Scientific Avoidance: Toward More Principled Judicial Review of Legislative Science

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Courts increasingly confront legislative enactments made in light of scientific uncertainty. Even so, the degree of deference appropriate to this type of judicial review is a moving target, seemingly determined on an ad hoc, unprincipled basis. On one hand, the decision of how to legislate in light of scientific uncertainty is quintessentially one of policy, suggesting that the highest degree of deference is appropriate. But certain classes of cases, and certain types of scientific questions, seem singularly inappropriate for extreme judicial deference. While significant scholarly attention has focused on the comparative institutional competence of courts and legislatures with respect to substantive areas of law, analogous concerns related to science have been overlooked. This Article attempts to fill part of that gap by evaluating the courts' and legislatures' capabilities with respect to science from a comparative perspective. This analysis leads to a critical examination of courts' traditional deference to statutes enacted in light of scientific uncertainty, and to the conclusion that a more principled framework is needed. Finally, the Article proposes such a framework to account for both positive law and comparative scientific institutional competence.

INTRODUCTION

In the push-and-pull dynamic between courts and legislatures, the proposition that legislatures are better equipped to handle scientific uncertainty is usually taken for granted. Indeed, the Supreme Court has memorialized this concept with the following language: "When Congress undertakes to act in areas fraught with medical and scientific uncertainties, legislative options must be especially broad and courts should be cautious not to rewrite legislation."[1]

Appealing as this "scientific avoidance" principle is, it is based on a number of assumptions that do not always hold true. Contrary to conventional wisdom, for

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1. Marshall v. United States, 414 U.S. 417, 427 (1974); *see also* Gonzales v. Carhart (*Carhart II*), 127 S. Ct. 1610, 1636 (2007) (citing *Marshall*, 414 U.S. at 427 with approval).

example, there are times when courts are the institutions with the comparative institutional advantage regarding science. In addition, this principle of deference assumes a low-level standard of review, so it does not account for how a court should proceed when the scientific issues are relevant to matters that are subject to a more searching scrutiny. Furthermore, the principle leaves open a glaring question: how should a court engage in such review if a legislature actually gets positive science wrong?

Perhaps because of these unexamined assumptions, the courts' evolving application of scientific avoidance has resulted in unprincipled exercises in post hoc rationalization, which suggest that scientific values—rather than those of the legal system—are in control. This approach puts science on a pedestal over law and undermines the significant strengths of the legal system in implementing social, moral, and philosophical values. As between courts and legislatures, moreover, it risks a judicial abdication of constitutional responsibility.

This is not to say that scientific avoidance is never merited. To the contrary, there are many instances in which legislatures *are* the better institutions for considering science; because the legislative branch is politically accountable, there are many reasons to think that legislatures' policy decisions should be entitled to deference. Indeed, I use the term "scientific avoidance" purposefully for its potential to reflect considerations analogous to those bearing on the use of constitutional avoidance.[2] There has been no examination, however, as to when these considerations in favor of scientific avoidance outweigh the reasons to be cautious.

In this Article, I attempt to fill part of that gap by providing an in-depth analysis of scientific avoidance. This analysis has a positive component, but it is also deeply normative because it disentangles scientific competence from the constitutional analysis. This approach reveals scientific avoidance at its most and least principled, and suggests a framework for future applications.

To place the issue in concrete terms, consider the following examples. In *Jacobson v. Massachusetts*,[3] an individual challenged a law making smallpox vaccines mandatory. The basis of his substantive due process argument was that the legislature had acted irrationally because there were too many medical risks associated with the vaccine. In essence, he disagreed with the legislature's science. The U.S. Supreme Court soundly rejected this contention, upholding the legislature's prerogative to make reasonable policy decisions in light of scientific uncertainty.[4]

Just over one hundred years later, the Court confronted a challenge to the Partial-Birth Abortion Ban Act of 2003[5] in *Gonzales v. Carhart* (*Carhart II*).[6] In support of the Act, Congress made a number of factual findings, essentially concluding that a "partial-birth" abortion was never medically necessary.[7] But the legislative record suggested that there was scientific uncertainty whether, in some instances, "partial-birth" abortion might be medically necessary.[8] Every district court that had examined

2. For further discussion, see *infra* Part II.
3. 197 U.S. 11 (1905).
4. *Id.* at 30; *see also infra* text accompanying notes 119–133.
5. 18 U.S.C. § 1531 (2006).
6. 127 S. Ct. 1610 (2007).
7. *Id.* at 1624.
8. *Id.* at 1637–38.

the facts came to the same conclusion: there was not a medical consensus that a "partial-birth" abortion was *never* medically necessary.[9] The Court upheld the Act, but it had considerable difficulty factoring Congress's legislative findings into its analysis. While it echoed the principle of deference in light of medical or scientific uncertainty, it never satisfactorily explained how that deference should apply to the issues before it.[10]

Jacobson and *Carhart II* are different in many respects. One distinction centers on the dialogic nature of the legislative-judicial relationship. Specifically, the Court in *Carhart II* was confronting a statute that Congress expressly intended as a response to an earlier case striking down a partial-birth abortion ban,[11] while the *Jacobson* statute had no such history. Although any legislative response must comply with constitutional restraints, it seems possible that such statutes might carry at least some additional gloss of constitutionality.[12] Even so, *Carhart II* did not link its use of scientific avoidance to the historical facts surrounding the statute's passage.

A second distinction involves the nature of the rights at issue; historically, courts have reviewed health-and-safety laws of the *Jacobson* sort very deferentially, while abortion jurisprudence has involved a more searching approach.[13] On a related note, the general tiered system of review that is utilized in equal protection and substantive due process analyses typically varies the level of scrutiny according to whether a statute has targeted a suspect class or a fundamental right.[14] This scheme is supported by a number of normative justifications, one of which is the comparative legitimacy of the elected, representative branch and the countermajoritarian role of the judicial branch.[15] Yet the Court in *Carhart II* never explained why scientific avoidance—at heart a principle of deference—should be justified even in a heightened-review setting.

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9. *Id.* at 1638.

10. For further discussion, see *infra* text accompanying notes 237–258.

11. *See* Stenberg v. Carhart (*Carhart I*), 530 U.S. 914, 921–22 (2000) (striking down Nebraska's partial-birth abortion ban); *see also infra* text accompanying notes 220–258 (analyzing *Carhart I* and *Carhart II*).

12. For examples of the types of cases where this practice might legitimately apply, see Dan T. Coenen, *Structural Review, Pseudo-Second-Look Decision Making, and the Risk of Diluting Constitutional Liberty*, 42 WM. & MARY L. REV. 1881, 1883–84 (2001) (describing statutes upheld following constitutional "remands").

13. *Compare, e.g.*, Village of Euclid v. Ambler Realty Co., 272 U.S. 365, 391 (1926) (rational relation to "health and safety"), *with Carhart II*, 127 S. Ct. 1610, 1640 (2007) (Ginsburg, J., dissenting) ("close scrutiny").

14. *Compare, e.g.*, Craig v. Boren, 429 U.S. 190, 197–99 (1976) (applying intermediate scrutiny to a gender-based classification), *and* Williams v. Rhodes, 393 U.S. 23, 31 (1968) (applying strict scrutiny to a ballot-access provision), *and* Loving v. Virginia, 388 U.S. 1, 8–9 (1967) (applying strict scrutiny to a race-based classification), *with* Williamson v. Lee Optical, 348 U.S. 483, 488 (1955) (applying rational basis review to an economic regulation).

15. *See generally* ALEXANDER M. BICKEL, THE LEAST DANGEROUS BRANCH: THE SUPREME COURT AT THE BAR OF POLITICS (2d ed. 1986) (arguing that courts must apply neutral decision-making principles rather than merely decide matters of legislative policy); JOHN H. ELY, DEMOCRACY AND DISTRUST (1980) (arguing for representation-reinforcing judicial review that facilitates representation of minorities). For classic critiques of the tiered system, see generally Gerald Gunther, *The Supreme Court 1971 Term—Foreword: In Search of Evolving Doctrine on a Changing Court: A Model for Newer Equal Protection*, 86 HARV. L. REV. 1 (1972), describing

The purpose of this Article is not to quibble with the tiered system of review, or even to attempt to argue with how those standards have been applied in any particular cases. This Article takes that system, as well as the view that courts ought to avoid constitutional confrontations with legislatures where possible, as given. But it contends that these principles offer only one piece of the puzzle for scientific avoidance because they do not evaluate analogous concerns for science. The missing piece, for understanding *Jacobson* and *Carhart II* and applying scientific avoidance generally, is the comparative institutional competence of legislatures and courts with respect to *science*, yet that consideration has been systemically overlooked. The result is at best an incomplete understanding from which to inform judicial review of statutes. The potential consequences, however, implicate much broader concerns.

First, accuracy in decision making is closely tied to perceptions of fairness and legitimacy. With society's faith in science comes an inherent belief that scientific "truth" is inextricably linked to fairness. A result contrary to science, therefore, seems fundamentally unfair. Judicial review of statutes should seek to maximize scientific accuracy in both branches; failure to do so undermines the legal system's values of fairness and legitimacy.

Relatedly, there is a tendency in both legislatures and courts to assume that science is a panacea, particularly at law-science intersections where science is uncertain. For example, when courts are presented with unanswered, or unanswerable, scientific questions, there is a profound temptation to try to answer those questions, based on the mistaken belief that the scientific answer will provide the legal answer.[16] Legislatures are likewise tempted to assume that science will dictate policy.[17] In both institutions, there lies the assumption that resolving the science will resolve the issue. This dangerous assumption fails to recognize the *legal values* that so strongly contribute to society's way of living with, and responding to, uncertainty.

In this Article, I develop an analytical approach that incorporates the considerations of comparative scientific competence that have been missing in statutory review. This framework is intended to complement modern norms of statutory review while accounting for: (1) the competing values of the scientific and legal systems, and (2) the comparative abilities of courts and legislatures to incorporate "good science" into their decision making. Just as courts and legislatures differ in their strengths vis-à-vis substantive law, so too do they differ when one closely examines the types of scientific questions at issue in any given matter.

Part II of this Article establishes the context from which to start thinking about scientific avoidance. It begins by briefly examining the nature of science, with a particular focus on scientific uncertainty, the development of scientific consensus, and

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the tiered approach and arguing for rational basis review with "bite," and Hans A. Linde, *Due Process of Lawmaking*, 55 NEB. L. REV. 197 (1976), critiquing rationality review.

16. *See* Sheila Jasanoff, *Just Evidence: The Limits of Science in the Legal Process*, 34 J.L. MED. & ETHICS 328, 328 (2006) (criticizing "modern societies' conviction that science can deliver fail-safe, and therefore just, legal outcomes where the law, acting on its own, might fall short"); Howard T. Markey, *Jurisprudence or "Juriscience"?*, 25 WM. & MARY L. REV. 525, 529–30 (1984) (cautioning against judicial overreliance on science).

17. *See generally* Wendy E. Wagner, *Congress, Science, and Environmental Policy*, 1999 U. ILL. L. REV. 181 (arguing that Congress overrelies on science and shifts the costs of that overreliance to administrative agencies).

competing scientific and legal values. The discussion then turns to an evaluation of science in both relevant legal institutions: the courts and the legislatures. The courts have endured particular criticisms related to science, but this Part reveals that courts at times have comparative advantages over legislatures when confronted with scientific issues. Even so, other contexts reveal a distinct comparative advantage for legislatures. Thus, an assessment of where the comparative advantage lies in a particular case is a critical part of the scientific avoidance framework.

Part III turns to the legal context within which scientific avoidance has developed. As we shall see, the concept of judicial deference to legislatures in light of uncertain science originated in review of statutes like that in *Jacobson*, which were directed at the general health, safety, and welfare. Later, this deference was extended to cases implicating stronger liberty interests, as happened in *Carhart II*. With this extension came a tendency to use scientific avoidance as a post-hoc rationalization rather than a guiding principle or doctrine. Thus, I develop a typology for scientific avoidance cases that informs my proposed new framework. This framework accounts for both the substantive legal issue and the particular scientific issue in a way that seeks to maximize the relative institutional capabilities of courts and legislatures. I show how the historical scientific avoidance cases can be understood according to this framework, and I suggest future applications and potential avenues for extension. Part IV concludes that scientific avoidance promises another step toward the ongoing search for synergy in law and science.

I. AN INSTITUTIONAL PERSPECTIVE ON LAW AND SCIENCE

Before beginning an analysis of scientific avoidance, it is constructive to examine how scientific values differ from those of the legal system. Conflicts between science and law can be understood as problems of competing values, and to the extent scientific avoidance serves those differing values, it may help ease some of that conflict. But the analysis should not be confined to general observations about scientific values as opposed to legal-system values. Although that is the starting point, this Part's final component evaluates the judicial and legislative branches' *comparative* capabilities with respect to internalizing scientific values. This particularized analysis facilitates interpreting past scientific avoidance cases and developing a framework for more principled future applications.

A. The Nature of Uncertain Science

1. Scientific Method

One of the most difficult challenges of incorporating science into legal decisions lies in science's propensity to stay in motion. Legal systems do—and must, if they are to bring fairness and finality to disputes—try to capture "good" science. But scientific certainty as it relates to the law travels along a continuum. The doctrine of judicial notice, for example, relies on science at its most certain to preclude the need for proof of "things which must happen according to the laws of nature,"[18] and some science,

18. Brown v. Piper, 91 U.S. 37, 42 (1875); *see* FED. R. EVID. 201(b) (describing kinds of

while not certain enough for judicial notice, may still be sufficiently settled that it is not ordinarily considered problematic to ask a fact finder to consider it or rely on it when considering questions of fact.[19] This is the area where outcomes that conflict with science are most obvious. But the far more perplexing other end of the continuum—that of unresolved (and perhaps unresolvable) scientific uncertainty—places scientific and legal-system values in greatest tension. A brief look at the nature of science shows why this is so.

Whatever its place on the continuum of certainty, science is widely understood to be a methodology; the "scientific method" involves making observations, devising and empirically testing hypotheses to explain those observations, and revising or abandoning those hypotheses in a continual process.[20] The longer a hypothesis holds up to this process, the more acceptance it gains in the scientific community, such that it might rise to the status of scientific theory.[21] Even so, "scientific truth" is something of a fiction: "Although [science's] goal is to approach true explanations as closely as possible, its investigators claim no final or permanent explanatory truths. Science changes. It evolves. Verifiable facts always take precedence."[22]

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facts that may be judicially noticed); Daubert v. Merrill Dow Pharms., Inc., 509 U.S. 579, 592 n.11 (1993) ("[T]heories that are so firmly established as to have attained the status of scientific law, such as thermodynamics, properly are subject to judicial notice under Federal Rule of Evidence 201."); *see also* Shahar v. Bowers, 120 F.3d 211, 214 (11th Cir. 1997) (providing examples of matters ordinarily within judicial notice, including "scientific facts, such as when the sun rises or sets"); Fowler v. Tenn. Valley Auth., 321 F.2d 566, 570 (6th Cir. 1963) ("[I]f electrical power line is grounded by [the] conductor, current will flow through the conductor."); Jamieson v. Woodward & Lothrop, 247 F.2d 23, 29 (D.C. Cir. 1957) (noting that the distance and force of recoil of elastic are proportional to the amount of tension placed upon it); Application of Gruskin, 234 F.2d 493, 498 (C.C.P.A. 1956) (basic properties of calcium carbonate); Miller Brewing Co. v. G. Heileman Brewing Co., 427 F. Supp. 1204, 1205 (W.D. Wis. 1977) (taking judicial notice that consuming food results in heat measured as calories). For a criticism of the current rules for judicial notice as applied to science and technology, see generally Christopher Onstott, *Judicial Notice and the Law's "Scientific" Search for Truth*, 40 AKRON L. REV. 465 (2007).

19. To name but one example, courts routinely admit DNA evidence, even though such evidence is not foolproof. *See generally* Thomas M. Fleming, Annotation, *Admissibility of DNA Identification Evidence*, 84 A.L.R. 4TH 313 (1991 & Supp. 2008) (collecting cases and describing criticisms). On the other hand, there is little scholarship assessing the appropriateness of judicial reliance on scientific information when deciding matters of law. For a notable exception, see generally DAVID L. FAIGMAN, LABORATORY OF JUSTICE (2004) (providing detailed account of empirical assumptions underpinning constitutional doctrine).

20. *See* FAIGMAN, *supra* note 19, at 120–21; NAT'L ACADEMIES PRESS, RESPONSIBLE SCIENCE VOLUME I: ENSURING THE INTEGRITY OF THE RESEARCH PROCESS 38 (1992) [hereinafter RESPONSIBLE SCIENCE]; *cf.* THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 36–42, 52 (3d ed. 1996) (describing normal science as puzzle-solving, cumulative exercise that ultimately leads to paradigm shifts). *But see* SUSAN HAACK, DEFENDING SCIENCE—WITHIN REASON 23 (2007) (arguing science is not epistemologically privileged because these are standards by which we judge "*all* inquirers, detectives, historians, investigative journalists, etc., as well as scientists") (emphasis in original).

21. *See* KUHN, *supra* note 20, at 166 ("In its normal state . . . a scientific community is an immensely efficient instrument for solving the problems or puzzles that its paradigms define.").

22. RESPONSIBLE SCIENCE, *supra* note 20.

"Verifiable facts" should be distinguished from hypotheses and theories; this distinction will later provide an important key to unlocking the comparative strengths of courts versus legislatures. A scientific fact is simply an observation or measurement of a natural or experimental phenomenon.[23] Thus, once a scientific fact is established, it makes sense that the fact could be the proper object of judicial notice, for example, because the observation itself is usually less likely to be a contested issue. For the same reason, legislatures relying on scientific facts as implicit assumptions underlying statutes are unlikely to face challenges to those statutes on scientific grounds.

By contrast, hypotheses offer proposed explanations of those facts, and tend to be much more controversial. Theories are hypotheses that have gained acceptance because their predictions have survived rigorous testing; but even familiar theories, such as the theory of gravity, have grey edges of uncertainty.[24] It is accurate, then, to say that science is never certain. But if that is true, how does scientific consensus ever emerge? And when is there enough agreement to say that there is a consensus at all? That topic is broad enough to merit volumes of scholarly assessment, but for our purposes the following contours are useful.[25]

2. Consensus Development and Uncertainty

Though science values a constant of change, there are certain enduring principles by which scientific validity is measured in the scientific community itself.[26] Foremost is a basic adherence to the scientific method described in the preceding Part. In addition, two particular attributes are frequently mentioned as supporting scientific validity and are therefore worth special mention: testability and falsifiability. The first, testability, was considered in detail by Carl G. Hempel, who wrote extensively about the logical relationship between observations and theories.[27] In his work the *Philosophy of*

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23. *Id.*

24. KUHN, *supra* note 20, at 149 (describing difficulty of reconciling Newtonian physics and its concomitant paradigm of space, with Einstein's general theory of relativity, which introduced the concept of curved space).

25. Any search for the ultimate definition of science is better left to its philosophers, and in any event, is unnecessary for purposes of this Article. *Cf.* HAACK, *supra* note 20, at 21 (commenting that many scientists regard philosophy of science as irrelevant—"about as useful to scientists as ornithology is to birds") (internal quotation and citation omitted).

26. Barry P. McDonald, *Government Regulation or Other "Abridgments" of Scientific Research: The Proper Scope of Judicial Review Under the First Amendment*, 54 EMORY L.J. 979, 1003 (2005); *see also id.* at 988 ("[M]ost contemporary experts appear to define science . . . by the adherence to a certain process or method of deriving knowledge."). Indeed, the *Daubert* standard attempts to capture many of those principles. *See* Daubert v. Merrill Dow Pharms., Inc., 509 U.S. 579, 593–94 (1993) (setting forth a nonexclusive list of factors for reliability including testability, peer review and publication, the known or potential rate of error, and general acceptance).

27. Hempel was a philosopher of the logical positivism movement, which was "best known for its efforts to eliminate ideological and metaphysical influences from science and culture, and to develop rigorous standards, based on logic, of scientific validity." KENNETH R. FOSTER & PETER W. HUBER, JUDGING SCIENCE: SCIENTIFIC KNOWLEDGE AND THE FEDERAL COURTS 41 (1997). Professors Foster and Huber note that positivism is so "out of intellectual fashion that sociologists of science now use 'positivist' as a loose epithet." *Id.* at 48. Nevertheless, testability

Natural Science, Hempel argued that scientific explanations must meet two requirements.[28] The first, explanatory relevance, requires that an explanation must afford "good grounds for believing that the phenomenon to be explained did, or does, indeed occur."[29] The second requirement is that of testability: some empirical finding must support or contradict the explanation.

Closely related to testability is the more controversial validating attribute, falsifiability. Described by Karl Popper as a way to distinguish science from pseudo-science in his work *Conjectures and Refutations*, falsifiability requires that scientific hypotheses must be refutable.[30] Consider, for example, Intelligent Design (ID) in contrast to evolution as a scientific theory for the diversity of species.[31] Proponents of ID contend that "certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection."[32] The difficulty from a scientific perspective, however, is that there is currently no way to prove this statement wrong.[33] Moreover, it is vulnerable to "confirmation bias"; that is, nearly any scientific roadblock can be explained away as being attributable to an intelligent creator.[34] Evolutionary theory, on the other hand, is the subject of constant revision as scientists test hypotheses and find some of them false.[35] Indeed, the

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remains in fashion as a defining mark of good science. *See, e.g.*, *Daubert*, 509 U.S. at 593.

28. CARL G. HEMPEL, THE PHILOSOPHY OF NATURAL SCIENCE 48 (1966).

29. *Id.*

30. KARL R. POPPER, CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE 44, 47–48 (Routledge 2002) (1962).

31. For an extended discussion about this topic, see Kitzmiller v. Dover Area Sch. Dist., 400 F. Supp. 2d 707, 735–46 (M.D. Pa. 2005) (concluding ID is "an interesting theological argument, but that it is not science").

32. Discovery Institute, What is Intelligent Design?, http://www.intelligentdesign.org/whatisid.php.

33. Indeed, ID's inability to be falsified undergirds the scientific community's failure to accept it as a legitimate scientific theory. *See* American Association for the Advancement of Science, American Association for the Advancement of Science Board Resolution on Intelligent Design Theory, http://www.aaas.org/news/releases/2002/1106id2.shtml (relying in part on ID proponents' inability to propose a scientific means of testing their claims in rejecting ID as a scientific theory for the diversity of species). Note that falsifiability can be understood as a species of testability; Popper contended that *genuine* tests of theories are attempts to falsify them. POPPER, *supra* note 30, at 48 ("Every genuine test of a theory is an attempt to falsify it, or to refute it."); *see* FOSTER & HUBER, *supra* note 27, at 235 (1999) (describing testability as a "signpost on the road that leads to *Frye*. Scientific views that are formulated in terms concrete enough to be falsified if in fact they are wrong are views that are likely to become 'generally accepted' over time if in fact they are correct.").

34. *See Kitzmiller*, 400 F. Supp. 2d at 742 ("ID is reliant upon forces acting outside of the natural world, forces that we cannot see, replicate, control or test"); FOSTER & HUBER, *supra* note 27, at 44–46 (describing confirmation bias as the phenomenon of looking for data to confirm a theory, rather than discredit it).

35. *See, e.g.*, Richard A. Kerr, *Did Darwin Get It All Right?*, 267 SCI. 1421, 1421 (1995) (describing research suggesting punctuated equilibrium is the dominant mode of speciation, rather than Darwin's gradualism); *see also* John Rennie, *15 Answers to Creationist Nonsense*, SCI. AM., July 2002, at 78, *available at* http://www.sciam.com/article.cfm?articleID=000D4FEC-7D5B-1D078E49809EC588EEDF&pageNumber=2&catID=2 (describing testability of evolution and debates amongst evolutionary biologists).

impressive thing about falsifiable theories is that there is a risk in making predictions—the risk that they may be refuted.[36]

To be sure, some theories are more testable than others, and falsifiability can be a difficult criterion to actually apply.[37] Numerous scholars have harshly criticized Popper's reliance on falsifiability;[38] nevertheless, that trait remains as a tool from which to assess adherence to scientific values.[39] And indeed, regardless of one's particular philosophy of science, it is worth emphasizing that the scientific community manages to implement its values in such a way as to reach accord over time. Even Thomas Kuhn, who wrote the influential *Structure of Scientific Revolutions* with its description of paradigm shifts, emphasized the remarkable ability of the scientific community to "reach a firm consensus unattainable in other fields."[40]

As I have described it thus far, scientific methodology contributes to consensus development in an informal manner, with few rigid rules or required structures. It unfolds on its own timeframe as scientists publish, present, or otherwise communicate their findings and subsequent studies build on or refute that work. But throughout the history of science, there have been attempts to formalize the consensus development process. Here, I offer two modern examples that shed further light on scientific values and methodology. Later, they help characterize the comparative institutional advantages of legislatures and the courts.

First, consider the Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization and the United Nations Environment Programme. IPCC's purpose is to evaluate the state of science relevant to understanding human-induced climate change.[41] The IPCC does not conduct any research, but instead assesses the latest scientific and technical information for the purpose of providing reports on the state of knowledge on climate change.[42] Utilizing strict procedures, draft reports are prepared by teams of expert authors and undergo a two-stage review involving experts as well as governments.[43] The resulting product is

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36. *See* POPPER, *supra* note 30, at 47.

37. *See* FOSTER & HUBER, *supra* note 27, at 46–48 (describing critiques of Popper's views).

38. *Id.* at 47–48 (collecting criticisms of Popper's criteria).

39. *See* Daubert v. Merrill Dow Pharms., Inc., 509 U.S. 579, 593 (1993) (citing with approval KARL M. POPPER, CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE 37 (5th ed. 1989)). The concept of falsifiability is not limited to the evidentiary context of the *Daubert* test. *See* McLean v. Ark. Bd. of Educ., 529 F. Supp. 1255, 1267 (E.D. Ark. 1982) (including falsifiability in list of essential characteristics of science and concluding creationism is not science); FOSTER & HUBER, *supra* note 27, at 53–54 (considering whether creation science is falsifiable and describing criticism of *McLean* list); *see also* STEVEN GOLDBERG, CULTURE CLASH 10 (1994) (describing various schools of science philosophy and concluding that regardless of philosophical view of science, scientific community "is remarkably adept at defining itself and at adjudicating what is and is not good science from its own professional perspective").

40. KUHN, *supra* note 20, at 173.

41. IPCC, About IPCC, http://www.ipcc.ch/about/index.htm.

42. IPCC, IPCC Reports, http://www.ipcc.ch/ipccreports/index.htm.

43. IPCC, 16 YEARS OF SCIENTIFIC ASSESSMENT IN SUPPORT OF THE CLIMATE CONVENTION 4 (2004), *available at* http://www.ipcc.ch/pdf/10th-anniversary/anniversary-brochure.pdf.

intended to be the policy-neutral result of an open, broad-based and transparent process of high scientific standards.[44]

A second example is the National Institutes of Health (NIH) Consensus Development Program (CDP), whose purpose is to evaluate the state of science on biomedical issues and compose a statement addressing specific questions.[45] Like the ICPP methodology, the CDP does not involve independent scientific research. The process begins with selection of a broad-based, independent panel to which experts present data; the panel then conducts a systematic literature review on selected biomedical issues. The panel prepares a draft statement, which is open for comment and usually finalized a month or two later.[46] The statement may reflect uncertainties, options, or minority viewpoints, and it is meant to advance understanding rather than further any particular policy.[47]

Although the scientific community can utilize both formal and informal methods of developing consensus, a consensus does not always emerge.[48] This may be at least partly attributable to the perception that a particular consensus would lead to particular policy choices, but it also reflects the unavoidable reality that traditional scientific methodologies cannot always answer scientific questions. This reality was captured by scientist Alvin M. Weinberg when he coined his famous term "trans-science."[49] Trans-scientific questions are those which, while capable of being posed in scientific terminology, "are unanswerable by science; they transcend science."[50] An example trans-scientific question concerns the effects of low-level toxic exposure.[51] Measuring

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44. IPCC, *supra* note 41. The global warming debate has been the target of informal consensus development as well. *See* COMM'N ON THE SCI. OF CLIMATE CHANGE, NAT'L ACAD. OF SCIS., CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS 3 (2001) ("The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue."); Naomi Oreskes, *Beyond the Ivory Tower: The Scientific Consensus on Climate Change*, 306 SCI. 1686, 1686 (2004) (describing review of peer-reviewed scientific journals for dissenting opinions, and finding lack thereof).

45. NIH, NIH Consensus Development Program, http://consensus.nih.gov/ABOUTCDP.htm.

46. *Id.*

47. *Id.*

48. *See* Donald Ludwig, Ray Hilborn & Carl J. Walters, *Uncertainty, Resource Exploitation, and Conservation: Lessons from History*, 260 SCI. 17, 17 (1993) ("We propose that we shall never attain scientific consensus concerning the [fisheries] systems that are being exploited"). Indeed, NIH has an analogue to the Consensus Development Conference: a State-of-the-Science Conference, which summarizes evidence and recommends directions for further research. NIH, *supra* note 45.

49. *See generally* Alvin M. Weinberg, *Science and Trans-Science*, 10 MINERVA 209 (1972). This conceptualization has received little attention in the legal commentary, with a notable exception being Professor Wagner's Note, which suggests a burden-shifting approach in scientifically uncertain toxic torts cases. Wendy E. Wagner, Note, *Trans-Science in Torts*, 96 YALE L.J. 428 (1986).

50. Weinberg, *supra* note 49, at 209; *see also* Alvin M. Weinberg, *Origins of Science and Trans-Science*, CITATION CLASSICS, Aug. 26, 1991, at 18, *available at* http://garfield.library.upenn.edu/classics1991/A1991GA09900001.pdf; Alvin M. Weinberg, Editorial, *Science and Trans-Science*, 177 SCI. 211 (1972).

51. *See* Weinberg, *supra* note 49, at 210. Weinberg wrote in particular of the trans-

any kind of very low-level environmental exposure would require a protocol, or sample size, so large as to render the experiment practically impossible.[52] Moreover, even if no effect were observed during such an experiment, one could say there was no link only in probabilistic terms.[53]

Trans-science provides a useful end-of-the-spectrum in this discussion of the nature of science, as well as an introduction to the next Part. Whereas "positive science," or observable facts, might undergird statutes or be the subject of judicial notice without cause for concern, as uncertainty increases, institutional choices should be closely examined. This is because—as discussed in the next Part—policy considerations must take an increasingly important role in decision making. Indeed, at the trans-scientific level, decision making is nearly completely policy-driven in the sense that there is only a *lack* of science from which courts or legislatures can inform their choices. In between scientific facts and trans-science are the uncertainties that confront courts and legislatures daily—many examples of which form the basis for the cases presented in Part III.A. For now, this overview of the scientific method, consensus development, and the nature of uncertainty provides a basis for identifying key differences between science and law as institutions.

3. Comparing Values

This brief description of science should make apparent at least three points. First, scientific and legal systems embrace different values. Even though philosophies of science may differ, most people agree upon several intrinsic scientific values. Those include such things as empiricism, independence, skepticism, and progress.[54] Testability, for example, generally requires empirical analysis, and results are often stated in probabilistic terms.[55] Likewise, falsifiability relates to the values of skepticism and independence because it requires attention to ways that theories could be proven wrong. Finally, the scientific method, with its constant revisions and refining, represents continual progress and the search for new knowledge. Trans-science, too, relates to these values; unanswered questions are ripe for creative new approaches, and the questions that seem unanswerable today may be the topic of tomorrow's hot new research.[56]

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scientific questions surrounding the biological effects of low-level radiation exposure. *Id.*

52. *Id.*

53. *Id.* Similarly, the extent and locations of future global temperature changes pose trans-scientific issues. *See* Carol L. Silva & Hank C. Jenkins-Smith, *The Precautionary Principle in Context: U.S. and E.U. Scientists' Prescriptions for Policy in the Face of Uncertainty*, 88 SOC. SCI. Q. 640, 642 (2007) (describing uncertainties involving global climate change).

54. *See* NAT'L ACAD. OF SCIS., NAT'L ACAD. OF ENG'G & INST. OF MED., ON BEING A SCIENTIST: RESPONSIBLE CONDUCT IN RESEARCH 1–2 (2d ed. 1995) (describing attributes of scientific research).

55. *See* Troyen A. Brennan, *Causal Chains and Statistical Links: The Role of Scientific Uncertainty in Hazardous-Substance Litigation*, 73 CORNELL L. REV. 469, 482 (1988) (explaining that scientific hypotheses are often expressed as probabilities); *see also* Lee Loevinger, *Standards of Proof in Science and Law*, 32 JURIMETRICS J. 323, 333 (1992) ("[S]cientific standards of proof are expressed numerically, stating degrees of probability or confidence, while legal standards of proof are categorical and are expressed entirely in verbal terms.").

56. Even Weinberg conceded that an issue appearing to be trans-scientific may later be

Legal-system values tend to be of a different character, encompassing such ideals as fairness, justice, finality, and predictability.[57] Thus, "[t]he law is rarely concerned solely with factual truth in the scientific sense because that is rarely society's sole concern."[58] And as Justice Stephen Breyer argues, "a court proceeding, such as a trial, is not simply a search for dispassionate truth. The law must be fair."[59] But this difference in values leads to my second point: if science always encompasses some quantum of uncertainty, there will always be a policy gap for our legal institutions to fill. This will happen regardless of whether the relevant institution is a court or a legislature. For example, pre-injury toxic exposure claims are often squarely in the trans-scientific realm. By refusing to hold such injuries actionable, courts implement tort law policy that rejects speculative harm or the threat of future harm as a compensable injury.[60] Declining to recognize a cognizable injury serves as a funneling measure, placing the risk of loss on plaintiffs, and essentially reflecting a societal value in compensating only a certain definable class of injuries.[61] Likewise, legislatures are

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resolvable by more sophisticated science. *See* Alvin M. Weinberg, *Letters*, 180 SCI. 1122, 1123 (1973) (stating that the question may be "whether the enormous effort required for such studies is an appropriate allocation of resources").

57. Perhaps as a corollary, it is also frequently observed that science is rapidly changing, while law is a more plodding institution. FAIGMAN, *supra* note 19, at 8. *But see* Peter H. Schuck, *Multi-Culturalism Redux: Science, Law, and Politics*, 11 YALE L. & POL'Y REV. 1, 25 (1993) ("The law is usually in much more of a hurry to decide than science is."). Even so, law can and does change, and the constant testing and revising inherent in the common-law system must certainly have analogies in the scientific method. *Cf.* GOLDBERG, *supra* note 39, at 14 ("The law does gradually change . . . . But the process is slow, uncertain, and controversial; there is nothing in the legal community like the consensus in the scientific community on whether a particular result constitutes progress."). Further, at their best, both systems share many values, including intellectual honesty and creativity.

58. GOLDBERG, *supra* note 39, at 16; *Id.* at 18 ("[O]ur legal system stresses the process by which a decision is reached in an attempt to ensure that the decision will be, at the very least, something society can accept."); *see also* Joëlle A. Moreno, *Beyond the Polemic Against Junk Science: Navigating the Oceans that Divide Science and Law with Justice Breyer at the Helm*, 81 B.U. L. REV. 1033, 1091 (2001) ("Those trained as advocates must recognize that scientific validity is independent of our legal goals."); Markey, *supra* note 16, at 528 ("In cases where the law is clear and unchallenged, decisions appropriately may turn on a scientific fact. Such cases must be distinguished, however, from those in which the law, rather than scientific fact, must control.") (citation omitted).

59. Justice Stephen Breyer, *The Interdependence of Science and Law*, 280 SCI. 537, 538 (1998); *see also* Harold P. Green, *The Law-Science Interface in Public Policy Decisionmaking*, 51 OHIO ST. L.J. 375, 388 (1990) ("The law, on the other hand, is more concerned with the optimal resolution of disputes than it is with achieving 'correct' decisions that accord with objective truth. Although the law aspires to decide issues correctly, it is also concerned with reaching decisions that will be acceptable to the public."); Jasanoff, *supra* note 16, at 329 ("The law has its own institutional needs and constraints, and these are broadly geared toward ensuring that justice is done in each individual case.").

60. *See* PROSSER & KEETON ON THE LAW OF TORTS § 30 (William L. Prosser et al. eds., 5th ed. 1984).

61. *See* Schweitzer v. Consol. Rail Corp., 758 F.2d 936, 942 (3d Cir. 1985) ("We believe, however, that subclinical injury resulting from exposure to asbestos is insufficient to constitute the actual loss or damage to a plaintiff's interest required to sustain a cause of action under generally applicable principles of tort law."); Parker v. Brush Wellman, Inc., 420 F. Supp. 2d 1355 (N.D. Ga. 2006) (declining to recognize beryllium sensitization as actionable tort injury);

constantly deciding how best to act, as a policy matter, given scientific uncertainty. Recent debates in the U.S. Senate as to how to respond to global climate change provide a salient example.[62]

These observations lead to the third and most crucial point: it should never be assumed that finding a scientific "answer" will dictate a policy decision. This trap is in some ways understandable, because society puts such faith in science. But it is a misuse of science and a barrier to transparent, well-reasoned decision making. As former Federal Circuit Chief Judge Howard T. Markey put it, a failure to distinguish between science and policy "would allow moral, philosophical, and political decisions to be based solely on the outcome of a purely technical debate between scientific experts."[63] In our legal institutions, science should inform the law, but should not be put on a pedestal over it.[64]

Rather than elevate science over law in this manner, the goal should be to maximize the quality of scientific information so that informed policy decisions can be made. By

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Boyd v. Orkin Exterminating Co., 381 S.E.2d 295, 297 (Ga. Ct. App. 1989), *overruled on other grounds by* Hanna v. McWilliams, 446 S.E.2d 741 (Ga. Ct. App. 1994) (rejecting claims for pesticide exposure where plaintiffs exhibited metabolites but showed no actual disease); *see also* O'Bannon v. Town Court Nursing Ctr., 447 U.S. 773, 804 (1980) (Blackmun, J., concurring) ("Recognition of a constitutional right plainly cannot rest on such an inconclusive body of research and opinion.").

62. *See generally* David M. Herszenhorn, *After Verbal Fire, Senate Effectively Kills Climate Change Bill*, N.Y. TIMES, June 7, 2008, at A12; John M. Broder, *Senate Opens Debate on Politically Risky Bill Addressing Global Warming*, N.Y. TIMES, June 3, 2008, at A16.

63. Markey, *supra* note 16, at 530; *see also* Sheila Jasanoff & Dorothy W. Nelkin, *Science, Technology, and the Limits of Judicial Competence*, 214 SCI. 1211, 1213 (1981) ("[T]he element of technical and scientific uncertainty often seems to encourage litigants to translate questions of social value into a technical discourse."). Scholars of administrative law have also lodged this criticism convincingly. "When scientific data are limited and legislative value judgments have been made only at the broadest level, political choices necessarily, and legitimately, factor into natural resource decisions. The core of the problem is not the involvement of politics but its concealment behind a cloak of science." Holly D. Doremus, *Science Plays Defense: Natural Resource Management in the Bush Administration*, 32 ECOLOGY L.Q. 249, 253 (2005). Professor Doremus's piece studies the handling of science against the political administrative backdrop. She illustrates that, as in judicial decision making, administrative approaches that emphasize transparency and learning may be more normatively defensible and politically effective over time. *Id.*

64. *See* DAVID L. FAIGMAN, DONALD H. KAYE, MICHAEL J. SAKS & JOSEPH SANDERS, SCIENCE IN THE LAW: STANDARDS, STATISTICS, AND RESEARCH ISSUES 116 (2002) ("God does not whisper the answers into the ears of scientists, as though they were members of a modern priesthood."); David S. Caudill & Lewis H. LaRue, *Why Judges Applying the Daubert Trilogy Need to Know About the Social, Institutional, and Rhetorical—And Not Just the Methodological—Aspects of Science*, 45 B.C. L. REV. 1, 3–4 (2003) (arguing that legal scholarship regarding *Daubert* often idealizes science at the expense of social, institutional, and rhetorical aspects of science); Jasanoff & Nelkin, *supra* note 63, at 1215 ("The belief that scientific expertise is inherently removed from value considerations and that scientists are therefore political celibates is an anachronistic and even dangerous one."); Irving M. Klotz, SCI. AM., May 1980, at 168, 168 ("Science, like any other area of human endeavor, has had its grand illusions."). *But cf.* McDonald, *supra* note 26, at 989 ("It is this emphasis on the empirical reliability and objectivity of scientific knowledge, or the establishment of facts or truths thought to be 'universal' in nature . . . that impel many to make the claim that science produces knowledge that is epistemically superior to more 'subjective' forms of knowledge.").

examining the relative capabilities of courts and legislatures with respect to maximizing scientific quality, therefore, we can develop the foundation for a principled application of scientific avoidance.[65] This Part next briefly assesses how science fares in each institution.

B. Science in the Courts

Justice Breyer has asserted that courts should "aim for decisions that, roughly speaking, approximately reflect the scientific 'state of the art.'"[66] Courts struggle to reach this ideal, as numerous scholars have documented.[67] In addition to concerns about "junk science," the scholarship emphasizes that the adversarial model in general prevents a full consideration of scientific issues, and most lawyers and judges lack scientific or technical training. In essence, these concerns speak to the courts' limited ability to deal with scientific uncertainty.

When one combines these considerations with the fact that legislatures are the politically accountable institutions, one might be tempted to say that courts should always attempt to avoid science. But that approach would fail to account for the courts' constitutional role and would also ignore the contexts in which courts are equipped to handle science at least as well as the legislatures. So, although I begin this Part with a discussion of courts' challenges, I end by suggesting circumstances in which courts' institutional competence is not necessarily weaker than that of legislatures.

Courts have struggled to find ways of maximizing the quality of science before them while staying true to legal-system values. This goal is particularly difficult to achieve when the necessary scientific information is simply too uncertain or

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65. *See generally* NEIL K. KOMESAR, IMPERFECT ALTERNATIVES (1994) (describing considerations of institutional choice amongst imperfect institutions).

66. Justice Stephen J. Breyer, Speech at the Association for the Advancement of Science Annual Meeting and Science Innovation Exposition: The Interdependence of Science and Law (Feb. 16, 1998), *available at* http://instruct1.cit.cornell.edu/Courses/comm352-fall2000/Labs/breyerspeech.html.

67. *See generally* PETER W. HUBER, GALILEO'S REVENGE: JUNK SCIENCE IN THE COURTROOM (1991). One prominent example is *Wells v. Ortho Pharm. Corp.*, 788 F.2d 741, 742 (11th Cir. 1986), which upheld a district court's credibility-based determination that spermicidal jelly caused birth defects, even though scientific consensus indicated otherwise. *See Federal Judges vs. Science*, N.Y. TIMES, Dec. 27, 1986, § 1, at 22 (calling *Wells* "an intellectual embarrassment"); *see also* HUBER, *supra*, at 174 (stating that authors supporting plaintiffs later repudiated their work); William M. Brown, *Déjà Vu All over Again: The Exodus from Contraceptives Research and How to Reverse It*, 40 BRANDEIS L.J. 1, 28 (2001) ("The case is renowned for [the judge's] complete lack of reasoning or analysis of the scientific evidence. Specifically, [the judge] reportedly decided the case based on his evaluation of the trustworthiness of the expert witnesses, rather than their science."). *But see* Joseph L. Gastworth, *The Need for Careful Evaluation of Epidemiological Evidence in Product Liability Cases: A Reexamination of* Wells v. Ortho *and* Key Pharmaceuticals, 2 LAW, PROBABILITY & RISK 151, 153 (2003) ("While some authors have strongly criticized the Wells decision, this review suggests that both the trial and appellate judges involved did the best they could with the information available to them."); Kenneth J. Chesebro, *Galileo's Retort: Peter Huber's Junk Scholarship*, 42 AM. L. REV. 1637, 1668–70 (1993) (emphasizing that not all authors of *Wells* plaintiffs' studies repudiated their work, a fact which Huber did not disclose).

unavailable at the time of the litigation. For instance, several juries have held in favor of plaintiffs who contended that taking the anti-nausea drug Bendectin while they were pregnant caused their children's birth defects. Yet the best available scientific evidence was then unable, and remains unable, to support general causation.[68]

Bendectin litigation itself produced one of the federal judiciary's most prominent tools for managing science's quality: the evidentiary standard announced in *Daubert v. Merrell Dow Pharmaceuticals*, which governs the admissibility of expert testimony in federal courts and many state courts.[69] Under the familiar *Daubert* test, courts are to ensure that expert testimony is both relevant and reliable, with the reliability inquiry focusing on: (1) testability or falsifiability; (2) peer review and publication; (3) the known or potential rate of error; and (4) the degree of acceptance in the field's community.[70] At its core, *Daubert* is aimed at ensuring that scientific evidence meets the same standards of reliability that the relevant scientific field itself would require.[71]

Daubert is an important tool; although scholars debate its overall efficacy,[72] it seems at the very least to have increased judicial sensitivity to the problem of "junk science."[73] It does not solve every problem of science in the courts, however, and it seems to have created a few of its own. First, *Daubert* may never come into play in cases where the applicable procedural posture does not require consideration of evidence, where *Daubert* challenges are never made,[74] or where *Daubert* does not apply.[75] Second, *Daubert* was never meant to be a guarantee against scientific

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68. *See* Brock v. Merrell Dow Pharms., Inc., 874 F.2d 307 (5th Cir. 1989) (reversing $550,000 jury verdict); Richardson v. Richardson-Merrill, Inc., 857 F.2d 823 (D.C. Cir. 1988) (affirming district court's grant of judgment notwithstanding the over-one-million-dollar verdict); *see also* Oxendine v. Merrell Dow Pharms., Inc., No. 82-1245, 1996 WL 680992 (D.C. Super. Oct. 24, 1996) (collecting cases); FOSTER & HUBER, *supra* note 27, at 7 ("A few statistically significant correlations have been reported in the literature, but taken together the results are overwhelmingly negative.") (footnote omitted); David E. Bernstein, *Learning the Wrong Lessons from "An American Tragedy": A Critique of the Berger-Twerski Informed Choice Proposal*, 104 MICH. L. REV. 1961, 1966 (2006) ("A review of the relevant medical literature finds a consensus that Bendectin is not a teratogen.").

69. 509 U.S. 579 (1993).

70. *Id.* at 593–94; *see also* FED. R. EVID. 702 advisory committee's note (suggesting other useful factors for determining reliability).

71. *Daubert*, 509 U.S. at 594–95.

72. On *Daubert*'s shortcomings, see, e.g., Lisa Heinzerling, *Doubting* Daubert, 14 J.L. & POL'Y 65 (2006); Erica Beecher-Monas, *Blinded by Science: How Judges Avoid the Science in Scientific Evidence*, 71 TEMP. L. REV. 55 (1998) (arguing courts misapply *Daubert* by continuing to admit certain forms of forensic evidence). For a study of *Daubert's* outcomes as compared to the old *Frye* standard, see generally Edward K. Cheng & Albert H. Yoon, *Does* Frye *or* Daubert *Matter? A Study of Scientific Admissibility Standards*, 91 VA. L. REV. 471 (2005).

73. Cheng & Yoon, *supra* note 72, at 503.

74. *See* Kumho Tire Co. v. Carmichael, 526 U.S. 137, 152 (1999) (noting trial judge has discretion "to avoid unnecessary 'reliability' proceedings in ordinary cases where the reliability of an expert's methods is properly taken for granted . . . .").

75. For example, *Daubert* principles are generally not applied in judicial review governed by the Administrative Procedures Act. *See, e.g.*, Sierra Club v. Marita, 46 F.3d 606, 621–22 (7th Cir. 1995) (declining invitation to apply *Daubert* principles as means of determining appropriate level of agency deference); Stewart v. Potts, 996 F. Supp. 668, 678 n.8 (S.D. Tex. 1998) (noting

uncertainty—it is a principle of evidence, not a rule of decision for how courts should utilize policy in the gap of uncertainty.[76] Proponents of scientific evidence "do not have to demonstrate to the judge by a preponderance of the evidence that the assessments of their experts are *correct*, they only have to demonstrate by a preponderance of evidence that their opinions are reliable."[77] Thus, the standard leaves open the possibility of admitting testimony of experts who disagree. In the typical trial scenario, this means that if the disagreements constitute genuine issues of material fact, the uncertainties must be resolved by fact finders.[78]

Here lies one of the difficult tensions between science and law in the courts. If science is uncertain, how can the judicial process purport to say what science is? One response is that judicial answers should be thought of in probabilistic terms; for example, a jury's finding that a manufacturer's product caused a disease is really only a determination that causation was more likely than not.[79] Similarly, summary judgment in favor of the manufacturer merely means that the plaintiff failed to show genuine issues of material fact—not that there was in fact no causation.[80] But those answers are unsatisfactory in that they ignore the consumers of judicial outcomes; the public in particular is quick to view a jury's determination of causation as one of scientific fact.[81]

Furthermore, whenever courts attempt to resolve scientific uncertainty—even if that science was properly screened through the *Daubert* filter and even if that resolution was only probabilistic—there is the danger that scientific consensus will later regard a judicial outcome as wrong. Although the *Daubert* standard is young, several illustrations have come to light. For example, post-*Daubert* breast implant litigation garnered many favorable results for plaintiffs even though—according to the editor of the *New England Journal of Medicine*—the cause-and-effect relationship between

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that *Daubert* standards do not apply to judicial review of agency action). *But see* Alan C. Raul & Julie Z. Dwyer, *"Regulatory* Daubert*": A Proposal to Enhance Judicial Review of Agency Science by Incorporating* Daubert *Principles into Administrative Law*, 66 LAW & CONTEMP. PROBS. 7 (2003) (arguing that *Daubert* standards should apply to judicial review of agency action).

76. This is not to say that *Daubert* rulings are not outcome-determinative. As *Daubert* itself showed on remand, excluding plaintiffs' causation expert meant that the plaintiffs could not bear their burden of showing genuine issues of material fact and so the defendants were entitled to summary judgment. *See* Daubert v. Merrell Dow Pharms., Inc., 43 F.3d 1311 (9th Cir. 1995).

77. *In re* Paoli R.R. Yard PCB Litig., 35 F.3d 717, 744 (3d Cir. 1994) (emphasis in original), *cited with approval in* FED R. EVID. 702 advisory committee's note to the amended rule.

78. *See* FED. R. EVID. 702 advisory committee's note to the amended rule ("When a trial court, applying this amendment, rules that an expert's testimony is reliable, this does not necessarily mean that contradictory expert testimony is unreliable."); Ruiz-Troche v. Pepsi Cola of P.R. Bottling Co., 161 F.3d 77, 85 (1st Cir. 1998) ("Daubert neither requires nor empowers trial courts to determine which of several competing scientific theories has the best provenance.").

79. *See* ARIEL PORAT & ALEX STEIN, TORT LIABILITY UNDER UNCERTAINTY 18–22 (2001) (describing how the more-likely-than-not standard functions to evenly allocate the risk of error).

80. FED. R. CIV. P. 56(b)–(c).

81. *See supra* note 67 (describing reactions to Wells v. Ortho Pharm. Corp., 788 F.2d 741 (11th Cir. 1986)).

silicone breast implants and disease is unproven, and will likely remain so.[82] Likewise, courts have reached differing outcomes in toxic mold personal-injury cases under the *Daubert* standard, even though the science behind "toxic mold" is currently uncertain.[83]

Another difficulty for courtroom science lies in the nature of the adversarial system itself. Simply put, parties have every incentive to produce evidence favorable to their respective sides, regardless of the quality of that science.[84] The resulting "battle of the experts" places the fact finder in the unenviable position of deciding science based on only limited information. In sum, the adversarial process will not necessarily produce a full spectrum of scientific research on a particular topic, making it very different from the formal and informal consensus-building methods that science itself uses.

This weakness may be amplified because judges and lawyers usually lack scientific or technical backgrounds and may not even know what is missing.[85] While judges in

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82. MARCIA ANGELL, SCIENCE ON TRIAL 195–98 (1996); *see also* David E. Bernstein, *The Breast Implant Fiasco*, 87 CAL. L. REV. 457, 458 (1999) (reviewing MARCIA ANGELL, SCIENCE ON TRIAL (1996)).

83. *See* Jeffrey J. Hayward, Comment, *The Same Mold Story?: What Toxic Mold Is Teaching Us About Causation in Toxic Tort Litigation*, 83 N.C. L. REV. 518, 522–27 (2005) (describing uncertainty regarding link between mold and human health). *Compare* New Haverford P'ship v. Stroot, 772 A.2d 792 (Del. 2001) (upholding admissibility of scientific evidence under *Daubert* standard and jury verdict in favor of toxic mold plaintiffs), *with* Roche v. Lincoln Prop. Co., 278 F. Supp. 2d 744 (E.D. Va. 2003) (holding inadmissible, under *Daubert* standard, expert testimony regarding toxic mold).

84. Indeed, some scholars have decried the problem of litigation-driven science, to which *Daubert* itself may be a contributing factor. *E.g.*, William G. Childs, *The Overlapping Magisteria of Law and Science: When Litigation and Science Collide*, 85 NEB. L. REV. 643, 665–68 (2007); William L. Anderson, Barry M. Parsons & Drummond Rennie, Daubert*'s Backwash: Litigation-Generated Science*, 34 U. MICH. J.L. REFORM 619 (2001). Notably, on remand in *Daubert* itself, the Ninth Circuit added litigation-driven science as a factor that cut against reliability. *See* Daubert v. Merrell Dow Pharms., Inc., 43 F.3d 1311, 1318–19 (9th Cir. 1995).

85. "Judges and lawyers usually react to science with all the enthusiasm of a child about to get a tetanus shot." Bert Black, Francisco J. Ayala & Carol Saffran-Brinks, *Science and the Law in the Wake of* Daubert*: A New Search for Scientific Knowledge*, 72 TEX. L. REV. 715, 716 (1994); *see also* Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 600–01 (1993) (Rehnquist, J., concurring in part and dissenting in part) ("I do not doubt that Rule 702 confides to the judge some gatekeeping responsibility in deciding questions of the admissibility of proffered expert testimony. But I do not think it imposes on them either the obligation or the authority to become amateur scientists in order to perform that role."); Marconi Wireless Tel. Co. v. United States, 320 U.S. 1, 60–61 (1943) (Frankfurter, J., dissenting in part) ("It is an old observation that the training of Anglo-American judges ill fits them to discharge the duties cast upon them by patent legislation."); Lawrence M. Sung, *Echoes of Scientific Truth in the Halls of Justice: The Standards of Review Applied by the United States Court of Appeals for the Federal Circuit in Patent-Related Matters*, 48 AM. U. L. REV. 1233, 1241 (1999) (noting criticisms of patent system and Federal Circuit "may be based solely upon an asserted lack of ability of the legal arbiter to determine scientific truth or merit"); Markey, *supra* note 16, at 538 (regarding preparatory education, "[a]n interdisciplinary approach is needed in which those planning a career in law would learn about science and scientists, and in which science students would learn about law and lawyers"). Some studies suggest that judges make many of the same

particular can draw on the assistance of special masters or court-appointed scientific experts,[86] this potential has gone largely untapped.[87] According to Professor Cheng, explanations likely include the difficulty courts can have identifying quality experts, their expense (both in money and judicial efficiency), and a perception that they interfere with the adversarial process.[88] These transaction costs are likely difficult to overcome in a lawsuit because they must be borne solely by plaintiffs and defendants; even in class actions where plaintiffs' resources might be pooled, the cost spreading is not nearly what can be achieved in a legislature.

A common denominator of many of these issues is not just scientific uncertainty but the nature of the scientific question presented. When a court is asked to resolve a question science itself has not resolved, it is simply unequipped to do so because legal values—and more particularly, the judicial process—do not employ the scientific method. I call these types of questions qualitative, or non-binary; for example: Does Bendectin cause birth defects? Will a statute establishing a cap-and-trade program for emissions reduce global warming?[89]

While courts are poorly situated, from an institutional perspective, to resolve these types of questions, they have a significant institutional strength in answering what I call binary questions. That is, when the scientific issue relates to "certain," or positive science—such as a judicially noticeable scientific fact—no additional scientific methodology needs to be employed. Instead, usual legal-system values easily discern a binary answer in a way indistinct from courts' other fact-finding methods.

Importantly, science need not relate only to the judicial-notice end of the certainty spectrum to be presented as a binary issue. To truly evaluate comparative scientific institutional competence, it is necessary to appreciate that different types of scientific questions may be relevant to a legal issue. Examples of binary questions might be: Have scientists observed a warming trend? Is there scientific uncertainty regarding the extent to which temperatures will rise in the next fifty years? These binary questions stand in marked contrast to a related non-binary question: How much will temperatures rise in the next fifty years?

Courts are very good at reaching binary decisions relatively quickly. Consider the classic example of a plaintiff and defendant each testifying whether the traffic light was green or red; the role of the fact finder has always been to decide which it is and reach a yes-or-no, win-or-lose result.[90] More subtly, judges reach binary decisions at

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mistakes attributed to jurors when processing scientific information. *See, e.g.*, Neil Vidmar & Shari S. Diamond, *Juries and Expert Evidence*, 66 BROOK. L. REV. 1121, 1170–73 (2001) (collecting studies and noting that in one example, only four percent of judges could provide an explanation of falsifiability that revealed a clear understanding of that attribute). *See generally* Chris Guthrie, Jeffrey J. Rachlinski & Andrew J. Wistrich, *Inside the Judicial Mind*, 86 CORNELL L. REV. 777 (2001) (presenting results of empirical study suggesting judges use heuristics that can produce systematic errors in judgment).

86. *See, e.g.*, FED. R. EVID. 706 (authorizing appointment of expert witnesses).

87. *See generally* Edward K. Cheng, *Independent Judicial Research in the* Daubert *Age*, 56 DUKE L.J. 1263 (2007) (arguing for independent judicial research as a more effective alternative).

88. *Id.* at 1271–72.

89. *See, e.g.*, S. 3036, 110th Cong. § 3(1) (as introduced May 20, 2008) (stating purpose of establishing program to reduce greenhouse gas emissions).

90. *See* Green, *supra* note 59 at 391 ("Whereas science can duck issues of [particular difficulty] by asserting that the evidence is inconclusive, a court does not have this luxury.

every step of the pretrial process: whether to grant or deny a motion to dismiss, a motion for summary judgment, or a motion in limine, for example. These types of binary decisions benefit from the adversarial process because that process is an effective way to ensure that the very strongest arguments for each outcome are presented. Furthermore, courts are expected to reach these decisions within a reasonable timeframe, providing finality to the litigants.

Because courts are so well-versed in reaching binary outcomes, it makes sense that where a scientific issue demands only a binary answer—such as *whether* there is scientific uncertainty—a court would not have the same difficulties as with attempting to resolve the uncertainty itself. For this reason, it is critical to factor the type of scientific question into any analysis of whether scientific avoidance is appropriate. In addition, doing so provides a useful standpoint from which to compare the scientific capabilities of courts and legislatures.

C. Science in the Legislatures

On the surface, courts and legislatures face many of the same hurdles with respect to scientific uncertainty. While science aspires to be apolitical as a general matter, those who bring it to a legislature—whether as legislators themselves or interested groups—are incentivized by the very nature of that institution to present science in a manner that tends to support a particular political decision. Indeed, legislatures use a different sort of adversarial process that nevertheless suffers from weaknesses similar to those of the courts. Further, legislators as a group have only a marginally larger percentage of members with scientific or technical backgrounds. Even so, anecdotal evidence suggests legislatures are far better positioned than courts to make decisions in light of scientific uncertainty. These observations raise some fundamental questions: How do legislatures learn about science? What are the institutional strengths and weaknesses associated with that process? And to what extent does the legislative process capture "good" science?

Collecting scientific information is well within the inherent legislative investigative power to conduct inquiries concerning existing laws as well as potential statutes.[91] Although this broad capability is frequently held up as a rationale for judicial restraint—the idea being that legislatures are better fact finders than courts[92]—there

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When a lawsuit is filed, the case must be decided in a binary manner: liability or no liability.").

91. Watkins v. United States, 354 U.S. 178, 187 (1957) ("The power of the Congress to conduct investigations is inherent in the legislative process. That power is broad."); *see also* Gibson v. Fla. Legislative Investigation Comm., 372 U.S. 539, 544 (1963) ("[T]here can be no question that the State has power adequately to inform itself—through legislative investigation, if it so desires . . . ."); Barenblatt v. United States, 360 U.S. 109, 111 (1959) ("The scope of the power of inquiry, in short, is as penetrating and far-reaching as the potential power to enact and appropriate under the Constitution.").

92. *See* Gen. Motors Corp. v. Tracy, 519 U.S. 278, 309 (1997) ("Congress has the capacity to investigate and analyze facts beyond anything the Judiciary could match."); Turner Broad. Sys. v. FCC, 512 U.S. 622, 672 n.4 (1994) (Stevens, J., concurring in part and dissenting in part) (noting the "deference this Court should accord to the factfinding abilities of the nation's legislature") (quoting Turner Broad. Sys. v. FCC, 819 F. Supp. 32, 46 (D.D.C. 1993)). *But see* United States v. Morrison, 529 U.S. 598 (2000) (striking down Violence Against Women Act where Congress made insufficient showing connecting violence to interstate commerce); United States v. Lopez, 514 U.S. 549 (1995) (making a similar finding with respect to guns in school

seems to be little empirical basis for making such a claim.[93] Nevertheless, it is true that legislatures have a far broader universe of scientific and technological resources than do courts. Congress, for example, has the powers to conduct hearings and subpoena witnesses on science and technology generally, and can also obtain expert advice from the National Academies ("Academies"), a rich source of expertise in science, engineering, and medicine.[94] A sampling of congressionally requested Academies studies illustrates the broad scope and scale of scientific studies that may be ordered. For example, the Food and Drug Administration Amendments Act of 2007[95] mandates that the Institute of Medicine conduct a study and report to Congress on certain pediatric research.[96] Another mandate requires a "multi-year, comprehensive in-water study" to measure the efforts, effects, and impact of turtle excluder devices used by shrimp fisheries;[97] the same Act also directs the Secretary of Commerce to request the National Research Council to conduct a study of the acidification of oceans and the impact on the United States.[98] Yet another study will investigate the incidence and impact of addictions to prescription opioid analgesics.[99]

Congress may also avail itself of the Congressional Research Service (CRS), which is the public policy research arm of Congress; this source of information links science and policy. For example, CRS consulted with Congress regarding EPA's air quality standards for particulate matter, providing an analysis of the history of air standards, legislative requirements for setting those standards, and potential health and economic impacts of the EPA's proposed standards.[100] Of note is CRS's nonpartisan approach to its analyses. As one commentator describes, CRS strictly guards against offering policy recommendations and even reviews outgoing reports for neutrality and balance.[101] The Government Accountability Office, another agency that works for

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zones). For a recent article criticizing these cases, see Ruth Colker & James J. Brudney, *Dissing Congress*, 100 MICH. L. REV. 80, 83 (2001) ("[T]he Court has undermined Congress's ability to decide for itself how and whether to create a record in support of pending legislation.").

93. *See* FAIGMAN, *supra* note 19, at 8 (stating that this premise is likely inaccurate, and in any event, is unsound as a matter of constitutional principle).

94. "[T]he National Academy shall . . . , whenever called upon by any department of the Government, investigate, examine, experiment , and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports, to be paid from appropriations which may be made for the purpose . . . ." An Act to Incorporate the National Academy of Sciences, ch. 111, § 1, 12 Stat. 806 (1863); *see also* About the National Academies, http://www.nationalacademies.org/about/.

95. Food and Drug Administration Amendments Act of 2007, Pub. L. No. 110-85, 121 Stat. 823 (2007).

96. *Id.* § 505B(l)(1), 121 Stat. at 874.

97. Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, Pub. L. No. 109-479, § 212, 120 Stat. 3618 (2007).

98. *Id.* § 701, 120 Stat. at 3649.

99. Office of National Drug Control Policy Reauthorization Act of 2006, Pub. L. No. 109-469, § 1106, 120 Stat. 3541 (2006).

100. CONGRESSIONAL RESEARCH SERVICE, ANNUAL REPORT FISCAL YEAR 2006, at 26, *available at* http://www.loc.gov/crsinfo/CRS06_AnnRpt.pdf. Much of CRS's work is unavailable to the general public. *See* BRUCE A. BIMBER, THE POLITICS OF EXPERTISE IN CONGRESS: THE RISE AND FALL OF THE OFFICE OF TECHNOLOGY ASSESSMENT 79 (1996) ("CRS is officially forbidden from publicly distributing most of its documents.").

101. BIMBER, *supra* note 100, at 82. Even so, CRS prepares reports in support of particular legislation by adopting the legislator's viewpoint and labeling its product "directed writing,"

Congress, provides policy analysis aimed at making government function more effectively; its role naturally intersects with many scientific endeavors.[102]

These examples are notable because they highlight the ability of Congress to obtain full-blown science—studies conducted by scientists, according to the scientific method, in separate institutions. The luxury of being able to call on separate institutions for informational needs enables better decision making in a legislature, but is antithetical to the adversarial system of courts, which largely limits information to that provided by the parties. And as an aspirational matter, science requested from the Academies should not be biased by *propter hoc* political expectations. By contrast, science is marshaled for the purpose of furthering particular outcomes in the judicial branch. Furthermore, the impetus for judicial science comes from the parties themselves—usually not the impartial court. Finally, Congress can in many instances wait for scientific information to become available before deciding the best course of action. Courts do not have this luxury of time.

In spite of this tremendous capacity to obtain scientific information, legislatures may not have incentives to engage in careful fact finding, if they engage in it at all.[103] Although the costs of such research can be spread more broadly than in litigation, the political nature of legislatures means committees have considerable opportunities to screen and channel sources of facts toward particular policy-driven goals.[104] Moreover, facts provided by lobbyists may find their way into the legislative record—again suggesting a process that is more policy-driven than those of courts and science.[105] And even after a statute has been passed, the ability of a legislature to alter the statute based on changes in facts (or the revelation that facts were wrong in the first place) depends on its ability to overcome significant inertia; the combination of limited time and nearly unlimited demands on legislatures means that there are large hurdles to cross before they can revisit statutes.[106]

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which is not officially traceable to the agency. *Id.* at 82–83.

102. *See* U.S. Government Accountability Office, About GAO, http://www.gao.gov/about/. For examples of its policy analysis, see U.S. GOVERNMENT ACCOUNTABILITY OFFICE, CLIMATE CHANGE RESEARCH: AGENCIES HAVE DATA-SHARING POLICIES BUT COULD DO MORE TO ENHANCE THE AVAILABILITY OF DATA FROM FEDERALLY FUNDED RESEARCH (2007), *available at* http://www.gao.gov/new.items/d071172.pdf; U.S. GOVERNMENT ACCOUNTABILITY OFFICE, GLOBAL HEALTH: U.S. AGENCIES SUPPORT PROGRAMS TO BUILD OVERSEAS CAPACITY FOR INFECTIOUS DISEASE SURVEILLANCE (2007), *available at* http://www.gao.gov/new.items/d071186.pdf. Until 1995, there was also a Congressional Office of Technology Assessment, which provided members and committees analyses of scientific and technological subjects. Topics ranged from the cost-effectiveness of colorectal screening in average-risk adults to biologically based technologies for pest control. *See* Princeton University, OTA Publications by Year: 1995, http://www.princeton.edu/~ota/ns20/year_f.html.

103. *See* State v. Kantner, 493 P.2d 306, 310 n.5 (Haw. 1976) ("We know of nothing that *compels* the Legislature to thoroughly investigate the available scientific and medical evidence when enacting a law.") (emphasis in original) (quoting Commonwealth v. Leis, 243 N.E.2d 898, 901–02 (Mass. 1969)).

104. CONGRESS AND THE CONSTITUTION 225 (Neal Devins & Keith E. Whittington eds., 2005).

105. *See id.* (noting potential impact of lobbyists and special interest groups); *see also* KOMESAR, *supra* note 65, at 54–58 (describing interest group theory of politics).

106. *See* Lawrence C. Marshall, *"Let Congress Do It": The Case for an Absolute Rule of Statutory Stare Decisis*, 88 MICH. L. REV. 177, 190–91 (1989); Mathew D. McCubbins &

Nor are legislatures required, as a general matter, to put science to any test of reliability. Courts have soundly rejected invitations to review evidence relied upon by legislatures for compliance with the *Daubert* standard.[107] Where uncertain science is at issue, the lack of standards suggests legislatures might be susceptible to the same "junk science" problems as courts. But interestingly, there are few examples in the scholarly literature of legislatures getting positive science wrong.[108] Indeed, neither the major scientific organizations nor the legal scholarship suggest that getting positive science wrong is a systemic problem of legislatures. This lack of evidence might be attributed to a general failure to empirically examine the science in statutes.[109] But as Professor Wagner notes with respect to her research regarding environmental statutes, the absence of criticism regarding positive science is noteworthy, particularly when compared to the attention given to such deficiencies in courts.[110] As she explains, the incentives lean toward getting positive science right because positive science is politically appealing.[111]

Indeed, if we view legislatures as a place for robust debate from both sides of an issue, we would expect the political process itself to ferret out "bad" science, just as we would rely on the adversarial model of the judiciary to do the same thing. To be sure, the premise of robust debate is weak, as many have documented.[112] Yet it does suggest the possibility that, like courts, legislatures can produce good results with respect to positive science. Of course, legislatures' approaches to scientific uncertainty are much more difficult to assess because the resulting statutes are ultimately policy choices. As compared to courts, the most we can say is that legislatures have comparatively better *tools* at their disposal. Whether they use those tools effectively, therefore, ought to be a factor in scientific avoidance analyses.

To summarize, courts and legislatures both bring relative strengths and weaknesses to scientific fact finding, the effects of which are likely to be more concentrated when uncertain science is at issue. Both institutions are weak in the sense that the major players often lack scientific or technical backgrounds, though to be fair, both are populated with smart people, many of whom work hard to understand the science at issue. Both are susceptible to missing a full consideration of science due to their adversarial-judicial or adversarial-political processes. Although legislatures have better tools than the courts for evaluating uncertain science, the disincentives to using those tools are high and suggest that whether and how those tools are used might be a case-specific factor for considering scientific avoidance. Finally, with respect to binary questions of science, neither institution appears to have a significant advantage over

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Thomas Schwartz, *Congressional Oversight Overlooked: Police Patrols Versus Fire Alarms*, 28 AM. J. POL. SCI. 165, 166 (1984).

107. *See* Gammoh v. City of La Jabra, 395 F.3d 1114, 1127 (9th Cir. 2005); G.M. Enters., Inc. v. Town of St. Joseph, 350 F.3d 631, 640 (7th Cir. 2003); UFO Chuting of Haw., Inc. v. Young, 380 F. Supp. 2d 1160, 1163 (D. Haw. 2005).

108. *But see* Gonzales v. Carhart, 127 S. Ct. 1610, 1638 (2007).

109. *See* Wendy E. Wagner, *Congress, Science, and Environmental Policy*, 1999 U. ILL. L. REV. 181, 198–99 (noting that perhaps some environmental legislation is so technical that scholars avoid it or are unprepared to critique it).

110. *Id.*

111. *Id.* at 221.

112. *See, e.g.*, KOMESAR, *supra* note 65, at 53–97 (describing theories of majoritarian influence and minority bias).

the other. With these considerations in mind, we can develop a typology from which to analyze scientific avoidance.

II. SCIENTIFIC AVOIDANCE IN CONTEXT

A. Tracing the Development of Scientific Avoidance

This Part traces the development of the scientific avoidance principle while critically examining its application. Originally applied to the most basic of state police powers, the principle's use took a notable shift in the latter part of the twentieth century and is now cited more frequently in opinions reviewing legislative acts that are more intrusive on individual rights. With this shift, however, came a decrease in the principle's usefulness.

The answers to two questions are critical to understanding this change and its implications. First, I ask what *type* of scientific issue is presented—binary or non-binary. As the cases show, courts do not make distinctions regarding the types of scientific questions at issue when choosing scientific avoidance. But to overlook the scientific particularities is a mistake because they have direct bearing on the legitimacy of implementing scientific avoidance. To the extent that scientific avoidance tips the interbranch balance toward legislatures, it should be grounded in a determination that the scientific issue is one that is better addressed in legislatures. By contrast, as we have seen, binary scientific issues are likely as easily handled by courts as by legislatures.

The second question asks about the *relevance* of the scientific issue to the substantive law, the answer to which should make a difference whether scientific avoidance is appropriate at all. Where science plays only a supporting role in illustrating what is within the realm of reasonableness, the corresponding standard of review will reflect the notion that courts' intervention is not particularly critical. But where the standard of review encompasses special reasons for invoking courts' countermajoritarian role, the corresponding scientific issues may appropriately be a matter of constitutional fact finding.

This approach reflects one final point about scientific avoidance—that of terminology. As already mentioned, the term "scientific avoidance" itself is meant to capture some of the ideals supporting constitutional avoidance. A familiar explanation of constitutional avoidance provides that "[t]he Court will not pass upon a constitutional question although properly presented by the record, if there is also present some other ground upon which the case may be disposed of."[113] Corollaries include the rule that courts should construe statutes to avoid finding them unconstitutional, as well as the principles limiting Supreme Court review of state court

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113. Ashwander v. Tenn. Valley Auth., 297 U.S. 288, 347 (1936) (Brandeis, J., concurring). *See generally* Philip P. Frickey, *Getting from Joe to Gene (McCarthy): The Avoidance Canon, Legal Process Theory, and Narrowing Statutory Interpretation in the Early Warren Court*, 93 CAL. L. REV. 397, 399–401 (2005) (emphasizing prominence, but describing criticism, of Justice Brandeis's statement of the canon of constitutional avoidance). For a comprehensive look at constitutional avoidance and its structural, democracy-forcing function, see Dan T. Coenen, *A Constitution of Collaboration: Protecting Fundamental Values with Second-Look Rules of Interbranch Dialogue*, 42 WM. & MARY L. REV. 1575, 1604–16 (2001).

judgments when there are adequate, independent state grounds.[114] The canon and its corollaries serve several purposes; most particularly, they are meant to avoid confrontations with other coequal branches (or states), thereby preserving judicial legitimacy.[115] More practically, they provide "a sensible ambiguity-resolving rule" that can help conserve judicial resources.[116]

Carefully applied, scientific avoidance ought to reach similar concerns. As noted already, the resolution of uncertain science will not supply answers. Relatedly, a decision made in light of uncertain scientific information is at its core a decision of policy. Like constitutional avoidance, scientific avoidance presumes that legislatures are generally better and more legitimately equipped to make such policy decisions. In that sense, scientific avoidance is a doctrine of deference to a coequal branch or of comity to a state. Its baseline view is that deference is indeed appropriate when legislatures have made decisions on matters of scientific uncertainty. But scientific avoidance also encompasses the flexibility needed to justify lesser degrees of deference, just as constitutional avoidance anticipates that sometimes, a confrontation between branches is justifiably unavoidable. This understanding thus provides additional support for differentiating scientific avoidance cases based on the relevance of the scientific question to the legal issue.

Thus, two questions inform the analysis and application of scientific avoidance. First, what type of scientific question is presented? Second, what is the question's relevance to the legal issue? These questions suggest a framework running along two axes. The first axis relates to the type of scientific issue. As a matter of the relative institutional capabilities of courts and legislatures, courts can more legitimately determine issues of a binary nature. By comparison, legislatures are better situated, at least in the abstract, to consider issues of a non-binary, or qualitative, nature.

The second axis relates to the relevance of science to the standard of review. Again this axis can be divided in a way that reflects basic views of institutional competence; the first category relates to scientific issues that are relevant to a legal issue under a heightened standard of review, where courts are viewed as legitimately scrutinizing legislative actions. The second category, where science provides only a spectrum of reasonableness, applies where there is no special reason for courts to meddle with their elected counterpart.[117] Table 1 presents the resulting framework:

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114. *Ashwander*, 297 U.S. at 347 (citation omitted).

115. Coenen, *supra* note 113, at 1608 ("By reserving constitutional intervention to instances of the most pressing urgency, the Court minimizes potentially power-sapping confrontations with coordinate branches, portrays itself as temperate in character, conserves judicial capital, and, through all this, solidifies its claim to exercise the power of judicial review."); *see also* Cass R. Sunstein, *Interpreting Statutes in the Regulatory State*, 103 HARV. L. REV. 405, 469 (1989) (phrasing purposes of avoidance in terms of separation of powers values).

116. Coenen, *supra* note, 113 at 1607.

117. These categories loosely reflect, but are not limited to, the two-tier structure the Court employs in substantive due process and equal protection analyses. However, for purposes of the typology, I do not distinguish between highly deferential rational basis review, as in *Lindsley v. Natural Carbonic Gas Co.*, 220 U.S. 61 (1911), and rational basis review with bite, as in *City of Cleburne v. Cleburne Living Center, Inc.*, 473 U.S. 432 (1985). In addition, I put cases involving scrutiny higher than reasonableness, such as for gender as in *United States v. Virginia*, 518 U.S. 515 (1996), in the heightened category, even if they would not qualify for strict scrutiny, as in *Loving v. Virginia*, 388 U.S. 1 (1967).

Table 1. Framework for Scientific Avoidance

Relevance of Question	Type of Question	
	Binary	Non-Binary/Qualitative
Spectrum of Reason	*Quadrant II*	*Quadrant I*
Heightened Review	*Quadrant III*	*Quadrant IV*

In the discussion that follows, I use this framework to characterize several scientific avoidance cases.[118] In selecting the quadrants, I focus on how the court actually characterized the scientific issue and its relevance, as opposed to ways the court might have done so. This descriptive approach allows for a normative critique and also provides insights into how this framework can be used to realize the full potential of scientific avoidance.

1. Origins

The earliest scientific avoidance cases involved judicial review of state statutes grounded in states' most basic police powers. *Jacobson v. Massachusetts* provides an example.[119] There, a citizen challenged, on substantive due process grounds, a Massachusetts statute enabling localities to implement mandatory smallpox vaccinations. The citizen was charged with failing to be vaccinated as required, and in his defense he contended that the statute violated the Fourteenth Amendment.[120] At trial, the defendant made numerous offers of proof aimed at showing the dangers of smallpox vaccinations, but the trial court excluded all his evidence and he was convicted.

The Supreme Court reviewed the proffered evidence on appeal, but determined that the evidence would not have made a difference because the statute was an exercise of broad police powers.[121] As the Court explained, a state's police powers "must be held to embrace, at least, such reasonable regulations established directly by legislative enactment as will protect the public health and safety."[122] Thus, the state's power was bounded only where a statute was arbitrary or unreasonable.[123] In light of the smallpox epidemic and the reasonable statutory scheme that delegated decision-making power to local boards of health, the statute was no different from other public health measures such as quarantine laws.[124] Furthermore, the Court did not examine what particular information Massachusetts considered when choosing to require vaccinations: "We

118. Although many of the examples involve U.S. Supreme Court review of federal or state legislative acts, there is no reason the framework should not apply to state supreme court review of state legislative acts.

119. 197 U.S. 11 (1905).

120. *Id.* at 26.

121. *Id.* at 24–25.

122. *Id.* at 25.

123. *Id.* at 28.

124. *Id.* at 28–29.

must *assume* that when the statute in question was passed, the legislature of Massachusetts was not unaware of these opposing theories [as to vaccines' safety], and was compelled, of necessity, to choose between them."[125]

Even with this highly deferential standard, the Court briefly reviewed the state of scientific opinion regarding the efficacies and dangers of vaccinations. It described studies throughout Europe, particularly in London, France, and Belgium, that supported the importance of vaccinations for reducing the incidence of the disease.[126] In a survey of 552 physicians in Britain, for example, only two had spoken against the utility of the vaccination.[127] Here the Court seemed to be double checking to make sure that there was some basis for what it concluded was a "common belief,"[128] held by the lay public as well as the medical profession, that smallpox vaccines were appropriate public health measures. The facts of some remaining uncertainty, a lack of an absolute consensus, and a possibility that science might yet prove the current belief wrong were not fatal because the legislature was well within its power to pass laws it viewed as promoting the common welfare, "*whether it does in fact or not.*"[129]

The Court grounded its reasoning in principles at the heart of scientific avoidance values. The "relations existing between the different departments of government" informed the scope of the Court's review such that only an arbitrary act, or one which ran afoul of some particular constitutional guarantee, would justify the Court's invasion into the legislature's province.[130] The Court repeatedly emphasized that it was reviewing an act of a legislature—which expressed the will of the people—and it explained that a single individual could not utilize the courts to dominate the majority's will.[131]

I place the science of *Jacobson* in the non-binary, qualitative category. The Court was not called upon to consider whether there was a dispute as to the efficacy of the vaccine. Nor was it asked to determine, in this particular instance, whether the smallpox vaccine would harm this particular plaintiff.[132] Instead, it was asked to survey evidence reflecting the available scientific information to decide whether it was reasonable to require the vaccination as a prospective matter. To the extent the citizen challenging the statute was asking the Court to choose a different side than the

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125. *Id.* at 30 (emphasis added).

126. *Id.* at 31 n.1.

127. *Id.* at 32 n.1.

128. *Id.* at 34 (quoting Viemeister v. White, 72 N.E. 97, 99 (1904)).

129. *Id.* at 35 (quoting Viemeister v. White, 72 N.E. 97, 99 (1904)) (emphasis added); *see also id.* ("While we do not decide and cannot decide that vaccination is a preventive of smallpox, we take judicial notice of the fact that this is the common belief of the people of the State, and with this fact as a foundation we hold that the statute in question is a health law, enacted in a reasonable and proper exercise of the police power.").

130. *Id.* at 31.

131. *Id.* at 38.

132. *Id.* at 30–31. Notably, the Court left open the possibility that the statute might be unconstitutional in an as-applied challenge where an adult could show in his particular case that the vaccine would cause serious bodily harm. *Id.* at 39. This possibility is similarly noted in *Gonzales v. Carhart* (*Carhart II*), 127 S. Ct. 1610, 1638 (2007) ("[T]hese facial attacks should not have been entertained in the first instance. In these circumstances the proper means to consider exceptions is by as-applied challenge."), discussed *infra* text accompanying notes 239–255.

legislature in the scientific debate, he was asking the Court to engage in an analysis that would not have been at the heart of its institutional capabilities.

Likewise, the relevance of the science to the substantive standard was in its ability to define the scope of reasonableness. The legislature was well within legitimate scientific standards. Therefore, the Court did not need to resolve the scientific uncertainty itself to reach a determination of reasonableness. This explanation raises an interesting question: suppose the legislature had decided that, in light of the potential for these vaccines to cause rather than prevent harm, it would ban localities from mandating the vaccines until further information was available. The answer of course, is that it would be perfectly reasonable for a legislature to choose a precautionary approach, even if doing so sided with the minority in scientific thought.[133]

Thus, *Jacobson* is solidly within Quadrant I. As an institutional matter, the legislature was better equipped to consider matters of scientific uncertainty related to vaccines, and there was no special reason for the courts to interfere with the resulting policy decision. Examples following the *Jacobson* pattern continue to arise, with similar results. Thus, courts have rejected challenges to the fluoridation of public drinking water,[134] bans on indoor public smoking,[135] zoning ordinances aimed at protecting the environment,[136] and other restrictions designed to protect human health.[137] All of these instances involved Quadrant I, with non-binary, qualitative

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133. *See* Vance v. Bradley, 440 U.S. 93, 97 (1979) ("The Constitution presumes that, absent some reason to infer antipathy, even improvident decisions will eventually be rectified by the democratic process and that judicial intervention is generally unwarranted no matter how unwisely we may think a political branch has acted."); Metropolis Theatre Co. v. City of Chicago, 228 U.S. 61, 69–70 (1913) ("The problems of government are practical ones and may justify, if they do not require, rough accommodations—illogical, it may be, and unscientific.").

134. *E.g.*, Coshow v. City of Escondido, 34 Cal. Rptr. 3d 19, 33 (Cal. Ct. App. 2005) (upholding city's plan to fluoridate drinking water; plaintiff's reliance on potential harmful effects associated with fluoride compound insufficient to overcome rational health-and-safety basis for plan); Quiles v. City of Boynton Beach, 802 So. 2d 397 (Fla. Dist. Ct. App. 2001) (similar); Kraus v. City of Cleveland, 127 N.E.2d 609 (Ohio 1955) (similar); Chapman v. City of Shreveport, 74 So. 2d 142 (La. 1954) (rejecting challenge to fluoridation of public drinking water where plaintiffs relied on possible adverse consequences associated with exposure to fluoride but other scientific evidence supported legislature's decision).

135. *E.g.*, NYC C.L.A.S.H., Inc. v. City of New York, 315 F. Supp. 2d 461, 495 (S.D.N.Y. 2004) ("[D]ue process does not require a legislative body to await concrete proof of reasonable but unproven assumptions before acting to safeguard the health of its citizens.") (emphasis omitted) (citation omitted); Fagan v. Axelrod, 550 N.Y.S.2d 552, 557–58 (N.Y. Sup. Ct. 1990) ("Even if scientific evidence demonstrating the deleterious effect of environmental tobacco smoke were not so overwhelming as it is, it would not be the prerogative of this Court to contest the wisdom of the Legislature in choosing what evidence to credit.").

136. *E.g.*, UFO Chuting of Haw., Inc. v. Young, 380 F. Supp. 2d 1160 (D. Haw. 2005) (upholding statute banning seasonal parasailing in certain navigable waters for purpose of protecting humpback whales in face of challenge to quality of science used by legislature).

137. *E.g.*, Price v. Illinois, 238 U.S. 446, 452 (1915) (upholding prohibition on sale of food preservatives containing boric acid; debatable danger to public health viewed as strong reason for deference to legislature); Laurel Hill Cemetery v. City and County of San Francisco, 216 U.S. 358 (1910) (upholding ordinance forbidding burial of dead within city and county limits, while acknowledging differences in opinion regarding burial-related safety issues); Cal. Reduction Co. v. Sanitary Reduction Works of San Francisco, 199 U.S. 306, 320–21 (1905)

questions of scientific uncertainty, where the science was relevant to showing the bounds of the subject matter's reasonableness.

2. Classifications

Another natural fit for scientific avoidance is legislative definitions; legislatures have traditionally been afforded wide latitude in defining the objects of statutes. This makes intuitive sense: even if there is scientific uncertainty how something should be classified or defined, a legislative definition merely delineates the scope of the statute. Provided that scope does not run afoul of some other constitutional principle,[138] courts seem to view definitions—quite rightly—as a practical necessity. Thus, there is no need for a judicial rehashing of the science involved because the definitional components of statutes represent legislative policy choices.

In *Collins v. Texas*, for example, the Court confronted a substantive due process challenge to a state licensing statute aimed at regulating the practice of medicine.[139] Petitioner Collins was held for practicing medicine for money without having registered proof of his authority to do so with the State of Texas pursuant to the statute.[140] Collins was an osteopath,[141] and he claimed that the Texas statute's broad definition of practicing medicine was irrational because its breadth extended to those who practiced the healing arts without administering drugs.[142] Essentially, his claim was that osteopathy was not medicine and the state could not constitutionally claim otherwise.

Justice Holmes wrote the opinion for the Court. Using reasoning that sounded in scientific avoidance principles, he emphasized that the Act's only object was to define its applicability.[143] As applied, it was rational for the state to require some scientific training as a prerequisite to practicing osteopathy because, in contrast to nursing or massage therapy, osteopaths made a claim to "greater science."[144] In the end, however, Justice Holmes noted that perhaps the Court had discussed the case more than necessary—after all, it was already established that the State had a right "to adopt a

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(upholding ordinance specifying particular disposal methods for municipal waste, while acknowledging scientific uncertainty as to best disposal methods).

138. *See, e.g.*, State v. Kantner, 493 P.2d 306, 308 (Haw. 1972) (suggesting state legislature's power to define terms might be subject to certain state-constitutional procedural constraints, such as one-title, one-subject rule).

139. 223 U.S. 288, 294 (1912).

140. *Id.*

141. According to the American Academy of Osteopathy, "[o]steopathic medicine is a complete system of medical care. The philosophy is to treat the whole person, not just the symptoms. It emphasizes the interrelationships of structure and function, and the appreciation of the body's ability to heal itself." American Academy of Osteopathy, What is Osteopathy?, http://academyofosteopathy.org/whatis.cfm.

142. *Collins*, 223 U.S. at 296–97. The statute provided that any person who "shall treat or offer to treat any disease or disorder, mental or physical, or any physical deformity or injury, by any system or method, or to effect cures thereof, and charge therefor, directly or indirectly, money or other compensation" would be regarded as practicing medicine. *Id.* at 295.

143. *Id.* at 296.

144. *Id.* at 296–97.

policy even on medical matters concerning which there is difference of opinion and dispute."[145]

Classifications continue to be challenged on science-related grounds. In the customs context, for example, *eo nomine*[146] terms are accorded their common meanings, which are presumed to be their commercial meanings.[147] Thus, "where the scientific meaning of a tariff term differs from the term's common or commercial meaning, the term is not to be construed according to the scientific meaning, absent a contrary intent by Congress in using the term."[148] As its definition implies, this rule embodies strong scientific avoidance principles and is based on the rationale that persons involved in commerce would be expected to have familiarity with commercial and common meanings rather than scientific ones.[149] By implementing rules defaulting to those meanings, courts do not leave parties to second-guess possible outcomes, which presumably means less litigation and also provides some stability on which commerce may operate.

Consider, for example, *Aldrich Chemical Co. v. United States*,[150] a case involving the customs classification of an organic chemical compound. The dispute hinged on whether the compound, which was undisputedly nitrogenous, could also be classified as an alkaloid.[151] The court heard extensive scientific testimony regarding the origin and synthesis of the compound, and concluded that the compound was considered an alkaloid.[152] The court declined, however, to adopt a new definition of alkaloid that

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145. *Id.* at 297–98. Regulation of healthcare practitioners is a traditional area for this principle's application. *See* Williamson v. Lee Optical, Inc., 348 U.S. 483, 487 (1955) ("[I]t is for the legislature, not the courts, to balance the advantages and disadvantages of [a new statute dealing with regulation of visual care].").

146. "An 'eo nomine' designation is one which describes a commodity by [a] specific name, usually one well known to commerce." BLACK'S LAW DICTIONARY 535 (6th ed. 1990).

147. Swan v. Arthur, 103 U.S. 597, 598 (1881) ("While tariff acts are generally to be construed according to the commercial understanding of the terms employed, language will be presumed to have the same meaning in commerce that it has in ordinary use, unless the contrary is shown.").

148. Alexandria Int'l, Inc. v. United States, 13 Ct. Int'l Trade 689, 692 (Ct. Int'l Trade 1989).

149. Two Hundred Chests of Tea, 22 U.S. (9 Wheat.) 430, 438–39 (1824). Occasionally this principle has resulted in commercial classifications wholly at odds with positive science. *See* Dalquest v. United States, 53 Cust. Ct. 99, 109 (Cust. Ct. 1964) (classifying sea lion carcasses as fish not fit for human consumption); Cent. Commercial Co. v. United States, 11 Ct. Cust. 131, 133 (Ct. Cust. App. 1921) ("We are regretfully forced to the conclusion that judges, legislators, and people in general have classified the whale as a fish, and as the popular acceptation of tariff terms having no different commercial meaning must prevail as against their scientific signification, we must hold that the whale is a fish and that its flesh is fish . . . ."); *see also infra* text accompanying note 256 (discussing how to address binary holdings counter to science in scientific avoidance context).

150. 2 Ct. Int'l Trade 192 (Ct. Int'l Trade 1981).

151. *Id.* at 193. Alkaloids are naturally occurring chemical compounds containing basic nitrogen. Examples include morphine and nicotine. *See* WEBSTER'S ENCYCLOPEDIC UNABRIDGED DICTIONARY 54 (1996).

152. *Aldrich Chemical*, 2 Ct. Int'l Trade at 195. The court examined "usage in the scientific community" to determine whether the compound was an alkaloid. *Id.* Although the court did not discuss the point, the usage upon which it settled was presumably that accepted in commerce as

would resolve the ambiguities that had given rise to the dispute before it. In so doing, it exercised scientific avoidance:

> In the final analysis, the Court did not try to arrive at a new and more accurate definition of alkaloids, although plaintiff's proposed definition did appear to be more satisfactory. This was not necessary in light of its conclusion that [the compound] is an alkaloid within the traditional definition. Nor is the Court of the opinion that it ought to undertake to define so specialized a term in a manner which has not yet gained acceptance in the field, even though the traditional definition is losing its value. *At least it should not do so unless there is no other way to arrive at a decision.*[153]

Thus, where an overriding purpose (like facilitating commerce) depends on predictability and eschews scientific uncertainty, a doctrine that unapologetically looks for answers outside of science can further avoidance and legal-system values at the same time.

This variety of scientific avoidance is not limited to customs classifications. Numerous challenges to drug laws, for example, have contended that cocaine or marijuana is improperly classified as a scientific matter rendering related criminal penalties unconstitutional.[154] In particular, *United States v. Brookins* provides a straightforward illustration of scientific avoidance in Quadrant I. The *Brookins* defendant brought a motion to dismiss his indictment under the Comprehensive Drug Abuse Prevention and Control Act of 1970,[155] contending that Congress could not have rationally classified cocaine as a narcotic.[156] The court denied the motion, inquiring only whether the statute bore any rational relationship to a legitimate legislative purpose.[157] A simple review of the parties' affidavits satisfied the court that "there is an honest scientific difference of opinion concerning the effects of cocaine."[158] That difference alone was sufficient to uphold the statute.[159]

Collins, *Brookins*, and *Aldrich Chemical* fit easily within Quadrant I. First, they involve the scientific uncertainty of classification—a scientific enterprise that relies on

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well as in some scientific circles, while a more nuanced view of the (unsettled) science might have provided a different definition.

153. *Id.* at 196–97 (citation omitted) (emphasis added).

154. *See* United States v. Brookins, 383 F. Supp. 1212, 1215–16 (D.N.J. 1974), *aff'd*, 524 F.2d 1404 (3d Cir. 1979) (upholding classification of non-narcotic cocaine as narcotic for legal purposes); State v. Kantner, 493 P.2d 306, 308 (Haw. 1972) ("The legislature has broad power to define terms for a particular legislative purpose, and the courts . . . are bound to follow legislative definitions of terms rather than commonly accepted dictionary, judicial or scientific definitions."); *see also* Commonwealth v. Leis, 243 N.E.2d 898, 901–02 (Mass. 1969) ("We know nothing that *compels* the Legislature to thoroughly investigate the available scientific and medical evidence when enacting a law." (emphasis in original)).

155. 21 U.S.C. §§ 801–971 (2006).

156. *Brookins*, 383 F. Supp. at 1213–14. The defendant contended that this classification as applied violated substantive due process and equal protection. *Id.*

157. *Id.* at 1215.

158. *Id.* at 1215–16.

159. *Id.* The court noted, in addition, that Congress was aware of discrepancies between the legal and pharmacological classifications of cocaine at the time of the hearings preceding the Act, but made the policy decision to retain cocaine's classification because of its established capacity as a dangerous drug. *Id.* at 1216.

perhaps uncertain mechanisms of biology, chemistry, and physics in a qualitative manner. This characteristic makes the legislature somewhat better than the courts for considering the science at issue, weighing in favor of scientific avoidance. Second, the relevance of the scientific question is in its bearing on a statute's rationality—a realm already accustomed to very deferential treatment.

3. Prohibition Era

Another early line of cases involved challenges to Prohibition-era statutes that proscribed the use of intoxicants for medicinal purposes. Although these cases are somewhat confined to the unique circumstances of Prohibition, they are worth consideration because they are frequently cited as justification for modern-day scientific avoidance, including in *Carhart I* and *II*.[160]

In *Everard's Breweries v. Day*,[161] the Court considered whether section two of the Supplemental Prohibition Act was constitutional insofar as it prevented physicians from prescribing intoxicating malt liquors for medicinal purposes. The Act provided "[t]hat only spirituous and vinous liquor may be prescribed for medicinal purposes, and all permits to prescribe and prescriptions for any other liquor shall be void."[162] The challengers, a brewer and a bottler, lost their ability to sell malt liquor for medicinal purposes following the Act; they contended the Act was not authorized by the Eighteenth Amendment and ran afoul of "other provisions of the Constitution."[163] Concluding that prohibiting the use of these medicinal agents was neither arbitrary nor unreasonable, the Court focused on the legislative history of the Act. The House of Representatives had held an extended public hearing and collected evidence to evaluate whether intoxicating malt liquors possessed any significant medicinal qualities.[164] Overwhelmingly, the evidence showed that intoxicating malt liquors had no substantial value as medicinal agents. There was some difference of opinion, but the Court brushed it aside as being debatable at the most.[165] In light of this evidence, the Court concluded that it was reasonable for Congress to distinguish between spirituous and vinous liquors and malt liquors "based upon their essential differences."[166]

Two years later, the Court rejected yet another Prohibition era challenge in *Lambert v. Yellowley*.[167] This time, a physician challenged a portion of the National Prohibition Act that limited the amount of spirituous liquor he could prescribe to a patient within a

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160. Gonzales v. Carhart (*Carhart II*), 127 S. Ct. 1610, 1636 (2007); Stenberg v. Carhart (*Carhart I*), 530 U.S. 914, 970 (2000) (Kennedy, J., dissenting).

161. 265 U.S. 545 (1924).

162. Act Supplemental to the National Prohibition Act, 42 Stat. 222 (1921). This provision banned beer, ale, porter, and other malt liquor containing one-half of one percent of alcohol by volume and that was fit for beverage purposes. *Everard's Breweries*, 265 U.S. at 555 n.1.

163. *Everard's Breweries*, 265 U.S. at 556–57. Given the Court's analysis, it seems most likely that the challengers also brought substantive due process or equal protection challenges. *Cf.* Peil Bros. v. Day, 278 F. 223, 224 (D.N.Y. 1922) *aff'd*, 281 F. 1022 (2d Cir. 1922) (setting forth liberty challenges to section two).

164. *Everard's Breweries*, 265 U.S. at 561.

165. *Id.* at 562.

166. *Id.* at 562–63. Presumably, there was a greater consensus in the medical community that spirituous and vinous liquors had medicinal properties.

167. 272 U.S. 581 (1926).

ten-day period.[168] The physician alleged that, in certain cases, a greater amount was necessary for his patients' health, and that exercising his scientifically trained judgment in the interest of his patients' well-being was an essential part of his constitutional rights as a physician.[169] The Court summarily rejected this argument, explaining that in light of the conflict in "[h]igh medical authority" as to the medicinal value of spirituous and vinous liquors taken as a beverage, it would be strange if Congress lacked the power to determine that permissible prescriptions should be subject to some limitations.[170]

These cases share several attributes with *Jacobson* and the classification cases.[171] First, they involved true scientific uncertainty, putting them in the non-binary, qualitative realm. Second, the challenged statutes were within the heartland of police powers and were reviewed deferentially. State statutes aimed at health and safety, like the mandatory vaccinations in *Jacobson*, or at professional licensing, as in *Collins*, are comfortably regarded as policy decisions wholly apart from any scientific avoidance considerations. Likewise, although the Prohibition cases involved a unique constitutional provision, the additional challenges to those statutes—grounded as they were in the Fourteenth Amendment—reflected a similar attitude of judicial deference. A litigant's scientific objection to a statute only highlighted the fact that the legislature had made a policy choice in light of scientific uncertainty.

Science in these cases was presented as a basis for holding a statute arbitrary or unreasonable. But in all cases where there was scientific uncertainty and the legislature's choice was supported by at least some scientific possibility, the court refused to side with science different than what the legislature used.

4. Shifting Signals

As I have noted, courts continue to confront science-based challenges to police-power statutes and classifications. The great majority of these cases fall, as did *Jacobson*, within Quadrant I, with the courts concluding that the statute at issue represents a rational legislative policy choice and that the scope of scientific possibilities defines that spectrum of rationality. Although these cases arose in the early twentieth century, their reasoning continues to be applied in police-power, social, and economic-regulation cases. If the use of scientific avoidance stopped there, it would be entirely defensible. Not only were the scientific questions of a type better considered by a legislative body from the standpoint of institutional competence, but their subject matter and corresponding standards for review were well grounded in separation of powers and state comity concerns. But sometime after the mid-twentieth century, scientific avoidance began to creep into other areas of law. Along with this development came a decline in scientific avoidance as a useful decision-making guide, because it increasingly appeared as a rationalization rather than an independent standard.

The first step in this shift seemed deceptively unremarkable; it involved a classification for purposes of sentencing. But it was the first time the Supreme Court

168. *Id.* at 588.
169. *Id.*
170. *Id.* at 597.
171. *See supra* text accompanying notes 137–59.

had expressly spoken in scientific avoidance terms since the Prohibition era, and it became a building block from which later cases of a different nature drew support. *Marshall v. United States*[172] involved a prisoner's equal protection and substantive due process challenges to his exclusion from a drug treatment program on account of his having three prior felony convictions.[173] The statute at issue, the Narcotic Addict Rehabilitation Act (NARA) of 1966,[174] provided for special rehabilitative treatment (as opposed to traditional imprisonment) for certain addicts, but excluded from eligibility offenders with two or more felony convictions.[175] Applying rational basis review, the Court rejected the claim.[176] In a six-to-three opinion authored by Justice Burger, the majority deferentially examined Congress's purposes in distinguishing between addicts based on criminal history and concluded that Congress rationally decided to restrict eligibility to those it viewed as most likely to respond to treatment.[177] Furthermore, the Court emphasized that there was no consensus in the medical community as to the nature of addiction or the efficacy of treatment methods. Thus, the NARA program was "fundamentally experimental in nature."[178] Congress might have permissibly set up NARA differently, but different possibilities did not render the current scheme unconstitutional.[179] The Court concluded with a statement of scientific avoidance: "[w]hen Congress undertakes to act in areas fraught with medical and scientific uncertainties, legislative options must be especially broad and courts should be cautious not to rewrite legislation."[180]

The three-Justice dissent, led by Justice Marshall, disagreed with the way the majority applied low-level scrutiny.[181] According to Justice Marshall, the presumption that two felonies indicated a nonamenability to rehabilitation was "plainly contrary to fact."[182] He cited evidence suggesting that some people with two or more felony

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172. 414 U.S. 417 (1974).

173. *Id.* at 418–19.

174. Narcotic Addict Rehabilitation Act of 1966, Pub. L. No. 89-793, 80 Stat. 1438 (codified in scattered sections of 18, 28, & 42 U.S.C.).

175. *Marshall*, 414 U.S. at 418.

176. *Id.* at 423.

177. *Id.* at 424–25.

178. *Id.* at 426.

179. *Id.* at 427–28 (citing Jefferson v. Hackney, 406 U.S. 535 (1972); Dandridge v. Williams, 397 U.S. 471 (1970); McGowan v. Maryland, 366 U.S. 420 (1961); Williams v. Lee Optical, Inc., 348 U.S. 483 (1955)).

180. *Id.* at 427; *see also* Traynor v. Turnage, 485 U.S. 535, 552 (1988) (upholding regulation categorizing alcoholism as willful against Rehabilitation Act challenge stating: "This litigation does not require the Court to decide whether alcoholism is a disease whose course its victims cannot control. It is not our role to resolve this medical issue on which the authorities remain sharply divided."); N.Y. Transit Auth. v. Beazer, 440 U.S. 568, 590–92 (1979) (upholding employer's policy of excluding therapeutic methadone users from employment, and reasoning that more precise policies were not required given uncertainties associated with heroin addiction and treatment, classification was rational).

181. *Marshall*, 414 U.S. at 431, 433 (Marshall, J., dissenting) ("[T]he Equal Protection Clause has been all but emasculated . . . . If deferential scrutiny under the equal protection guarantee is to mean more than total deference and no scrutiny, surely it must reach the statutory exclusion involved in this case.").

182. *Id.* at 436.

convictions were older, and older people often responded better to drug treatment programs.[183] To the majority's view that courts should be reluctant to interfere with legislative decisions that were fundamentally experimental in nature, Justice Marshall replied that that observation "must be tempered by a realization that we are experimenting here with people's lives and health."[184]

That reply, of course, has been rejected time and again; in fact, some due process challenges have expressly, and unsuccessfully, argued for a right not to be experimented upon.[185] But previous cases, focused as they were on the state's ability to legislate for the public health, implicated citizens' interests in bodily integrity that have long been held subordinate to the overall public health, provided there was some reasonable justification for the state's method of intrusion. The reason *Marshall* was a turning point is that it carried physical liberty overtones in ways distinct from *Jacobson*-type facts: persons participating in the NARA program were eligible for conditional release on parole following six months of treatment, whereas those offenders in the traditional system had no such opportunity.[186]

In spite of this distinction, *Marshall* is properly classified in Quadrant I. The scientific knowledge about the nature of addiction and efficacy of treatment was fundamentally qualitative and by no means binary, making the legislature the institution with superior decision-making capacities regarding this issue. Furthermore, the classification implicated no suspect classes or fundamental rights—a point that even the dissent embraced—and so the scientific issue merely framed the bounds of reasonableness. Thus, *Marshall* represented a most appropriate type of case for applying scientific avoidance. Even so, its physical liberty implications represented a shift that became manifest in the two Supreme Court cases that followed.

In the first, *Jones v. United States*,[187] the petitioner challenged his ongoing commitment to a mental institution. Charged with attempted petit larceny, a misdemeanor punishable by a maximum sentence of one year, the petitioner was diagnosed with paranoid schizophrenia during his trial's pendency, and he entered a plea of not guilty by reason of insanity.[188] Thereafter, he was committed to a mental institution pursuant to District of Columbia law.[189] After being hospitalized for a period longer than he would have spent in prison under the petit larceny charge, he pursued a claim that he should be either released or recommitted pursuant to the District's civil-commitment standards.[190]

The standard for involuntary commitment requires a dual finding of dangerousness and mental illness or abnormality reflecting a lack of volitional control.[191] Among

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183. *Id.*

184. *Id.* at 438.

185. This was a common theme in the fluoridation cases. *See supra* note 134; *see also* City Comm'n of City of Fort Pierce v. State *ex rel.* Altenhoff, 143 So. 2d 879, 891 (Fla. Dist. Ct. App. 1962) (rejecting contention that fluoridation unconstitutionally constitutes experimentation); Kraus v. City of Cleveland, 127 N.E.2d 609, 613 (Ohio 1955) (same).

186. *Marshall*, 414 U.S. at 438 n.11 (Marshall, J., dissenting).

187. 463 U.S. 354 (1983).

188. *Id.* at 359–60.

189. *Id.* at 360.

190. *Id.*

191. Addington v. Texas, 441 U.S. 418, 426–27, 432–33 (1979); *see* Kansas v. Hendricks,

other things, the petitioner argued that the requisite dangerousness was not established by his plea to a non-violent property crime.[192] And even if his crime could be considered dangerous, he contended that available research did not reveal any predictive value of this prior dangerous act.[193] Congress failed to cite any empirical evidence showing that a mentally ill person who had previously committed a criminal act was likely to commit additional dangerous acts in the future.[194] Indeed, the petitioner contended that the available research failed to support any such predictive value.[195]

Justice Powell authored the five-to-four majority opinion rejecting the petitioner's challenge.[196] In particular, the Court disavowed any need for the legislature to support its approach with empirical evidence, stating, "[w]e do not agree with the suggestion that Congress' power to legislate in this area depends on the research conducted by the psychiatric community."[197] In fact, the Court noted, "science has not reached finality of judgment" on matters of mental health, and so the lesson the Court has drawn "is not that government may not act in the face of this uncertainty, but rather that courts should pay particular deference to reasonable legislative judgments."[198]

As in *Marshall*, most of the *Jones* dissenters particularly emphasized the scientific uncertainty plaguing the legislative decision. The gist of Justice Brennan's dissent went to the standard applicable to the determination of future dangerousness. He argued that both mental abnormality and future dangerousness required showings by clear and convincing evidence.[199] The majority went off course, he argued, by linking a not guilty by reason of insanity verdict to future dangerousness and obviating the need to show future dangerousness separately by clear and convincing evidence. He contended that this link was not scientifically substantiated; there were too many inaccuracies in attempts to predict future dangerousness based on past actions.[200] Justice Brennan concluded, "[t]he causal connection between mental condition and criminal behavior that 'not guilty by reason of insanity' formulations universally include is more a social judgment than a sound basis for determining dangerousness."[201]

Perhaps that very conclusion points to reasons for scientific avoidance. If scientific uncertainty requires policy as a gap-filler, and social judgment is an expression of

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521 U.S. 346, 357–60 (1997) (elaborating on mental illness requirement); Jones v. United States, 463 U.S. 354, 362 (1983) (describing standard as requiring demonstration, by clear and convincing evidence, that individual is mentally ill and dangerous); *see also infra* text accompanying notes 200–17 (describing *Hendricks*).

192. *Jones*, 463 U.S. at 364–65.

193. *Id.* at 364 n.13.

194. *Id.*

195. *Id.* at 364–65, 364 n.13.

196. *Id.* at 355.

197. *Id.* at 364 n.13.

198. *Id.*

199. *See id.* at 377 (Brennan, J., dissenting). Justice Brennan was joined by Justices Marshall and Blackmun. *Id.* at 371. In a short separate dissent, Justice Stevens emphasized his opinion that if the petitioner was to be confined longer than he would have been incarcerated, the state must bear the burden of showing by clear and convincing evidence that the additional confinement is warranted. *Id.* at 387 (Stevens, J., dissenting).

200. *Id.* at 378–79.

201. *Id.* at 381.

policy, then the legislature ought to be better positioned than the judiciary to enact such an expression. At the same time, *Jones* was a step removed from *Marshall* because it squarely implicated physical liberty. That difference puts *Jones* in a different Quadrant—Quadrant IV—because even if the scientific issue is better considered by the legislature, the relevance of the science lies in its ability to justify taking away physical liberty, an act that ought to receive less deferential treatment. Thus, pure scientific avoidance of the *Jacobson* sort does not seem justified. And given these considerations, it is hard to see how scientific avoidance actually advanced the majority's analysis in *Jones*. Certainly the legislature was better situated to consider the scientific uncertainties, but given the lack of supporting findings and the liberty interest involved, *Jones* seems like an extension of scientific avoidance that undermines that principle's very purpose.

The next case to spring from the *Marshall* line was *Kansas v. Hendricks*.[202] Again in the realm of civil commitment, Hendricks was a repeat sexual offender whom Kansas sought to commit pursuant to the state's Sexually Violent Predator Act.[203] The Act provided for civil commitment of any person who had been convicted of a sexually violent offense and who suffered from a mental abnormality making the person likely to engage in acts of predatory sexual violence.[204] "[M]ental abnormality," in turn, was defined as a "congenital or acquired condition affecting the emotional or volitional capacity which predisposes the person to commit sexually violent offenses in a degree constituting such person a menace to the health and safety of others."[205] Hendricks challenged the law on substantive due process, double jeopardy, and *ex post facto* grounds; the Court's substantive due process analysis touched on issues of scientific avoidance.

The Kansas Supreme Court had been persuaded by Hendricks's due process claim because it determined that U.S. Supreme Court precedent required a finding of mental *illness* and dangerousness.[206] "Mental abnormality," the court had held, did not meet the mental illness requirement in this context because even if Hendricks was mentally abnormal, pedophilia did not qualify as mental illness.[207] On certiorari to the U.S. Supreme Court, Hendricks likewise argued that the Court's precedent required mental illness as a prerequisite to civil commitment, but a "mental abnormality" was insufficient because it was a term coined by the Kansas legislature rather than the psychiatric community.[208] In a five-to-four decision authored by Justice Thomas, the Court explained that not only did prior authority fail to attribute any "talismanic significance" to the words "mental illness," but psychiatrists themselves disagreed regarding the meaning of mental illness.[209] And in any event, legal definitions need not

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202. 521 U.S. 346 (1997).

203. *Id.* at 350.

204. KAN. STAT. ANN. §§ 59-29a01 to 59-29a22 (2005); *Hendricks*, 521 U.S. at 350–52.

205. *Hendricks*, 521 U.S. at 352 (quoting KAN. STAT. ANN. § 59-29a02(b) (2005)).

206. *In re* Hendricks, 912 P.2d 129, 137 (Kan. 1996), *rev'd sub nom.* Kansas v. Hendricks, 521 U.S. 346 (1997); *see e.g.*, Jones v. United States, 463 U.S. 354, 363 (1983) (using term "mental illness" with respect to meaning of verdict of not guilty by reason of insanity); Addington v. Texas, 441 U.S. 418, 429 (1979) (using term "mentally ill").

207. *In re Hendricks*, 912 P.2d at 138.

208. *Hendricks*, 521 U.S. at 358–59.

209. *Id.* at 359.

fit precisely with medical definitions because the law has different purposes in recognizing mental illness than does the medical profession.[210] While the Court recognized that psychiatric professionals disagreed whether pedophilia was a mental illness, it viewed this fact as favorable to the Act: "it is precisely where such disagreement exists that legislatures have been afforded the widest latitude in drafting such statutes."[211]

Three of the four dissenting Justices agreed with the majority on this point.[212] Justice Breyer's reasoning was particularly instructive. He emphasized that the psychiatric profession itself classified Hendricks's pedophilia as a serious mental disorder.[213] While the profession debated whether the disorder should be considered a "mental illness," Justice Breyer viewed the debate itself to be important because "[t]he Constitution permits a State to follow one reasonable professional view, while rejecting another."[214] The role of the psychiatric debate, therefore, was to "inform the law by setting the bounds of what is reasonable, but it cannot here decide just how States must write their laws within those bounds."[215]

Like *Jones* and *Marshall* before it, *Hendricks* involved the interest in avoiding physical restraint that is at the core of due process protection.[216] *Hendricks's* typology, therefore, seems as though it should be distanced from the prototypical Quadrant I cases exemplified by *Jacobson v. Massachusetts*. But what was the relevance of the scientific uncertainty to the substantive standard? In other words, when the Court used scientific avoidance terminology, to what, precisely, was it deferring? The answer is that the Court gave deference to the state legislature's choice of requiring "mental abnormality" rather than "mental illness"—a choice made in the face of conflict amongst psychiatrists whether some abnormalities, such as pedophilia, qualified as mental illnesses.[217] Yet once the *Hendricks* Court clarified its civil commitment standard to include mental abnormality, at least as applied to pedophilia, the scientific uncertainty became relevant, as Justice Breyer stated, only to the "bounds of what is reasonable."[218]

Furthermore, the scientific uncertainty was a qualitative, non-binary issue; the classification of pedophilia as a mental *illness* as opposed to an abnormality involved disputes in the field that centered on imperfect and evolving understandings of the human brain. This was an as-applied challenge, so a binary question might have been whether the petitioner's pedophilia constituted a mental abnormality. But in this case,

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210. *See id.*

211. *Id.* at 360 n.3. Thus, the reasoning of the *Hendricks* Court is similar to that of the classification cases. *See supra* text accompanying notes 138–59.

212. Justices Stevens and Souter joined Justice Breyer's dissent on this point; Justice Ginsburg joined the remaining portions of the dissent, but she did not write separately concerning the substantive due process claim. *See Hendricks*, 521 U.S. at 373.

213. *See id.* at 375 (Breyer, J., dissenting).

214. *Hendricks*, 521 U.S. at 375 (Breyer, J., dissenting).

215. *Id.*

216. *Id.* at 356.

217. *See In re* Hendricks, 912 P.2d 129, 131–32 (Kan. 1996) (describing legislative history), *rev'd sub nom.* Kansas v. Hendricks, 521 U.S. 346 (1997).

218. *Hendricks*, 521 U.S. at 375 (Breyer, J., dissenting) (citation omitted).

the abnormality question was not disputed.[219] So *Hendricks* became a Quadrant I case by virtue of its shift to reasonableness and the scientific uncertainty being qualitative and non-binary. This shift within *Hendricks* itself echoes the shift that started with *Marshall*, where scientific avoidance was applied to cases at least implicating fundamental rights. With the cases that follow, the shift became complete, and with it came an erosion of the reasons for using scientific avoidance in the first place.

5. Modern Erosion

The Supreme Court's most recent forays into scientific avoidance provide underappreciated insights into how that principle should be applied. In 2000, the Supreme Court issued its opinion in *Stenberg v. Carhart* (*Carhart I*)[220] striking down a Nebraska law banning "partial birth abortion."[221] Seven years later, the Court upheld the U.S. Partial-Birth Abortion Ban Act of 2003[222] in *Gonzales v. Carhart* (*Carhart II*).[223] *Carhart II*, in particular, demonstrates how—in a case now several generations removed from the original *Jacobson* approach—the doctrine's usefulness has been seriously eroded. Yet, as I argue in the next Part, that erosion reveals a unique opportunity to reassess and redefine the parameters of scientific avoidance.

As noted already, *Carhart I* raised a challenge to Nebraska's partial birth abortion ban. The challenge relied on two theories: first, the statute failed to provide an exception for the preservation of the health of the mother; and second, it posed an undue burden on a woman's ability to choose an abortion because its language extended to the most commonly used mid-term abortion procedure. A fractured Court struck down the statute on both grounds in an opinion written by Justice Breyer; I pay particular attention to the first ground because it raised scientific avoidance issues.

The health-exception debate centered on whether there would ever be a need for the partial-birth abortion procedure. Nebraska contended that the procedure was very rarely used, and then by only a few doctors, and that two other methods not covered by the ban were always safe alternative procedures.[224] But the District Court found that the banned procedure could significantly reduce health risks.[225] Further, the Court brushed aside the argument that the procedure was used only rarely; "the health exception question is whether protecting women's health requires an exception for

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219. *Id.* at 355 n.2 (majority opinion) (describing testimony regarding Hendricks's diagnosis); *see also In re* Hendricks, 912 P.2d at 130–31. Nor did Hendricks dispute that he was a pedophile. *Id.* at 143 (Larson, J., dissenting) (noting there was no objection to testimony that Hendricks was a sexually violent predator as defined by the statute).

220. 530 U.S. 914 (2000).

221. I use this term with some hesitation, knowing there is deep disagreement over its meaning and proper usage. As described by the cases themselves, it is generally thought to include the abortion procedures known as intact dilation and evacuation ("intact D&E"), and dilation and extraction ("D&X"). *See Carhart I*, 530 U.S. at 928 (noting technical differences but using terms interchangeably); *id.* at 999 (Thomas, J., dissenting) ("Legislatures, in fact, sometimes use medical terms in ways that conflict with their clinical definitions, . . . a practice that is unremarkable so long as the legal term is adequately defined." (citation omitted)).

222. 18 U.S.C. § 1531 (2006).

223. 127 S. Ct. 1610 (2007).

224. *See id.* at 931–33.

225. *See id.* at 932, 936.

those infrequent occasions."[226] Simply put, in the presence of a medical debate as to whether the procedure might sometimes be necessary for a woman's health, the majority held that the Constitution required a health exception.[227]

Justice Kennedy's dissent seized on the presence of a medical debate as a reason for upholding the statute.[228] "Courts are ill-equipped," he wrote, "to evaluate the relative worth of particular surgical procedures. The legislatures of the several States have superior factfinding capabilities in this regard."[229] Citing *Kansas v. Hendricks*,[230] *Collins v. Texas*,[231] *Lambert v. Yellowley*,[232] and *Marshall v. United States*,[233] he argued that there was substantial authority to support scientific avoidance even where fundamental rights are at issue.[234] Indeed, he argued that this case was simply another version of *Jacobson*, where there was no need for universal approval of a medical approach before a legislature could pass laws on the particular topic.[235] Curiously, the other Justices—whether via the majority, concurring, or dissenting opinions—did not address Justice Kennedy's argument.[236] But it proved an important foreshadowing of *Carhart II*.

In *Carhart II*, the statute under attack was the federal Partial-Birth Abortion Ban Act of 2003.[237] The Act is unusual in its extensive legislative findings, beginning with: "A moral, medical, and ethical consensus exists that the practice of performing a partial-birth abortion . . . is a gruesome and inhumane procedure that is *never medically necessary* and should be prohibited."[238] The findings recounted the Court's decision in *Carhart I*, and asserted that Congress is not bound to accept the same factual findings that the Supreme Court accepted in that case.[239] Indeed, Congress

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226. *Id.* at 934.

227. *Id.* at 938.

228. *See* Stenberg v. Carhart (*Carhart I*), 530 U.S. 914, 972 (2000) (Kennedy, J., dissenting).

229. *Id.* at 968 (Kennedy, J., dissenting).

230. 521 U.S. 346 (1997).

231. 223 U.S. 288 (1912).

232. 272 U.S. 581 (1926).

233. 414 U.S. 417 (1974). Justice Kennedy also included *United States v. Rutherford*, 442 U.S. 544 (1979), in support of this proposition. *Rutherford* is inapposite because it involved judicial deference to an agency's interpretation of its statutory mandate. *Id.* at 553–54 (affording deference to Food and Drug Administration's interpretation regarding whether unapproved drugs may be used by terminally ill patients).

234. *Carhart I*, 530 U.S. at 970 (Kennedy, J., dissenting).

235. *See id.* at 971–72 (Kennedy, J., dissenting).

236. Justice Thomas came closest in his dissent, where he argued that the majority had expanded the health exception jurisprudence by mandating the availability of a particular procedure, rather than abortion generally. Under this approach, he argued, there could be no regulation of abortion procedures because there would always be some support for any given procedure. *Id.* at 1012 (Thomas, J., dissenting). In other words, because there is always the potential for some scientific uncertainty as to medical procedures, Justice Thomas was concerned that particular procedures could never be banned under the majority's approach.

237. 18 U.S.C. § 1531 (2006).

238. Partial-Birth Abortion Ban Act of 2003, Pub. L. 108-105, § 2(1), 117 Stat. 1201, 1201 (2003) (emphasis added).

239. *See id.* §§ 2(3)–(8).

recited authority for the proposition that its findings were owed high deference by the Court, and then detailed its findings that partial-birth abortion poses serious health risks to women and is not accepted medical practice.[240]

The attacks lodged against the Act were largely the same as in *Carhart I*: the plaintiffs argued the Act once again failed to provide a health exception; it created a substantial obstacle to women seeking abortions; and additionally, that it was void for vagueness.[241] This time, Justice Kennedy wrote the opinion for the Court. He emphasized that the Act specifically responded to *Carhart I*; in addition to the findings, the language differed in that it described the prohibited procedure in more detail and required an overt act with scienter for criminal liability to attach.[242] Indeed, these features saved the statute from the vagueness and substantial-obstacle challenges.[243]

The Court's treatment of the health exception argument built upon Justice Kennedy's dissent from *Carhart I*. The opinion began by describing evidence presented at the trials below, which demonstrated that "[t]here is documented medical disagreement whether the Act's prohibition would ever impose significant health risks on women."[244] Then, again relying on cases such as *Kansas v. Hendricks* and *Jacobson*, the majority cited the "traditional" rule that courts are to give "state and federal legislatures wide discretion to pass legislation in areas where there is medical and scientific uncertainty."[245] Then Justice Kennedy cited *Hendricks* for the proposition that "[m]edical uncertainty does not foreclose the exercise of legislative power in the abortion context any more than it does in other contexts."[246]

Justice Kennedy contended that other considerations buttressed this conclusion. Primarily, other alternatives were available to the prohibited procedure—at least one of which had low complications rates and was commonly used.[247] But how would the Court reconcile the conclusion, based on evidence presented in the courts below, that there was medical uncertainty as to whether the banned procedure might sometimes be in the best interests of the woman's health, with Congress's finding that it was *never* medically necessary? The Court declined to place dispositive weight on Congress's findings, citing its "constitutional duty to review factual findings where constitutional rights are at stake."[248] In fact, it stated flatly that "some of the recitations in the Act are factually incorrect"[249] ; as a result, "[u]ncritical deference to Congress' factual findings in these cases is inappropriate."[250] But the Court rejected the view that medical uncertainty alone justified striking down a ban on a particular procedure—at least, where there were other safe alternatives—because "[c]onsiderations of marginal safety,

240. *See id.* §§ 14(A)–(G).
241. *See Carhart II*, 127 S. Ct. at 1627.
242. *See id.* at 1628.
243. *See id.* at 1627–35 (describing statute's features).
244. *Id.* at 1636.
245. *Id.*
246. *Id.* at 1637.
247. *Id.*
248. *Id.*
249. *Id.* at 1637–38.
250. *Id.* at 1638.

including the balance of risks, are within the legislative competence when the regulation is rational and in pursuit of legitimate ends."[251]

Writing for the four-Justice dissent, Justice Ginsburg strongly criticized this approach. She described in detail both the purpose of the Act—to nullify *Carhart I*—and Congress's erroneous findings that the banned procedure was never medically necessary.[252] By contrast, the district courts had held full trials where the parties were able to present their best evidence.[253] In light of this evidence, the district courts *rejected* Congress's findings and instead found that the banned procedure would in some cases be the safest alternative for the woman's health. But the Court, Justice Ginsburg argued, had failed to provide any reason for rejecting the findings of the district courts; moreover, its assertion that medical uncertainty justified upholding the Act was "bewildering."[254] Indeed, she argued that the Court had shifted its scrutiny from one of heightened review to review for rationality.[255]

Both the majority and the dissenting opinions in *Carhart II* reveal important lessons for scientific avoidance and help illuminate *Carhart II*'s typology. A comparison with *Carhart I* is also instructive. Under the standard described in *Carhart I*, the scientific question was binary: was there a medical consensus that partial-birth abortion is never medically necessary? If there was no such consensus, then for some women the banned procedure would be necessary to protect their health, and the ban could not stand. The scientific issue, therefore, was relevant not to a spectrum of reasonableness but to whether, under a more heightened standard, the statute was constitutional at all. Thus, *Carhart I* was a Quadrant III case.

Carhart II is in a different quadrant. The scientific issue was binary, just as it had been in *Carhart I*. But this time Congress had purported to provide an answer, and in so doing provided a rare example of Congress getting positive science wrong.[256] Both the majority and the dissenting Justices acknowledged the fallacy of Congress's finding on this point,[257] but Justice Ginsburg emphasized an observation important to scientific avoidance more generally: because the district courts made findings following full trials, they were able to consider much more extensive evidence concerning the safety of the procedures than Congress had heard.[258] Importantly, the courts were not attempting to decide the best procedure (an inquiry that would have been non-binary), but merely to consider whether the banned procedure might sometimes be necessary. This was a quantitative, binary question for which either the legislature or the judiciary ought to be competent. Although Congress failed to reach the "right" answer with respect to its findings, the judiciary was well within its bounds to consider evidence and make a determination. This type of binary fact finding is the

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251. *Id.*

252. *See id.* at 1643–44 (Ginsburg, J., dissenting).

253. *Id.* at 1644.

254. *Id.* at 1646.

255. *See id.* at 1650.

256. *Cf.* Wagner, *supra* note 17, at 199 ("[I]t appears that Congress may actually be doing a good job at finding and using positive scientific knowledge when that knowledge is available.").

257. *See Carhart II*, 127 S. Ct. at 1637–38 ("[S]ome recitations in the Act are factually incorrect."); *id.* at 1643 (Ginsburg, J., dissenting) ("Many of the Act's recitations are incorrect.").

258. *Carhart II*, 127 S. Ct. at 1644 (Ginsburg, J., dissenting).

sort that courts engage in all the time and are indeed well-suited to perform within the adversarial system.

The *relevance* of that scientific question to the legal issues, however, changed from *Carhart I* to *Carhart II*. Under the *Carhart I* standard, scientific uncertainty meant that a health exception would be required to protect even a single woman for whom the banned procedure might be necessary. But under the *Carhart II* standard, scientific uncertainty meant that the legislature would have discretion in choosing to ban a procedure where other procedures were available for women in the aggregate. In other words, *Carhart II* changed the denominator for measuring an abortion statute's impact on women's health—from one to all. In so doing, it shifted to a reasonableness standard where the contours of scientific uncertainty merely outlined the spectrum of what a legislature could enact. With this shift, *Carhart II* becomes a Quadrant II case because it involves a binary scientific question whose relevance is in setting the boundaries of reasonableness.

The puzzle of *Carhart II*—for scientific avoidance purposes—is the alarming hole it leaves with respect to judicial review of legislative science. It seems to make complete the subtle shifts begun with *Marshall* and leading to *Hendricks*, in the sense that it is far less clear now than in, say, *Jacobson*, what the doctrine actually does to further judicial review. And its classification in Quadrant II sets up a stubborn tension in institutional competence because the courts are favored with respect to the science issue, but the legislature is favored with respect to its relevance to the legal question. Because *Carhart II* stands to undermine the goal of good science in our legal institutions, Part II.B provides a means of deflecting that impact by offering a new framework for scientific avoidance.

B. Reclaiming Scientific Avoidance—A Proposed Framework

Now that we have developed a typology and analyzed the key scientific avoidance authority according to that typology, certain principles emerge that suggest a framework for judicial review of legislative science. To summarize the previous Part, Table 2 presents the typology:

Table 2. Scientific Avoidance Typology

Relevance of Question	**Type of Question**	
	Binary	Non-Binary/Qualitative
Spectrum of Reason	*Quadrant II* *Carhart II*	*Quadrant I* *Jacobson* *Collins* *Aldrich Chemical* *Marshall* *Hendricks* *Prohibition Cases*

Heightened Review	*Quadrant III* *Carhart I*	*Quadrant IV* *Jones*

Scientific avoidance in Quadrant I makes sense from a comparative institutional competence perspective. In that quadrant, the scientific issues are qualitative, non-binary ones that legislatures are marginally better at considering. Admittedly, legislatures do not always use the tools available to them for evaluating uncertain science, but given the weaknesses of the courts in doing so, the legislatures' capabilities are superior here. The specific contexts of the Quadrant I cases further illustrate the point. The safety and effectiveness of vaccines,[259] the classifications of professions[260] or chemicals,[261] the medicinal properties of alcohol,[262] the effectiveness of substance abuse treatment,[263] and pedophilia as it relates to mental illness[264] are issues on which there is no clear-cut scientific answer and on which numerous scientific perspectives could be brought to bear.

Further, the scientific questions in Quadrant I are relevant only to the spectrum of reasonableness from which a legislature may make a policy choice. This sort of reasonableness, or rational-basis-type review, reflects the view that legislatures are normally the better branch to make policy choices because they are politically accountable. Indeed, this observation for scientific avoidance is consistent with the rationales underpinning constitutional avoidance—that the "least dangerous branch" should avoid invoking the Constitution, thereby meddling with the politically accountable branch, unless strong countervailing concerns justify it.[265]

In stark contrast, scientific avoidance is not justifiable in Quadrant III. There, the scientific issue is binary and is therefore no different than the types of questions courts resolve all the time.[266] The adversary process of the court system is effective at reaching binary decisions, whether as matters of fact or of law, and the scientific question is really just a special type of factual question. Thus, the district courts in the *Carhart* cases were fully capable of determining whether partial-birth abortion was *never* medically necessary. As Justice Ginsburg described in her *Carhart II* dissent, the courts were *better* situated than the legislatures because they were neutral fora and the trial process incentivized the parties to present their very best evidence.[267]

Furthermore, in Quadrant III the relevance of the scientific question goes to the heart of higher-level scrutiny. In *Carhart I* for example, the science was outcome-determinative under the standard the Court used to assess a woman's right to obtain an abortion. One could also imagine a case involving, say, a race-based classification in

259. *See* Jacobson v. Massachusetts, 197 U.S. 11 (1905).
260. *See* Collins v. Texas, 223 U.S. 288 (1912).
261. *See* Aldrich Chem. Co. v. United States, 2 Ct. Int'l Trade 192 (Ct. Int'l Trade 1981).
262. *See* Lambert v. Yellowley, 272 U.S. 581 (1926); Everard's Breweries v. Day, 265 U.S. 545 (1924).
263. *See* Marshall v. United States, 414 U.S. 417 (1974).
264. *See* Kansas v. Hendricks, 521 U.S. 346 (1997).
265. *See generally* BICKEL, *supra* note 15.
266. *See supra* text accompanying note 90 (describing this superior institutional capability).
267. *See Carhart II*, 127 S. Ct. 1610, 1644–46 (2007) (Ginsburg, J., dissenting).

which a scientific issue related to how narrowly tailored the classification was to the legislative objective. In such a case, the burden of scientific uncertainty would likely fall on the defendant. That is to say, if a legislature were to actually get a binary scientific issue *wrong* in such a case, that fact alone would be a strong reason to suspect close or narrow tailoring had not been achieved. A court reviewing the legislature from this perspective now has the strong countervailing considerations justifying intervention that were lacking in Quadrant I.

Quadrants I and III therefore set the boundaries for scientific avoidance. In Quadrant I, scientific avoidance makes sense and is advisable for reasons of comparative institutional competence. By contrast, scientific avoidance in Quadrant III probably amounts to an abdication of judicial responsibility. The other two quadrants are more challenging to understand because each places the courts' and legislatures' competencies in tension. Even so, each suggests potential applications in which either axis would tilt in favor of, or away from, scientific avoidance.

Beginning with Quadrant II, how should a court respond when a legislature gets a binary scientific question wrong? How should that information relate to the reasonableness standard applicable to the legal issue? *Carhart II* failed to answer these questions; although it acknowledged the fallacy of Congress's findings, the Court hedged its response. Essentially, it refused to give dispositive weight to the findings, but it never addressed how those findings' errors should be accounted for as a matter of constitutional review. It seems that, at the very least, such facts should raise a red flag as to the possibility of irrationality. This assertion can be reconciled with *Carhart II* by understanding that the fact that Congress was wrong was ultimately immaterial to the standard is applied. To the *Carhart II* majority, what mattered was that there were other safe options available—a "rational" conclusion reached by Congress.[268] But in other scenarios, where the science truly is material to the reasonableness standard, an incorrect binary scientific finding should be treated as a factor bearing on irrationality.

Finally, Quadrant IV involves the mirror-image tensions to those of Quadrant III. Here the courts are not the preferable institution in terms of the scientific issues, but they are tasked with conducting a more searching review as a result of heightened scrutiny considerations. This quadrant is perhaps the most troublesome, as the courts have profound institutional weaknesses in terms of gathering and assessing the relevant science.[269] Two options seem possible here, each of which presents an opportunity for further study. First, a court might consider whether, and the extent to which, a legislature actually considered the scientific issue. While the court would certainly have independent fact finding responsibilities with respect to constitutional facts, the legislature's *actual* reliance on good science might have some bearing on fit between the statute's means and ends. Second, a court might consider a "remand" to the legislature for more particularized fact finding.[270] This approach would be consistent with scientific avoidance principles because it recognizes the legislature's superior abilities in this respect. But it would also safeguard important constitutional rights by

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268. *Id.* at 1638.

269. *See supra* text accompanying notes 66–88 (describing weaknesses).

270. *See* Coenen, *supra* note 12, at 1755–72 (providing exhaustive description of such "remands"); Mark V. Tushnet, *Legal Realism, Structural Review, and Prophecy*, 8 U. DAYTON L. REV. 809, 816 (1983) (describing this "structural review" as "paying attention to the decisionmaker rather than to the decision").

striking down the law at least temporarily, placing the burden of inertia on the institution better equipped to consider the scientific matters bearing on constitutional means-ends fit. Either way, the special capabilities of legislatures with respect to science are entitled to consideration without abdicating the courts' roles in cases of heightened scrutiny.

CONCLUSION

Recent cases invoking scientific avoidance have departed from the doctrine's origins and have lost sight of the justifications underpinning its original form. This trend risks clouded reasoning in the courts and disincentivizes legislatures from taking full advantage of the many resources available to them for considering issues of scientific uncertainty. By using insights regarding the nature of science to help identify comparative institutional strengths and weaknesses with respect to science, we can construct a means for evaluating prior applications of scientific avoidance as well as a framework for its more principled future use.

While legislatures are ordinarily better equipped to consider broad questions of scientific uncertainty, courts bring strengths with respect to binary decision making that should be accounted for before applying scientific avoidance. Further, by overlaying this binary/non-binary distinction over the scientific issue's relevance to a particular standard of review, we can achieve a methodology that accounts for courts' constitutional role in reviewing statutes as well as their institutional competence with respect to science. This, in turn, can further the goals of improving scientific quality in both courts and legislatures, making transparent the distinction between science and policy.