she is 100% certain that she can identify the defendant as the man she saw from fifty feet, across a dark parking lot, for five seconds; we impeach her. By the same token, we do not generally exclude testimony from a doctor who says that he *knows* that regular exercise decreases the risk of coronary heart disease. Like the eyewitness, even if this expert is correct on the ultimate issue, she may not be entitled to speak with the level of confidence that she expresses; like the eyewitness, the jury will usually be allowed to hear her testimony, and the opposing party will have a chance to try to get her to weaken or qualify it, or to make it seem unreasonable.

There are, however, several important differences between the lay eyewitness and the expert providing fact instruction. The structural incentives for the expert to distort and overstate are significantly greater. The pressure of litigation, the partisan identification an expert may develop over time, and the fact that the expert receives payment may spur even a well-intentioned expert to make instructional inferences in a stronger form than a fair-minded reading of the evidence supports. Moreover, it may be precisely the degree of overstatement that makes otherwise plausible testimony unreliable.

When does a general factual proposition become so unreasonable that it may be excluded entirely from evidence? In some tort cases a general factual proposition is a necessary step to establish causation, and substantive tort law requires expert testimony on causation that is phrased in terms of a specified level of confidence. In that situation the admissibility of expert instructional testimony on a question of general fact is outcome determinative, and detailed attention by the parties and the court is worth the candle. For example, in *Joiner*,⁶² the plaintiff claimed that he was exposed to PCBs by the defendant, and that the exposure caused the small cell lung cancer from which he suffered. The district court excluded the plaintiff's proffered expert testimony on causation because "the court is not persuaded by a preponderance of proof that the studies support the 'knowledge' the experts purport to have (i.e., that PCBs, 'to a 'reasonable degree of medical certainty,' promote small cell lung cancer in humans)."⁶³ And, since the plaintiff was now without this necessary testimony—"to a reasonable degree of medical certainty"—the court granted the defendant's motion for summary

⁶² 522 U.S. 136 (1997).

⁶³ *Joiner v. Gen. Elec. Co.*, 864 F. Supp. 1310, 1326 (N.D. Ga. 1994) (internal citation omitted).

judgment and dismissed the claim.

In *Joiner*, the Supreme Court affirmed the district court's ruling.⁶⁴ The main issue in *Joiner* was the standard of review on appeal of a ruling excluding evidence under Rule 702. The Supreme Court concluded that "abuse of discretion is the proper standard by which to review a district court's decision to admit or exclude scientific evidence," and that "the District Court did not abuse its discretion in excluding . . . [the plaintiff's expert] testimony."⁶⁵

Under *Joiner*, other district courts could reach the opposite conclusion and admit identical expert testimony on the identical issue of general causation. This is a disturbing rule. The trial court's conclusion in *Joiner* that "there is simply too great an analytical gap between the data and the opinion" is really a substantive judgment that the plaintiff's evidence is insufficient masquerading as a procedural judgment that it is inadmissible. It may make perfect sense to give trial courts the authority to decide this issue—but why call it an evidentiary ruling, all but eliminate appellate oversight, and create a situation in which the very evidence that is legally sufficient to prove a fact before Judge Monday is excluded entirely by Judge Friday?

There are bounds on the discretion conferred by *Joiner*. Courts do not like to look (or to be) foolish. If a general proposition becomes widely accepted in a respected community of experts, courts usually fall in line, if sometimes after an uncomfortable gap. In the first part of the twentieth century, most physicians believed that a single traumatic blow could cause a malignant tumor, but by 1940 there was a medical consensus rejecting this theory. It had an afterlife of sorts, however, in court: it was presented with approval in at least a few cases for another fifteen or twenty years⁶⁶—but apparently not beyond the early 1960s. Today, it would be rejected out of hand.

We have seen this process repeatedly in the past several decades in mass toxic tort litigation. In a typical mass tort situation, many separate plaintiffs make the identical argument on general causation, the issue is subject to systematic study and replication, and vast amounts of money are at stake. Given these circumstances, the general causal relationship between the substance and the pathology at issue is studied repeatedly, and eventually everybody (or almost

⁶⁴ *Joiner*, 522 U.S. 136 (affirming the district court's exclusion and reversing a decision by the Eleventh Circuit).

⁶⁵ 522 U.S. at 146-47.

⁶⁶ Gross, *supra* note 25, at 1184 n.217.

everybody) agrees that there is or is not a causal connection. In *Daubert*, for example, the plaintiff's experts were prepared to testify in 1989 "that to within a reasonable degree of certainty Bendectin is a teratogen,"⁶⁷—testimony that in form is very similar to that offered in *Joiner*. But the context was different. By 1989, thirty separate epidemiological studies had failed to find a significant relationship between Bendectin and birth defects.⁶⁸ Given that body of knowledge, the proposition that Bendectin does not cause birth defects—like the claims that asbestosis causes lung cancer⁶⁹ and that silicone-gel breast implants do not cause systemic disease⁷⁰—was no longer open to debate. One way or another, courts now treat these factual statements as rules of law.

Courts do not generally have problems with the expert instruction that sticks close to observable facts. They will not hesitate to admit testimony from a harbor pilot who testifies that he has seen several twelve-meter yachts pass under a particular bridge at high tide, or from a doctor who testifies that he has seen several patients with this sort of injury relearn to walk. Whether we trust doctors more than pilots (or less), the structure of the testimony is the same: "I've seen it happen; draw your own conclusions." For factual generalizations, however, courts are likely to discriminate between fields in a manner that reflects their assessment of the strength of the scientific basis for the discipline. The harbor pilot will be allowed to testify about the height of tides in the harbor he works in, but not about the causes of unusual tidal patterns. Epidemiological evidence that asbestos causes lung cancer is viewed as conclusive, but testimony from a questioned document examiner that forgeries can *always* be detected will meet with skepticism, and testimony from an astrologer that Virgos have controlling personalities would be excluded if it

⁶⁷ *Daubert*, 727 F. Supp. at 574 (emphasis added).

⁶⁸ *Daubert*, 951 F.2d at 1129.

⁶⁹ See, e.g., *Norfolk & W. Ry. v. Ayers*, ___ U.S. ___, 123 S. Ct. 1210, 1222 (2003) ("[T]here is an undisputed relationship between exposure to asbestos sufficient to cause asbestosis, and asbestos-related cancer.").

⁷⁰ See, e.g., *Meister v. Med. Eng'g Corp.*, 267 F.3d 1123, 1132 (D.C. Cir. 2001) ("[T]he defendants introduced expert testimony that was supported by a uniform body of evidence including epidemiological studies failing to establish a causal link between silicone breast implants and connective tissue disease Hence, the district court could reasonably conclude that reasonable people could not differ as to the import of the epidemiological evidence."); *Pozefsky v. Baxter Healthcare Corp.*, 92-CV-0314 (LEK) (RWS), 2001 U.S. Dist. LEXIS 11813, at *20 (N.D.N.Y. Aug. 16, 2001) ("Because Plaintiff has failed to establish the scientific reliability of his theories on causation and the overwhelming weight of scientific authority to the contrary, the Court will join these courts and exclude the testimony of [Plaintiff's expert] as to the causation of Plaintiff's alleged [systemic] condition by her silicone breast implants.").

were ever offered.

These sorts of distinctions, of course, are exactly what Rule 702 requires: courts must determine whether expert instruction “is the product of reliable principles and methods.”⁷¹ For factual generalizations about the nature of the world, our touchstone is the scientific method of observation, experimentation, and replication. How proficient courts are at applying these principles is another question. Occasionally, they exclude plausible but unproven generalizations (for example, that exposure to PCBs promotes small cell lung cancer). More often, courts admit unreliable generalizations because they are accustomed to evidence of that sort—handwriting expertise, for example⁷²—or because the witness has impressive professional credentials—a Ph.D. (like Louise Robbins⁷³) or an M.D.

(b) Norms

A different kind of instructional information concerns the norms of a field—typically, customs and standards of care. In a malpractice suit, for example, a witness may testify about the appropriate standard of care for treatment of asthma in infants, offering instructional expertise. These claims are also empirical—the witness is describing the custom of the field, her opinion about what is done in ordinary practice—but the empirical facts they concern are socially created. The expert’s task is not to describe the *best* treatment for a condition, but rather the *standard* treatment. Ideally, the latter will conform to the former, but not immediately, not always, and not everywhere.

Outside of litigation, this category of expert information is comparatively unimportant, except to the extent that it is used in less formal attempts to assign responsibility or blame. In torts cases involving professionals, however—doctors, lawyers, accountants, psychotherapists—these instructional opinions are often the heart of the case, the key testimony on the key legal question. Because the content of professional norms is central to malpractice litigation, factual information about these norms is essential. Because this information concerns social norms rather than natural facts, it is treated differently from other types of expert instruction.

The only essential requirement for an expert on the norms of a community is, obviously, familiarity with that community and its

⁷¹ FED. R. EVID. 702.

⁷² On the history of handwriting identification, see Mnookin, *supra* note 12.

⁷³ Giannelli, *supra* note 61.

behavior. This prerequisite mirrors the knowledge that is required of a translator, except that in this context, the expert must be familiar with the *customs* and *practices* of the culture (or subculture) rather than its *language*. Accordingly, in court, the only requirement for an expert witness who testifies about professional norms is that she qualify as an expert in that profession. Any competent endocrinologist can offer opinions about the ordinary and acceptable practice of endocrinologists, and any experienced criminal defense attorney can talk about the norms of her profession.

Note that the ultimate question in cases involving standards of care or custom is *Frye*-like: What is the *generally accepted* practice of a given community? Here however, the “general acceptability” of a practice is a question for the trier of fact, not a foundational requirement for admissibility. Since the content of the norm *is* the question for the jury—and perhaps also because the issue is so thoroughly one of *social* norms—we are willing to admit even idiosyncratic opinions about community norms, so long as these idiosyncratic opinions come from *bona fide* members of the relevant community. The key for determining admissibility is the speaker, rather than the substance of what is spoken; we evaluate qualifications, rather than the validity of the content of the testimony.

There are, of course, subsidiary issues. How close must the fit be between qualifications and the question at issue? Should a non-specialist physician be able to testify about the custom of a particular medical specialty? Should a family practitioner be allowed to testify about the standard of care in a case involving high-risk obstetrics? Should a properly trained physician who no longer sees patients be allowed to testify about treatment norms? Courts have generally treated these issues as going to weight rather than admissibility, but at some point, a mismatch between the expert’s experience and the norms about which she is testifying may become so glaring that exclusion is appropriate.

As always, bias is an important issue for instructional expert testimony about standards and customs. Two kinds of bias are of particular concern. First, there is partisanship—the bias of the professional expert who may be all too willing, consciously or unconsciously, to tailor her testimony to suit her client’s needs. Second, there may be a problem of professional solidarity—a tendency to avoid criticism of colleagues. Even if they have no personal relationship, one physician may be reluctant to testify against another, either out of a sense of professional camaraderie, or because the witness recognizes that the mistake the defendant made was one that the witness could well have made herself. In addition,

there is the general problem of hindsight bias: it may be too easy after the event to criticize actions that were in fact reasonable in light of what was known at the time. All of these issues of bias typically are understood to affect the weight of the evidence but not its admissibility.

Daubert and its progeny have had little effect on this kind of instructional testimony. While physicians' evidence about causation in toxic torts cases has been curtailed in the last decade,⁷⁴ physicians' testimony about standards of care remains substantially unchanged. This lack of substantive scrutiny seems largely appropriate since there is no external standard by which to evaluate evidence on the norms and practices of a social group. For the same reason, however, courts should scrutinize the *fit* between the speaker's experience and the community about which she speaks. Of course, requiring too close a fit may heighten the danger of bias. If only Charlottesville cardiovascular surgeons can testify about the proper standard of care for a triple-bypass operation in Charlottesville, we might be concerned that the only qualified witnesses would be biased in favor of the defendant because of local professional and community ties; a concern for fit should not be used as an argument for resurrecting the locality rule in medical malpractice cases. On the other hand, it seems reasonable to require that the witness practice cardiovascular surgery *somewhere*. So long as professional communities are defined on a national basis, it ought to be possible to require a close fit for an expert who testifies on professional norms without unduly limiting the pool of potential witnesses.

3. Assessment

When we hire an expert, an architect, or a surgeon, we usually want them to do things for us. One of the most important things we may want them to do is make decisions—where to build, whether to operate—or at least to make specific recommendations. Other than doing the tasks themselves, that is the central function of experts: to provide specific, concrete advice on what course of action to take. Their most conspicuous function in court is much the same, but in a context in which that sort of advice is otherwise prohibited.

Perhaps the most basic distinction in American trials is between the job of the witness and that of the trier of fact. These are the only two absolutely essential speaking roles in court. The parties typically only speak as witnesses, and we can and often do conduct trials

⁷⁴ On the transformation of standards for proving causation, see Finley, *supra* note 16, and Sanders & Machal-Fulks, *supra* note 16.

entirely without lawyers. But there can be no trial without someone to provide evidence and someone to judge it. At ancient common law, these functions might merge: jurors were sometimes selected because they knew the circumstances of the case. We now require strict separation. Jurors and judges evaluate evidence, but do not produce it. They may only consider information about the case that they hear from witnesses in court; they may not be witnesses themselves;⁷⁵ and if they know too much about the facts from extra-record sources, they may not be allowed to serve at all. On the other side, witnesses are supposed to present information, not evaluate it. They are limited by the personal knowledge⁷⁶ and lay opinion⁷⁷ rules to testimony about matters they perceived (“I saw two men cross the street”), and to low level descriptive inferences based directly on their own perceptions (“The older-looking man was speaking very quickly”).

Except for experts. Expert witnesses are not subject to the personal knowledge rule or the lay opinion rule. They are allowed to make wide-ranging evaluations based on many types of evidence, first- and second-hand, admissible and inadmissible; they may express opinions on the precise factual issues the judge or jury must decide; they may evaluate the entire body of evidence before the court and tell the trier of fact what decision to reach. These case-specific evaluations, applying background knowledge and expert skill to the facts at hand, are what we call “assessments.” In many cases expert assessments take the form of judgments that can be adopted directly by the trier of fact: “The accident was caused by faulty wiring in the fuselage,” or “the defendant is the biological father of the minor child.” For some claims, expert assessments are required as elements of proof.

Because of their power and importance, expert assessments have received a great deal of attention. They are the visible high-end of expert evidence. For just that reason, we devote relatively little space to them. Our main agenda is to explore types of expert evidence that have received insufficient attention, and this one does not qualify. Quite the opposite: We could not begin to do justice to the range of assessments that are offered by expert witnesses, or to the vast literature discussing them. Instead, we will offer a set of observations that connect expert assessments to the other types of expert evidence—observation and instruction—that we have already

⁷⁵ See FED. R. EVID. 605 (prohibiting judges from testifying as witnesses); FED. R. EVID. 606 (prohibiting jurors from testifying as witnesses).

⁷⁶ FED. R. EVID. 602.

⁷⁷ FED. R. EVID. 701.

discussed. Indeed, we have already discussed expert assessments themselves, to some extent, to point out the distinctions between assessment and observation or instruction, and the overlaps between them.

We use a medical malpractice case, *Zuchowicz v. United States*,⁷⁸ to illustrate a common and important type of expert assessment and to raise two issues that we will talk about briefly: (1) the relationship between assessments and other types of expert evidence, and (2) the treatment of expert assessments that are not based on “science.” While our discussion focuses primarily on assessments of causation, much of the analysis is applicable to the other kinds of assessment in our taxonomy as well.

(a) Assessments and other types of expert evidence

The plaintiff in *Zuchowicz* developed the rare disease Primary Pulmonary Hypertension (PPH) shortly after a naval pharmacy instructed her to take over twice the maximum daily dose of the drug Danocrine.⁷⁹ The United States as defendant conceded that its doctors and/or pharmacists had been negligent, and that the plaintiff died from this disease. The only triable issues were causation—did the overdose of Danocrine cause Mrs. Zuchowicz’s PPH?—and damages. The district court, sitting without a jury, granted judgment to the plaintiff, and the Second Circuit affirmed.⁸⁰

Most of the factual discussion in the Second Circuit opinion is based on expert evidence, although the court does not always seem to be aware of this. We are told that starting in late February 1989,

Mrs. Zuchowicz took the 1600 milligrams of Danocrine each day for the next month. Thereafter, from March 24 until May 30, she took 800 milligrams per day. While taking Danocrine she experienced abnormal weight gain, bloating, edema, hot flashes, night sweats, a racing heart, chest pains, dizziness, headaches, acne, and fatigue.⁸¹

The symptoms discussed in this section could have been described by lay observers. Undoubtedly, most of the information (hot flashes, night sweats, headaches, dizziness, etc.) originally came from statements by the deceased plaintiff herself. In practice, however, it is likely that all of these symptoms were described in court by experts, the testifying physicians, and mostly on the basis of reports from

⁷⁸ 140 F.3d 381 (2d Cir. 1998).

⁷⁹ *Id.* at 383.

⁸⁰ *Zuchowicz v. United States*, 870 F. Supp. 15 (D. Conn. 1994), *aff’d*, 140 F.3d 381 (2d Cir. 1998).

⁸¹ *Zuchowicz*, 140 F.3d at 384.

other physicians or nurses. Certainly few patients would describe a symptom they experience as “edema.” We are then told that:

In October 1989, [Mrs. Zuchowicz] was diagnosed with primary pulmonary hypertension (“PPH”), a rare and fatal disease in which increased pressure in an individual’s pulmonary artery causes severe strain on the right side of the heart. At the time she was diagnosed with the disease, the median life expectancy for PPH sufferers was 2.5 years. Treatments included calcium channel blockers and heart and lung transplantation.⁸²

Most of this section is expert instruction: the nature of PPH, the fact that it is rare, a patient’s life expectancy after diagnosis, and standard treatments. The initial statement, however, is an expert *assessment*: that the plaintiff was diagnosed as suffering from PPH. In the context of this case, it is not controversial, but it is an expert assessment of her condition all the same. Inevitably, it will have been based in part on expert observations—blood pressure measurements, perhaps other tests—by the testifying witnesses or (more likely) by other experts, that may or may not have been described in court.

The opinion next proceeds to a detailed discussion of the PPH:

Pulmonary hypertension is categorized as “primary” when it occurs in the absence of other heart or lung diseases. “Secondary” pulmonary hypertension is diagnosed when the hypertension results from another heart or lung disease, such as emphysema or blood clots. PPH is very rare. A National Institute of Health registry recorded only 197 cases of PPH from the mid-1980s until 1992. It occurs predominantly in young women. Exogenous agents known to be capable of causing PPH include birth control pills, some appetite suppressants, chemotherapy drugs, rapeseed oil, and L-Tryptophan.

According to the district court’s findings of fact, the disease involves the interplay of the inner layers of the pulmonary blood vessels known as the endothelium and the vascular smooth muscle. The endothelium releases substances called vasodilators and vasoconstrictors, which dilate and constrict the blood vessels.⁸³

The court goes on to present the current theory of the cause of PPH: “If too many vasoconstrictors are released, the blood vessels

⁸² *Id.* (citation omitted).

⁸³ *Id.* at 384-85 (internal citations omitted). In the context of this case, the instructional testimony about the causal relation between PPH and other drugs was uncontroverted, part of the generally accepted background information about the condition. If one of these other causal relations were at issue in the case, what was taken as true in *Zuchowicz* might instead have been challenged as insufficiently established.

contract, the endothelial cells die, and the vascular smooth muscle cells proliferate. These actions create increased pulmonary vascular resistance.”⁸⁴ All of this, of course, is based on expert instruction, which continued in the court’s discussion of the drug at issue, Danocrine:

According to the testimony of plaintiff’s expert Dr. W. Paul D’Mowski, who personally performed much of the initial research on the drug, Danocrine is safe and effective when administered properly. Based on studies by Dr. D’Mowski and others, Danocrine was approved by the Food and Drug Administration (“FDA”) for use in dosages not to exceed 800 mg/day. Mrs. Zuchowicz was accidentally given a prescription instructing her to take twice this amount—1600 mg/day. According to Dr. D’Mowski no formal studies of the effects of Danocrine at such high doses have been performed, and very, very few women have received doses this high in any setting.⁸⁵

This too is expert instruction, and like everything above it, uncontroversial, at least in this case. With all that now on the table, the dispute is narrowed to the two last points the plaintiff must prove: “(a) that defendant’s act in giving Mrs. Zuchowicz Danocrine was the source of her illness and death, and (b) that it was not just the Danocrine, but its negligent overdose that led to Mrs. Zuchowicz’s demise.”⁸⁶

After the discussions of PPH and Danocrine, the opinion turns to a new section entitled “The Expert Testimony” and describes in detail the testimony of two expert witnesses for the plaintiff, a professor of medicine and a professor of pharmacology.⁸⁷ The heading is telling, and misleading. Most of the opinion up to this point is based on expert testimony; one of the experts (Dr. D’Mowski) is even named. What distinguishes the issues discussed under the heading “The Expert Testimony” from those discussed above it is that they are in dispute; they define the question the court must answer: did the plaintiff adequately prove causation? This is a difficult, perhaps unanswerable question; it is the focus of the case. But the context of the question is at least equally important; the issues have been narrowed to that one question, and the court has learnt a great deal about what is generally known (or believed) about Danocrine and PPH. All of this is the product of expert testimony.

And what was included in the evidence labeled “Expert

⁸⁴ *Id.* at 385.

⁸⁵ *Id.*

⁸⁶ *Id.* at 389.

⁸⁷ *Zuchowicz*, 140 F.3d at 385.

Testimony”? Two critical items:

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.⁸⁸

. . . .

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. . . .⁸⁹

The court then proceeds to describe the mechanisms by which, according to Dr. Tackett, Danocrine probably caused the plaintiff’s illness and death.

These are expert assessments of the most ambitious sort. Drs. Matthay and Tackett each testified, in effect, “If I were judge, I’d find for the plaintiff on the issue of causation.” Like any other layperson who consults an expert, the trial judge was free to disregard this advice. In fact—although it is not relevant to the Second Circuit opinion—the defendant almost certainly presented other experts who said the opposite.⁹⁰ A plaintiff, however, is required to present expert evidence of this sort to meet her burden of proof in a medical malpractice case,⁹¹ and if it is accepted by the trier of fact, she wins. In this case, as always, the expert assessments were built on a foundation of expert description and instruction. Much of that was uncontroversial: Mrs. Zuchowicz’s medical history, the nature of PPH, etc. But each of the doctors also relied, implicitly if not explicitly, on two general factual claims that *were* controversial: that Danocrine can cause PPH, and that an overdose of Danocrine increases the chances of developing PPH.⁹² Those propositions were as necessary a step in their reasoning as the parallel claim in *Daubert* that Bendectin can cause birth defects. To the extent that they were discussed explicitly, that too was expert instruction: testimony designed to persuade the trier of fact on an issue of general application.

⁸⁸ *Id.* (emphasis in original).

⁸⁹ *Id.* at 386.

⁹⁰ The trial court’s opinion mentioned one of the defendant’s experts in passing, noting that this expert acknowledged one of the plaintiff’s experts to be an expert in pulmonary hypertension. *Zuchowicz*, 870 F. Supp. at 18.

⁹¹ See *Aspiazu v. Orgera*, 535 A.2d 338, 342 (Conn. 1987); *Shelnitz v. Greenberg*, 509 A.2d 1023, 1027 (Conn. 1986). *Aspiazu* was cited in *Zuchowicz* by the Second Circuit, 140 F.3d at 389, and by the trial court, 870 F. Supp. at 16.

⁹² If the plaintiff would have been equally likely to get PPH if she had received the proper dose, then the pharmacy’s negligence would not have been the cause of her illness.

(b) Nonscientific assessments

In *Daubert*, the Court noted that while Rule 702 applies to all expert testimony, “[o]ur discussion is limited to the scientific context because that is the nature of the expertise offered here.”⁹³ That left open the question of whether *Daubert* applies to nonscientific expertise. In *Kumho Tire*, the Court said Yes: “We conclude that *Daubert*’s general holding—setting forth the trial judge’s general “gatekeeping” obligation—applies not only to testimony based on ‘scientific’ knowledge, but also to testimony based on ‘technical’ and ‘other specialized’ knowledge.”⁹⁴ This holding left open the question of how this general gatekeeping obligation should be carried out for nonscientific expertise, an issue that the Court begins to address in *Kumho Tire* itself, and that has attracted a great deal of attention since.

We start with a different question: Why is the expert testimony that was excluded in *Daubert* described as “scientific” (or at least, would-be scientific) evidence, and the expert testimony that was excluded in *Kumho Tire* as “nonscientific” evidence? The evidence at issue in *Daubert*, as we know, was testimony by several qualified medical experts “that Bendectin can cause birth defects.”⁹⁵ The evidence in *Kumho Tire* was testimony by a qualified engineer with experience as a tire failure consultant, that “a defect in its manufacture or design caused the blow-out” that led to the accident that was the basis for the lawsuit.⁹⁶ What makes the evidence in *Daubert* “science” and that in *Kumho Tire* “non-science”? The distinction does not reflect a difference in the scientific bases of the two disciplines at issue. As the Court notes in *Kumho Tire*, “[e]ngineering testimony rests upon scientific foundations . . .”; arguably, engineering is at least as scientific as medicine.⁹⁷

The difference, rather, is the nature of the issue the experts addressed. The question in *Daubert* was general causation: Can this drug ever have the claimed effect? Because it is a general issue it could be, and, as it happens, had been, systematically studied. The question in *Kumho Tire* was the specific historical cause of a single accident: Why did this tire blow out when it did? Science may provide us with tools (microscopes, reagents, etc.) to help answer that question by examining the remains, but the actual event cannot be

⁹³ 509 U.S. at 590 n.8.

⁹⁴ 526 U.S. 137, 141 (1999).

⁹⁵ 509 U.S. at 583.

⁹⁶ 526 U.S. at 143.

⁹⁷ *Id.* at 150.

replicated and studied systematically. The main factual issue in *Daubert* was what to make of the thirty published epidemiological studies that had failed to find a relationship between Bendectin and birth defects. That issue—in our terminology, a question of fact instruction—is properly in the sphere of science. The factual question in *Kumho Tire* was “whether the expert could reliably determine the cause of this tire’s separation” on the basis of visual inspection of the tire in question.⁹⁸ That question—an issue of expert assessment—was a matter for practical judgment.

There’s an irony here. Although the “nonscientific” expertise in *Kumho Tire* came from an engineer, there is no doubt that the bulk of similar testimony comes from medical experts, the same category of witnesses who provided some of the prohibited “scientific” evidence in *Daubert*. A majority of all witnesses in American trials are medical professionals—M.D.’s alone make up half of the total⁹⁹—who testify primarily in personal injury trials of one sort or another. The most common role for a medical witness is to offer an expert assessment of the medical status of an individual—her condition (diagnosis), or its causes, or her future prospects (prognosis). These assessments are often nonscientific, practical clinical judgments in the same way that the disputed expert testimony in *Kumho Tire* was nonscientific. The disputed expert testimony in *Zuchowicz* is a good illustration.

As the Second Circuit points out, the nature of the issue of causation in *Zuchowicz* essentially precluded scientific evidence on causation:

The rarity of PPH, combined with the fact that so few human beings have ever received such a high dose of Danocrine, obviously impacted on the manner in which the plaintiff could prove causation. The number of persons who received this type of overdose was simply too small for the plaintiff to be able to provide epidemiological, or even anecdotal, evidence linking PPH to Danocrine overdoses.¹⁰⁰

Instead, one of the plaintiff’s experts, Dr. Tackett, offered a causal hypothesis: “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.”¹⁰¹ The conclusion of Dr. Matthey, the plaintiff’s

⁹⁸ *Id.* at 154 (emphasis omitted).

⁹⁹ Gross, *supra* note 25, at 1119; Samuel R. Gross & Kent D. Syverud, *Don’t Try: Civil Jury Verdicts in a System Geared to Settlement*, 44 UCLA L. REV. 1, 31-32 (1996).

¹⁰⁰ *Zuchowicz*, 140 F.3d at 385.

¹⁰¹ *Id.*

second expert on causation, “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.”¹⁰²

There may be nothing wrong with Dr. Tackett’s hypothesis, but that’s all it is—an untested hypothesis. The hypothesis itself was quite possibly reasonable,¹⁰³ and if Dr. Tackett had said that this was a *possible* cause of Mrs. Zuchowicz’s illness, that would have been a plausible scientific statement. Instead, he testified “to a reasonable degree of scientific certainty” that it was “more likely than not” that this theoretical process had the effect he hypothesized, and, even more specifically, that it was more likely than not that the *overdose* caused the disease.¹⁰⁴ This language may have been necessary to meet the substantive legal requirements of the plaintiff’s malpractice claim, but asserting, with that level of confidence, that an untested hypothesis is true in general, and explains a particular event, is not science. Dr. Tackett inferred too much on the basis of too little.

Dr. Matthay’s testimony sticks closer to an accepted expert methodology: differential diagnosis. But it too is not science. Treating physicians must make judgments about the nature and causes of their patients’ pathologies even when they only have limited information, just as judges and juries must make decisions about disputed facts. In the process, doctors (like courts) gather the best information they can—scientific and nonscientific—consider the range of plausible theories, and try to exclude as many as possible. This is probably the best they can do. It may have been reasonable, for example, to conclude that an overdose of Danocrine might have caused Mrs. Zuchowicz’s PPH. That may have been the best educated guess a treating physician could produce; it may have justified a therapeutic decision. But in the absence of any other evidence that Danocrine has ever had this effect, the temporal coincidence between the overdose and the disease in this one case cannot justify a high degree of certainty that the former caused the latter. Dr. Matthay’s testimony—like much medical testimony based on sound clinical medicine—is far closer to the “nonscientific” expertise in *Kumho Tire* than to the “scientific” expert evidence in *Daubert*. But the problem with this testimony, insofar as there is one, is not that it is not science; it is, once again, the excessive confidence with which

¹⁰² *Id.*

¹⁰³ As the trial court notes, another one of the plaintiff’s experts deemed the theory “very plausible.” *Zuchowicz*, 870 F. Supp. at 20. Obviously questions of partisan solidarity—a form of bias—arise when assessing the weight due to corroboration by another expert testifying for the same side.

¹⁰⁴ *Zuchowicz*, 140 F.3d at 385.

the expert's assessment is pronounced.

The expert testimony in *Zuchowicz* was controversial because of the unanswered underlying question of general causation: Can Danocrine, or an overdose of Danocrine, ever cause PPH? This question—a matter that is subject of general expert instruction—is of the sort than could in theory be studied and answered scientifically, although in this instance that might be exceedingly difficult. The district court admitted the testimony over objection, and the circuit court affirmed, essentially on the theory that the plaintiff was presenting the best expert testimony available. Given the discretion conferred by the Supreme Court in *Joiner*, a different trial court could have done the opposite and also have been affirmed.¹⁰⁵ In *Joiner* itself, for example, the trial court excluded specific expert assessments that exposure to PCBs promoted the plaintiff's lung cancer for lack of evidence on general causation: "Plaintiffs have failed to show by a preponderance of proof that their experts' opinions regarding the PCB/lung cancer link are admissible under the standards set out in Rule 702 and explicated in *Daubert*."¹⁰⁶

In many cases, there is no dispute about general causation. Everybody agrees that exposure to asbestos *can* cause lung cancer. But *did* asbestos cause the lung cancer that killed a particular plaintiff—a fifty-eight year-old worker, for example, who was exposed to a moderate amount of asbestos and who smoked a pack of cigarettes a day since the age of 16? In that situation the only disputed issue is one of clinical judgment. In the usual case, each side will present one or more qualified doctors who will testify that asbestos did or did not cause the disease, and the opposing party will not even bother to object.

We do not mean to say that assessments of specific causation are inherently "nonscientific." The terminology is the Supreme Court's, not ours. In some cases the cause of a person's disease can be determined with a high degree of confidence. Extensive studies have shown that the vast majority, if not all cases of mesothelioma—a rare cancer of the lining of the chest, abdominal cavity, or heart—are caused by exposure to asbestos. Given that body of "scientific"

¹⁰⁵ There are no other reported cases regarding a causal relation between Danocrine and PPH. For an example of a disputed issue of causation on which courts are currently reaching contradictory conclusions about admissibility under *Daubert*, see Mark Hansen, "When Expert Testimony Fails the Test: District Courts Disagree on what Defines Causation Evidence in Drug Disability Cases," 88 A.B.A. J. 22 (2002) (examining the cases considering whether Parlodel, an anti-lactation drug, causes stroke, and finding that plaintiff's causation evidence has been excluded under *Daubert* in half of the cases and permitted in the other half).

¹⁰⁶ *Joiner*, 864 F. Supp. at 1326.

knowledge, an expert could assert with a high degree of confidence that the mesothelioma suffered by a particular patient was caused by exposure to asbestos. And advances in science may improve the ability of experts to determine the cause of a patient's illness in harder cases. New tests could perhaps be developed that will detect subtle morphological differences between lung cancer caused by asbestos and lung cancer caused by smoking. Our point rather is that doctors and other experts must regularly make judgments of this sort with limited information. When experts render opinions in the face of great uncertainty, we should recognize both their expertise and its limits.

In our culture, science is the dominant method for answering general factual questions: Does the consumption of trans-fatty acids increase the risk of heart disease? Can earthquakes be predicted by observing the behavior of animals? What is the relationship between confidence and accuracy for eyewitness identifications of strangers? Does Bendectin cause birth defects? When experts claim to be able to address these questions—to provide general factual instruction—courts should require an appropriate relation between the evidence supporting their claim and the degree of confidence asserted. In many cases the best scientific answer is uncertainty: It's likely, it's possible, it's plausible, it's unlikely—but in any event, we don't know.

The capacity to recognize and acknowledge uncertainty and to postpone judgment is an essential element of scientific inquiry. This is a luxury that does not extend to trials, however, or to any other situation in which decisions about particular cases must be made. Doctor, engineers, investigators, judges and juries all must decide how to act on particular facts in the face uncertainty. There is nothing illegitimate about a doctor's decision to recommend radiation treatment instead of chemotherapy to a cancer patient, even though an equally competent colleague down the hall would have done the opposite. Scientific studies may frame the issue and narrow the options, but if they do not provide a clear answer to a question that cannot be put off the doctor will have to do her best by other means: rely on anecdotal data, reason by analogy, or play a hunch. By the same token, it makes perfect sense for courts to listen to expert evidence about specific factual assessments—the diagnosis of a patient's disease or the cause of an accident—even though assessments are not in themselves scientific statements. If similar assessments are used to decide how to treat patients or design tires, courts should be willing to listen.

From a scientific point of view, the main danger of specific assessments based on limited information is overconfidence. To

some extent, this danger may be inherent in the process of making decisions, especially difficult and important ones: those of us who are not plagued by self-doubt tend to become committed to our choices, however arbitrary. A doctor who prefers radiation to chemotherapy for idiosyncratic reasons may come to believe, and tell others, that it is far superior. The use of partisan experts magnifies this effect. Lawyers are likely to encourage their expert witnesses to talk in strong, unambiguous terms and to choose those experts who are likely to do so anyway or willing to take direction. The oncologist who says the plaintiff's lung cancer was "clearly caused by asbestos" may be hired by the plaintiff; the one who says it was "clearly caused by smoking" may be hired by the defendant; but the doctor who says "it looks like _____, but it's hard to tell" will never appear in court, regardless of how he fills in the blank. In addition, as we have seen, the substantive law governing the claim may provide an additional push for the expert to testify that a theory that is reasonable and plausible, but utterly uncertain, is "more likely than not" "to a reasonable degree of scientific certainty."

IV. CONCLUSION

American evidence law consists primarily of objections to the admission of evidence, so most judicial and academic discussions of expert evidence focus on admissibility. In the wake of *Daubert*, the central issues have been the validity of expert evidence, and to a lesser degree the competence of expert witnesses—both of which can pose problems for admissibility—rather than the bias of expert witnesses or the clarity of their testimony, which are almost always said to go to the weight of the evidence. This is a narrow point of view. For most uses of expert evidence, across topics and fields, admissibility is not a problem. The great majority of experts who are called are deemed competent to testify—"qualified"—without opposition. Many types of expert evidence are routinely admitted without explicit consideration of their validity; and in the uncommon cases in which the validity of expert testimony is genuinely disputed, exclusion is often not the best remedy.

We have tried to explore the entire assorted range of expert evidence that is offered in court, and the full range of issues it presents, by developing a taxonomy of expert information. We hope this scheme has some value; we know that it is a preliminary and incomplete effort. For the most part, we give a descriptive account of those uses of expert evidence that we discuss. We do, however, have a few general recommendations. We do not mean to imply that these ideas are original, or that courts do not (sometimes) act on them.

We intend rather to salute those who do and encourage those who as yet do not.

First, attend in detail to the content of expert evidence. Expert witnesses may make many different types of statements. Their testimony will frequently blend observation, description and assessment. Even when part of their testimony is insufficiently reliable, other portions may be admissible. Most qualified experts who are called at trial probably have something to say that the jury should be allowed to hear, even if it is not everything the proponent wants to offer. In deciding on the admissibility of expert evidence, courts should focus on the actual statements the experts intend to make, and exclude only those that are for one reason or another inadmissible, rather than thinking of the expert's testimony as a unit that stands or falls in its entirety. And in *evaluating* expert evidence that is before them, courts should likewise focus on the separate statements rather than the testimony as a whole, and make use of what is reliable and valuable.

Second, pay special attention to the level of confidence the expert witness expresses. In *Daubert* itself the problem was categorical. By 1989, the claim that Bendectin causes human birth defects was simply *bad science*: there had been "more than 30 published studies involving over 130,000 patients," none of which "demonstrated a statistically significant association between Bendectin and birth defects."¹⁰⁷ To assert the opposite, given the strength of the available evidence, was simply not scientifically plausible. More often, however, the real problem with questionable expert testimony is less extreme, that the expert witness has expressed an unjustified degree of confidence. In *Zuchowicz*, for example, it would have been perfectly reasonable to conclude that the plaintiff's primary pulmonary hypertension *might* have been caused by an overdose of Danocrine. That would not have been a scientific *conclusion*—there was too much uncertainty to justify a confident conclusion about causation—but it would have been a plausible *hypothesis*, a clinical judgment on which a doctor or perhaps even a court might reasonably act, especially given the lack of better information. Unfortunately, the informational value of that sort of hypothesis in court is often degraded when it is described as a fact, or even when it is said to be "probable" or "likely" for no better reason than that the party calling the expert would like that statement to be heard. What could be modest but useful expert evaluation is transformed into misleading pseudo-science.

All of us—doctors, lawyers, teachers, judges—are prone to

¹⁰⁷ *Daubert*, 951 F.2d at 1129.

exaggerate. It would be reassuring if this tendency were mitigated in the solemn precincts of our courts, if witnesses and advocates spoke with unusually measured care. For experts at least, the truth is probably exactly the opposite. Confidence and certainty are traits that lawyers seek when they choose experts—and traits they try to instill as they prepare them for trial—because they are understood to be effective. Worse, in many cases substantive rules of law require expert witnesses to phrase their testimony in terms of a specified level of confidence. It is no accident that Dr. Tackett testified “to a reasonable degree of scientific certainty” that it was “more likely than not” that Mrs. Zuchowicz’s death was caused by an overdose of Danocrine; he was required to do so. It may be perfectly reasonable for courts to decide as a matter of law some questions that turn on expert evidence, and to take those issues—or the entire cases—away from the jury. But there is nothing to be gained from rules that distort the evidence that goes into the process, or that require talismanic language that creates special incentives for experts to exaggerate. The experts we call as witnesses will provide better information if we do not encourage them to speak with excessive confidence in order to be heard at all. After they are heard, it may make sense to reject the claims they address by finding insufficient evidence in support as a matter of law—but that judgment should be made on the basis of the best expert evidence we can get, not the most pliable.

Finally, look after the adversarial system. We insist on using partisan, adversarial expertise in court almost exclusively. There are other ways to make use of expert information in litigation—perhaps better ones—but this is ours. As long as we do depend on the adversarial system, we need to have one that actually is what it claims to be: a contest with two sides, where each serves as a check on the other. In many criminal cases, there is only one side on expert issues: the prosecution. The result is a national scandal. We have seen case after case of systematic fraud and incompetence by prosecution experts and police crime laboratories, with no end in sight. *Daubert* and the cases following it were civil cases; the problems they address limit the efficiency of our system of civil litigation, and may result in erroneous judgments at trials where money damages are at stake. The abuses that have been discovered in the use of experts in criminal prosecutions call into question the integrity of our system of determining the guilt or innocence for the most serious crimes, and have produced false convictions that have destroyed the lives of many innocent defendants.