

**UNCERTAINTY ABOUT UNCERTAINTY: THE IMPACT OF
JUDICIAL DECISIONS ON ASSESSING SCIENTIFIC UNCERTAINTY**

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I. INTRODUCTION

Both legislatures and administrative agencies often act in the face of scientific uncertainty in matters ranging from criminal punishment¹ to environmental protection² to food labeling and safety regulations³ to health care regulation.⁴ When disputes arise regarding the scientific support for these actions, courts must struggle to determine either the science relevant to the dispute, or determine the appropriate institution to make that scientific determination. Judicial resolutions may therefore involve laying out default approaches for further inquiry into the matter by courts, or rules for deference to other institutions, or some combination of the two. Such resolutions can be es-

¹ See, e.g., Eric S. Janus, *The Use of Social Science and Medicine in Sex Offender Commitment*, 23 NEW ENG. J. ON CRIM. & CIV. CONFINEMENT 347, 369 (1997).

² See, e.g., David E. Adelman, *The Art of the Unsolvable: Locating the Vital Center of Science for Environmental Law & Policy*, 37 ENVTL. L. 935, 936-37 (2007) (“Issues ranging from the toxicity of industrial chemicals to the protection of endangered species and the projected magnitude of global warming transcend existing scientific knowledge.”); Alyson C. Flournoy, *Legislating Inaction: Asking the Wrong Questions in Protective Environmental Decisionmaking*, 15 HARV. ENVTL. L. REV. 327, 327-28 (1991) (discussing how the presence of scientific uncertainties can create barriers to protective environmental decisionmaking); Judith Jones, *Regulatory Design for Scientific Uncertainty: Acknowledging the Diversity of Approaches in Environmental Regulation and Public Administration*, 19 J. ENVTL. L. 347, 348 (2007) (listing seven different approaches for dealing with the existence of scientific uncertainty in designing environmental regulations); Vern R. Walker, *The Myth of Science as a “Neutral Arbiter” for Triggering Precautions*, 26 B.C. INT’L & COMP. L. REV. 197, 203 (2003) (“[E]ven scientific evidence about causation, of the kind used to warrant a finding of risk, necessarily involves several distinct types of uncertainty. Scientists sometimes can reduce the levels of such uncertainties, but they can never eliminate those uncertainties altogether.”).

³ See, e.g., Scott D. Deatherage, *Scientific Uncertainty in Regulating Deliberate Release of Genetically Engineered Organisms: Substantive Judicial Review and Institutional Alternatives*, 11 HARV. ENVTL. L. REV. 203, 204 (1987) (“[U]ncertainty about the risks of releasing genetically engineered material into the environment is perhaps the key element of the problem . . . [in evaluating] what regulatory mechanisms are best suited for deliberate release decision making.”); Mara A. Michaels, Comment, *FDA Regulation of Health Claims Under the Nutrition Labeling and Education Act of 1990: A Proposal for a Less Restrictive Scientific Standard*, 44 EMORY L.J. 319, 328 (1995) (noting that “the public can understand the need for a policy of public protection in the face of scientific uncertainty” as to the safety of foods).

⁴ See, e.g., M. Gregg Bloche, *The Invention of Health Law*, 91 CAL. L. REV. 247, 288 (2003) (explaining that scientific uncertainty in part causes “[i]ndeterminacy about what maximizes welfare [that] pervades medical practice and health care policy”).

pecially complicated where statutory challenges arise facially because the science before courts can involve legislative facts beyond those concerning the immediate parties in the case,⁵ given that formal factual records may not exist in such situations.⁶

This Article examines the Supreme Court's response to scientific uncertainty in the context of facial statutory challenges where the scientific support for those statutes is questioned. In doing so, I will use the lens of *Gonzales v. Carhart* ("*Carhart II*"),⁷ in which the majority suggested that the Court will give heightened deference to legislative choices when the legislature is acting in areas of medical and scientific uncertainty. In *Carhart II*, the majority deferred (though not "uncritical[ly]")⁸ to Congress's decision to restrict a medical procedure called intact dilation and extraction, or D & X, in the face of medical uncertainty, given that the Court found documented medical disagreement about whether the prohibited abortion method would cause serious health risks to women.⁹ Providing greater deference to legislatures acting in areas of scientific uncertainty suggests that legislative discretion would be curtailed were scientific certainty to be established. I will abstract from *Carhart II*, and the cases from which it draws support, differences between what the Court suggests might change were scientific certainty present, and what the actual practical effect of having scientific knowledge might be.¹⁰

I will suggest that such heightened deference may have the positive effect of giving room for legislatures to act in areas where scientific and medical knowledge is still in development, a context that applies to many contemporary areas of environmental and public health risks. Whether these positive effects outweigh potential problems of legislative deference, such as institutional bias and scientific capacity, is far from clear. Indeed, the appropriateness of legislative

5 See Kenneth Culp Davis, *An Approach to Problems of Evidence in the Administrative Process*, 55 HARV. L. REV. 364, 402 (1942) (distinguishing legislative facts, which inform legislative judgment, from adjudicative facts, which concern the immediate parties before the court).

6 See Rachael N. Pine, *Speculation and Reality: The Role of Facts in Judicial Protection of Fundamental Rights*, 136 U. PA. L. REV. 655, 698–700 (1988) (describing how in facial challenges, "critical legislative facts often are assumed, judicially noticed, or determined a priori by logic or reference to judicial precedent").

7 127 S. Ct. 1610 (2007).

8 *Id.* at 1638.

9 *Id.* at 1636–37.

10 For a comprehensive discussion of the Supreme Court's constitutional approach toward medical treatments, including that taken in *Carhart II*, see B. Jessie Hill, *The Constitutional Right to Make Medical Treatment Decisions: A Tale of Two Doctrines*, 86 TEX. L. REV. 277 (2007).

deference may be quite dependent on the particular type of risk being tackled by the legislature, the complexity and availability of information about that risk, and the types of stakeholders involved in managing the risk¹¹—concerns glossed over by the majority in *Carhart II*.

Moreover, I will observe that the use of dual judicial review modes—one in the presence of scientific certainty, another in the absence of scientific certainty—masks a less explicit, but nevertheless underlying, determination: the judicial inquiry into whether the science is “certain” or “uncertain.” This legal inquiry into the existence of uncertainty is not as easy a question for a court to answer as it might seem, given that the determination of certainty involves both reaching a certain level of scientific understanding and making normative judgments about the nature of science. But, because the answer to this question may act as a gateway between areas of more government options and areas of fewer government options, I suggest that courts should pay deeper attention to how they answer this question, both in individual cases and as a general matter. The majority in *Carhart II* did not provide such guidance. Instead, the majority created further confusion by making its own finding of scientific uncertainty sufficient to warrant legislative deference despite congressional findings of certainty, thereby usurping a political determination more legitimately left to legislatures.

This Article will also examine the possible implications of the differential approach for the production and communication of scientific research. In particular, I suggest that even if the actual practical effect on legal decisions is limited, the fact that the Court purports to change its review in light of the presence or absence of scientific certainty may affect the production of scientific research and limit opportunities for further dialogue between courts and scientists. Such an effect, albeit indirect, is cause for some caution on the part of courts in defining approaches for dealing with statutory challenges involving scientific uncertainty. Although such caution need not be determinative, courts should be aware of the impact that their decisions may have on creating incentives for bias in the production and communication of scientific research, as well as their own capacities for assessing such bias.¹²

11 See NEIL K. KOMESAR, IMPERFECT ALTERNATIVES: CHOOSING INSTITUTIONS IN LAW, ECONOMICS, AND PUBLIC POLICY 71–75 (1994).

12 See *id.* at 140–41.

Finally, in light of the Court's approach of legislative deference in the face of scientific uncertainty, I will suggest some guiding principles to aid in evaluating whether such "certainty" exists, at least for the purpose of judicial review, to reduce the incentives for bias in scientific research and to enhance, not diminish, dialogue between courts, legislatures, and the scientific community. To provide such suggestions, I will draw from the Court's own approaches in reviewing decisions made by federal agencies in the face of scientific uncertainties. In particular, I will argue that an articulation approach—similar to but far more limited than the approach in the regulatory review context—holds much promise for courts in evaluating whether the presence of scientific uncertainty is sufficient to warrant legislative deference. By providing heightened deference only when the legislature has articulated that it is acting in the face of scientific uncertainty, rather than allowing it to claim that scientific certainty mandates a particular action, courts can shift these politically shaped determinations back to the legislative arena, rather than either allowing legislatures to take advantage of science's appearance of objectivity or exposing courts to making such political determinations.

II. CATEGORIES OF SCIENTIFIC UNCERTAINTIES

A. *Uncertainty in the "Objective" Scientific Context*

Scientific uncertainties pervade a number of areas in which legislatures and administrative agencies must act. In environmental and natural resource regulation, for example, Holly Doremus has described "[u]ncertainty [as] the unifying hallmark."¹³ Public health, likewise, presents an area rife with scientific uncertainties, where decisionmakers must often address emerging health risks despite lack of sufficient prior research, or face disastrous health effects.¹⁴ Indeed, as philosophers of science Thomas Kuhn and Karl Popper have ob-

13 Holly Doremus, *Precaution, Science, and Learning While Doing in Natural Resource Management*, 82 WASH. L. REV. 547, 548 (2007); see also John C. Dernbach, *The Unfocused Regulation of Toxic and Hazardous Pollutants*, 21 HARV. ENVTL. L. REV. 1, 45–46 (1997) (describing how risk assessment inherently involves uncertainties in predicting health effects); Flournoy, *supra* note 2, at 333–38 (1991) (describing difficulties in risk assessment processes that lead to scientific uncertainties).

14 See, e.g., Jason W. Sapsin et al., *SARS and International Legal Preparedness*, 77 TEMP. L. REV. 155, 155–56 (2004) (explaining that the "relatively rapid dissemination [of severe acute respiratory syndrome, or SARS] across the globe left biomedical researchers and public health authorities struggling to maintain pace with the disease in the face of scientific uncertainties and difficult policy choices").

served, to some extent the very nature of science can be characterized as uncertain because scientific theories are either underdeterminative,¹⁵ or are never fully consistent with all the available evidence.¹⁶ Though the nature and degree of uncertainties may vary depending upon the given situation, the fact that much of scientific research can be characterized as “uncertain” should caution courts from taking a one-size-fits-all approach to inquiries regarding the “existence” or “non-existence” of scientific uncertainties.¹⁷

Although courts use the term “scientific uncertainty” to refer to a number of areas in which science is unresolved, either through an agreed-upon lack of certitude about the scientific findings or through a disagreement among scientists about the findings,¹⁸ this broad use of the term masks the wide variety of situations in which the science can be described as “uncertain,” either epistemologically, or for the purpose of judicial, legislative, or regulatory resolution. As one analysis has stated, “[t]he variety of types and sources of uncertainty, along with the lack of agreed terminology, can generate considerable confusion.”¹⁹ This confusion can be especially profound because of the divergence in judicial and scientific uses of the term. Scientists, especially in the area of risk assessment, focus more on uncertainties in scientific research—or “knowledge uncertainty,” as some commentators have described it²⁰—and less on the presence of controversies between scientists or sets of scientists.²¹ Courts, however, also often use the term “uncertainty” to include areas where significant dis-

15 See KARL R. POPPER, *THE LOGIC OF SCIENTIFIC DISCOVERY* 64–77, 108–11 (1959).

16 See THOMAS S. KUHN, *THE ESSENTIAL TENSION: SELECTED STUDIES IN SCIENTIFIC TRADITION AND CHANGE* 240-65 (1977); see also David E. Adelman, *Scientific Activism and Restraint: The Interplay of Statistics, Judgment, and Procedure in Environmental Law*, 79 NOTRE DAME L. REV. 497, 531 (2004) (applying Popper’s and Kuhn’s theories to existing debates within the legal community about scientific evidence).

17 Cf. Flournoy, *supra* note 2, at 386–87 (criticizing the “binary” approach taken in many environmental statutes, and stating that “[d]etermining whether a substance or activity causes harm, or whether a standard protects public health, is not necessarily a yes or no question; doubt may preclude a decision”).

18 See, e.g., *Carhart II*, 127 S. Ct. 1610, 1636 (2007); *Massachusetts v. EPA*, 127 S. Ct. 1438, 1444 (2007).

19 M. GRANGER MORGAN & MAX HENRION, *UNCERTAINTY: A GUIDE TO DEALING WITH UNCERTAINTY IN QUANTITATIVE RISK AND POLICY ANALYSIS* 47 (1990).

20 See Flournoy, *supra* note 2, at 388–89 (“For cases in which the source of doubt is *knowledge* uncertainty, the agency might regulate notwithstanding the uncertainty, especially if the threatened harm was severe, or regulation might be abandoned.”).

21 See ALAN KRUPNICK ET AL., *NOT A SURE THING: MAKING REGULATORY CHOICES UNDER UNCERTAINTY* 5-75 (2006) (discussing various types of uncertainty that play into risk analysis); Walker, *supra* note 2, at 204–11 (describing a similar typology of scientific uncertainties).

agreement exists on particular scientific findings—or “controversy uncertainty,” as I will call this use of the term “uncertainty.”²²

Moreover, even those discussions of knowledge uncertainty within scientific research can be quite wide-ranging. One recent attempt at providing a typology, based on a survey of the previous literature, discusses several categories: “parameter uncertainty,” “model uncertainty,” “variability,” and “decision uncertainty.”²³ Although uncertainties of multiple categories may be present in a given legal/scientific problem, each category also poses somewhat distinct implications for using science in a legal or policy decisionmaking model.

Parameter uncertainty, also referred to as epistemological or knowledge-based uncertainty, arises in factors that are measurable in principle, but nevertheless are uncertain through problems of measurement or diagnosis.²⁴ These can be further broken down into categories such as measurement uncertainty, conflicting or absent data, and extrapolation errors or misclassification.²⁵ Take, for example, the scientific research involved in deciding whether to allow or require a certain vaccine. Parameter uncertainties could arise from difficulties in measuring the response rate of individuals; the absence of tests on a specific population of individuals; difficulties in determining overall presence of a disease given a limited sample size; and problems in categorizing the immunoresponses observed by medical professionals. These uncertainties may confound legal or policy decisions to distribute or require a certain vaccine, but may be resolved through further research that better reaches a state of “certainty.” Thus, a decisionmaker may be faced with not only the question of whether to permanently allow or disallow a certain vaccine, but also the additional question of whether to act upon a problem now or await future research, taking into account the opportunity cost of delay.

Model uncertainty, another epistemic uncertainty, involves uncertainty about the nature of the system itself.²⁶ Model uncertainty can

²² See generally Charles Weiss, *Expressing Scientific Uncertainty*, 2 LAW PROBABILITY & RISK 25 (2003) (discussing scientific uncertainties in legal disputes and suggesting a lay nomenclature for various degrees of uncertainty).

²³ KRUPNICK, *supra* note 21, at 9–24.

²⁴ *Id.* at 13–14; see also Walker, *supra* note 2, at 206–09 (breaking down parameter uncertainty into those involving uncertainties in measurements and uncertainties in sampling).

²⁵ KRUPNICK, *supra* note 21, at 14–17.

²⁶ *Id.* at 17–18; see also Adelman, *supra* note 2, at 942–46 (discussing model uncertainty in toxic risk assessments); Walker, *supra* note 2, at 205–06, 209–11 (breaking down what is described in this Article as model uncertainty into “conceptual uncertainty,” which relates to uncertainty in choice of variables, “modeling uncertainty,” which are assumptions

arise from uncertainty in the structure chosen to describe a system, oversimplification of the model itself, or the failure of the model to take into account certain factors in describing a given system.²⁷ In the vaccine example, this could involve uncertainty in the transmission model for a disease, oversimplification in the communication pathway used in the model, or the failure to acknowledge (or even be aware of) alternative pathways for that model. Again, decisionmakers will be faced with the tradeoff between making an immediate decision (to allow or require the immunization, or never to allow it), or to await further research to establish “certainty” (with its ensuing opportunity costs).

Variability uncertainty, sometimes referred to as ontological or stochastic uncertainty, involves uncertainty arising from natural or inherent heterogeneity in the state of the system being studied.²⁸ Again, in the vaccine example, variability uncertainty could arise in the scientific evaluation of the effectiveness of the vaccine in different communities. Natural variations may exist in how different individuals in a given population respond to that vaccination. Most individuals might develop the responding immunity for which the vaccine was designed; some might develop only partial immunity; a few might be immunocompromised and thus be unable to develop any immunity at all; and others might respond with anaphylactic shock. Moreover, different communities might have different types of individuals in different proportions. Such variability in the population, therefore, can lead to scientific uncertainty in the evaluation of the vaccine’s effectiveness.

Unlike other types of uncertainties, variability uncertainty is the sort of uncertainty that may not be reduced through further scientific research because it derives from natural or inherent variations in the system being studied, rather than uncertainties in diagnosing the actual responses or developing an accurate immunoresponse model. Thus, in this context, certainty may never be established, and any legal or policy decision may involve having to assume or defer to assumptions about a given distribution of individuals (unless every single individual were actually to be tested). This does not mean, however, that the uncertainty cannot be better characterized. But it does mean that uncertainties will still remain unless every single

made by the model once the variables are chosen, and “causal uncertainty,” which is uncertainty in what events cause others).

27 KRUPNICK, *supra* note 21, at 18–19.

28 *Id.* at 11–13.

member of a given variable set is tested, which would be technically unfeasible.

Finally, decision uncertainty, also called value uncertainty, arises when uncertainties in normative choices, as is often the case in policy-relevant science, factor into the methodology chosen in the course of scientific research.²⁹ Decision uncertainty does not refer to normative uncertainty involving the values of actions themselves (although it could lead to that), but rather to uncertainties in the value factors that shape the scientific research. Returning to the vaccine example, normative uncertainties can, for example, arise in research decisions to explicitly model exposures faced by the least well-off, or to treat all exposures equally, regardless of the nature of those likely to face those exposures. They might also involve decisions to count only fatalities as negative events, or to also include chronic effects that may impair, but not kill, an individual, or to place greater weight on avoiding certain types of risks versus others. To some degree, additional research can help clarify the extent of these effects and their distribution through the development of finer and more exact probabilistic models, but uncertainty will always be present to the extent that the normative beliefs of both decisionmakers and the people they represent regarding the importance of possible decisionmaking factors are diverse.³⁰ “Certainty” in this context may never be resolved unless the decisionmakers—or the public—reach some consensus on the normative values to be incorporated into the research assumptions themselves.

All of these types of scientific uncertainty can impact the ultimate validity of a particular legal or policy decision.³¹ For example, para-

²⁹ *Id.* at 20–22; see also Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613, 1622–27 (1995) (describing numerous “trans-scientific” questions at each stage of a risk assessment process). Although Professor Wagner argues that these questions should ultimately be separated in the context of agency risk assessments, *id.* at 1701–18, such separation may be unfeasible for legislative science, where legislatures arguably have fewer expert resources devoted to them than do agencies.

³⁰ See KRUPNICK, *supra* note 27, at 22.

³¹ See Erica Beecher-Monas, *The Heuristics of Intellectual Due Process: A Primer for Triers of Science*, 75 N.Y.U. L. REV. 1563, 1596 (2000) (discussing how, even in common law tort cases, opposing experts may disagree yet offer scientifically valid hypotheses); Flournoy, *supra* note 2, at 365 (describing how scientific disagreement could stem from divergent “judgments [that] a scientist must make, including decisions about which experiments to perform, decisions about whether to adopt more or less conservative assumptions in calculations, and inferences to be drawn from the data”).

This is not to suggest that science alone can determine a legal or policy decision. In the risk assessment literature, for example, others have frequently observed that scientific uncertainties mean that policy decisions are always influenced by normative considera-

metric uncertainties may call into question the decision to require a vaccine, given a high degree of uncertainty about its safety and the likelihood that further development of that vaccine would resolve those safety issues. Variability uncertainty may entail making certain demographic or distributional assumptions about the particular population exposed to a disease, but may also require more transparency for those decisions to be considered valid. Likewise, decision uncertainty may require the decisionmaker to explicitly set forth the choices of normative assumptions made in the research, such as whether or not chronic effects are modeled.

B. Uncertainty in the Context of Controversy and Bias

In contrast to the discussion of uncertainty within the scientific community, when courts, including the Supreme Court, refer to uncertainty, they more often refer to areas in which there is disagreement among experts regarding the actual science on a particular point.³² It is helpful, however, to explore the relationship between controversy and uncertainty to better understand their distinctions and overlaps. Disagreement may not always connote uncertainty in the sense described earlier; for example, one study might conclude—in all “certainty”—that a particular vaccine would only harm a few individuals, while another study might conclude—again with “certainty”—that the risks are fairly significant.³³ Moreover, courts may encounter controversy over the existence of uncertainty itself; one study might conclude that the science is well-established through measurements and models, while another study might point to numerous uncertainties involving measurements and data gaps.

Scientific disagreement may arise from the differing types of “objective” scientific uncertainties described earlier. But differing scien-

tions. See Walker, *supra* note 2, at 198. Even the evaluation of whether an event is “adverse” under a statutory directive, for example, entails an inquiry into what counts as a benefit and what counts as a cost. See *id.* at 199–200.

³² See *Carhart II*, 127 S. Ct. 1610, 1636 (2007). Although this Article bifurcates uncertainty into “knowledge uncertainty” and “controversy uncertainty” for the purpose of providing a clearer typology, in a Bayesian sense, these two sorts of uncertainties could be merged into one single approach towards uncertainty given that “[p]robability and scientific judgment are merged for Bayesians because they treat probability as a subjective property that incorporates subjective judgments directly into probability estimates.” Adelman, *supra* note 16, at 508–15 (describing differences between traditional “frequentist” approaches and Bayesian approaches towards statistics). A full discussion of these differences is beyond the scope of this Article.

³³ Cf. Wagner, *supra* note 29, at 1639 (describing “wildly different ‘scientific conclusions’” reached by different federal agencies regarding the same questions).

tific opinions may also arise from bias in the production of science.³⁴ By this, I do not mean that researchers are deliberately skewing their explorations towards a certain result, although this has been documented.³⁵ Rather, funding pressures might create what science policy scholar Sheldon Krinsky has deemed an “evolutionary pressure that steers the research toward the interests of the sponsors.”³⁶ One area often cited is the development of science regarding the health risks of tobacco; in this area, research has documented “a systematic campaign to construct a science around tobacco safety while attempting to dismiss as ‘junk science’ findings that connect tobacco use to excess morbidity and mortality.”³⁷ Similarly, meta-analyses of biomedical research have shown that research sponsored by drug manufacturers is more likely to draw pro-industry conclusions.³⁸

Moreover, systematic pressures, such as availability of funding, may not only affect the way that research is produced, but may also lead to a more general exploration of one side of a question—say, the benefits of a given product or procedure—than another side.³⁹ A vaccine producer might have ample incentives to fund research demonstrating the effectiveness of a certain vaccine, while groups object-

34 Cf. KOMESAR, *supra* note 11, at 126–27 (discussing how, in the context of litigation, “this factual investigation is funded primarily by the parties, not the public”).

35 Jillian Clare Cohen-Kohler & Laura C. Esmail, *Scientific Misconduct, the Pharmaceutical Industry, and the Tragedy of Institutions*, 26 MED. & L. 431, 434–37 (2007) (describing suppression of data about adverse effects in the Vioxx case).

36 Sheldon Krinsky, *The Funding Effect in Science and Its Implications for the Judiciary*, 13 J.L. & POL’Y 43, 59 (2005).

37 *Id.* at 55.

38 *Id.* at 58–59 (discussing a study which “concluded that there was ‘a strong association between author published positions on the safety of calcium-channel antagonists and their financial relationships with pharmaceutical manufacturers’” (quoting Henry T. Stelfox et al., *Conflict of Interest in the Debate Over Calcium Antagonists*, 338 NEW ENG. J. MED. 101 (1998))).

39 See CARL F. CRANOR, TOXIC TORTS: SCIENCE, LAW, AND THE POSSIBILITY OF JUSTICE 216–17 (2006) (describing how manufacturers of potentially toxic substances have little incentive to provide funding for research about the adverse toxicological effects of those substances); Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn’t Always Better Policy*, 75 WASH. U. L.Q. 1029, 1066 (“Scientists in any given field form a loose-knit community, the members of which tend to share certain views. Those views undoubtedly contribute to the choices individual scientists make regarding research topics and techniques, both directly, and indirectly, through effects on funding opportunities.”); Krinsky, *supra* note 36, at 59 (explaining that “commercial affiliation of researchers has a biasing effect”); Stephanie Tai, *Three Asymmetries of Informed Environmental Decisionmaking*, 78 TEMP. L. REV. 659, 661 n.7, 682–84 (2005) (discussing the effects of “normative components” of regulatory science on environmental policymaking); see also Doremus, *supra* at 1066 n.193 (describing pressures posed by agency grant funding, peer review systems, and legislative targeting of research funds towards specific topics).

ing to mandatory vaccination might conduct their own studies calling that vaccine's safety into question. As a number of scholars have documented, the appearance of controversy is often more profound where greater normative and economic stakes in a given dispute create more incentives for parties to fund scientific research supportive of a particular result.⁴⁰ And areas where scientific research is more complex and costly, such as in many areas of environmental regulation,⁴¹ will be more sensitive to such systematic pressures than areas where research is less resource-intensive.

Individual researchers, too, may have their own biases that affect their research. These can involve the financial interests described earlier, but they can also involve political concerns held by some scientists, from hunger reduction to abortion prevention to climate change mitigation.⁴² These biases are often seen as being "neutralized" by the collective enterprise of science, through peer review and norms of skepticism.⁴³ However, individual studies reviewed by courts

⁴⁰ See David Michaels & Celeste Monforton, *Scientific Evidence in the Regulatory System: Manufacturing Uncertainty and the Demise of the Formal Regulatory System*, 13 J.L. & POL'Y 17, 17 (2005) (arguing that "[p]olluters and manufacturers of dangerous products have waged sophisticated campaigns to manufacture uncertainty about the scientific evidence used to support public health protection and victim compensation"); see also John S. Applegate & Robert L. Fischman, *Missing Information: The Scientific Data Gap in Conservation and Chemical Regulation*, 83 IND. L.J. 399 (2008) (introducing a symposium on scientific data gaps in risk regulation); Albert C. Lin, *Beyond Tort: Compensating Victims of Environmental Toxic Injury*, 78 S. CAL. L. REV. 1439, 1520–22 (2005) (criticizing the tort system as failing to generate appropriate incentives for non-ends-oriented scientific research into health risks); Wendy E. Wagner, *Commons Ignorance: The Failure of Environmental Law to Produce Needed Information on Health and the Environment*, 53 DUKE L.J. 1619, 1628–33 (2004) (describing how parties likely to be sued under environmental statutes resist producing information regarding the risks generated by their activities, even though such parties are those best situated to conduct such research); Wendy Wagner & David Michaels, *Equal Treatment for Regulatory Science: Extending the Controls Governing the Quality of Public Research to Private Research*, 30 AM. J.L. & MED. 119, 122 (2004) (describing how, where stakes are high, sponsors of scientific research "face strong incentives to design and report research in ways most favorable to their interests and to suppress adverse results provided they can do so without detection").

⁴¹ See William W. Buzbee, *Adjudicatory Triggers of Enhanced Ambient Environmental Information*, 83 IND. L.J. 583, 605 (2008) ("Information about the state of the environment . . . is costly to gather and requires great skill to analyze.").

⁴² See Krinsky, *supra* note 36, at 52 ("Scientists are not disinterested ideal observers when it comes to their own contributions, but rather are people with personal interests outside of science.").

⁴³ See JOHN ZIMAN, *REAL SCIENCE: WHAT IT IS, AND WHAT IT MEANS* 159 (2000) ("The trick is to nullify these individual interests by setting them against one another. In effect, the scientific ethos delineates an agonistic arena, where a hidden melodrama of clashing egos is transformed into apparently dispassionate intellectual debate. As in a free commercial

may still present some of the bias issues described. While some of these concerns may be addressed through rules of disclosure and conflict-of-interest prohibitions,⁴⁴ if this appearance of uncertainty—or controversy uncertainty, as I will call it—arises not from the sorts of variability or epistemological uncertainties discussed earlier, but rather from concerted attempts by advocates to develop supportive science, then awaiting additional research may not result in its reduction.

III. THE SUPREME COURT AND SCIENTIFIC UNCERTAINTIES

The Supreme Court has taken a number of approaches to resolving legal questions involving the scientific uncertainties discussed earlier. Although many of these approaches are applied in conjunction with, rather than exclusive of, each other, this Article outlines various available approaches in order to more methodologically describe the Court's treatment in various cases.⁴⁵

The first is a deferential approach, in which the Court could assign a high degree of deference to one institution or another. There are many variations of this model, from deference to a trial court or a jury; the legislature; an expert agency; an independent panel of experts; or even earlier decisions of appellate courts, like the Supreme Court itself. In such an approach, the Court would treat an external decision, for example, the decision to require childhood immunization from a particular disease, as one deserving of weight. This decision, in turn, could be based upon extra-scientific considerations, such as the greater evaluative capacity of a given institution, the greater scientific (or regulatory) legitimacy of that institution, or even greater structural regularity resulting from reliance upon the decisions of that institution.

market, the particular bias of each individual is neutralized in the collective outcome." (footnotes omitted).

⁴⁴ See Krinsky, *supra* note 36, at 61–66 (describing attempts at addressing funding bias through conflict-of-interest and disclosure rules, but ultimately arguing that “mere disclosure may . . . prove insufficient to protect the integrity of scientific research,” and that judges should understand “the means by which advocacy science surreptitiously enters the courtroom and the ways in which this science is distinct from science that is not designed to support a predetermined financial interest”).

⁴⁵ Cf. Jones, *supra* note 2, at 353–63 (discussing analogous approaches for regulatory agencies to address scientific uncertainty in their decisionmaking processes, including “acknowledgement,” “burden shifting,” “sound science,” “consequences,” “consensus,” “estimation,” and “adaptive management”).

In other instances, the Court has taken a more substantive approach by resolving uncertainties in favor of certain substantive concerns. These concerns could involve a reluctance to remove liberty, such as the liberty to refuse an immunization or a reluctance to impose its own regulatory interpretation absent some clear mandate. Such decisions might be framed in the context of constitutional or even statutory values.⁴⁶

Finally, the Court has taken a procedural approach in some instances, requiring an institution to go through a certain degree of deliberation and explanation, and upholding that institution's decision if such deliberation is determined to have occurred. In the vaccine example, this could involve requiring a legislature to at least explain its reasons and bases for requiring childhood immunization. As with the deferential approach, the process approach might be taken in light of capacity or legitimacy concerns, but with the additional gloss of transparency (based on, perhaps, constitutional due process or statutory requirements) involved.

As stated earlier, these approaches often overlap. The Court may place weight on the determinations of different institutions, but may base the amount of weight upon substantive considerations, such as the degree of liberty loss or the appearance of institutional bias. Or, in evaluating the validity of an institution's decision, the Court may factor in the amount of deliberation and explanation provided by that institution, but not treat the institution's statement as determinative of the decision's validity.

The Court's approach varies with regard to the nature of the decisionmaking institution. Such an institution-varied approach may be appropriate, as I shall argue, given the different formally recognized and practically available capacities of legislatures, courts, and agencies in evaluating the science before them. A complete evaluation of each institution's ability to evaluate the science before it, however, may ultimately depend on complexities of the science involved in a given situation, as well as the presence of interest groups with stakes in resolving the question at issue. Such a full evaluation is beyond the scope of this Article; nevertheless, I shall present such factors and explain how they could be better incorporated into the deference approach of *Carhart II*. Moreover, as I shall explain, regardless of the ultimate fitness of deferring to a given institution's choice of actions in the face of uncertain science, the Supreme Court's approach to-

⁴⁶ *Id.* at 356–57 (discussing substantive approaches for regulatory agencies to address scientific uncertainty in their decisionmaking processes).

wards evaluating the existence of uncertainty in *Carhart II* leaves a number of gaps that could be addressed in future cases.

A. *Approaches Towards Legislation: Carhart II*

The Supreme Court's decision in *Carhart II* tackles some of these questions about resolving scientific uncertainties in the context of judicial decisionmaking.⁴⁷ In particular, it attempts to formalize the role of legislatures in choosing options in the face of scientific uncertainty—and appears to foreclose some options when the science is “certain.” *Carhart II* dealt with a facial constitutional challenge to the federal Partial Birth Abortion Act of 2003, which prohibited a procedure called intact dilation and extraction, or D & X. Among other things, the challengers argued that the Partial Birth Abortion Act was an unconstitutional burden on the right to abortion because it lacked an exception allowing the prohibited procedure when necessary for the mother's health.⁴⁸

This challenge was entirely understandable, because the Court, in an earlier case, *Stenberg v. Carhart* (“*Carhart I*”),⁴⁹ had struck down a challenge to a similar Nebraska state statute. That statute had banned the D & X procedure entirely, without any explicit exception for women's health, and was not supported by findings about the necessity—or lack thereof—for such an exception.⁵⁰ Because of this absence, the majority held that the “State fail[ed] to demonstrate that banning D&X without a health exception may not create significant health risks for women, because the record shows that significant medical authority supports the proposition that in some circumstances, D&X would be the safest procedure.”⁵¹

But although the Partial Birth Abortion Act of 2003 contained restrictions similar to the Nebraska statute, the level of specificity in the congressional findings was quite different. In enacting the Partial Birth Abortion Act, Congress rejected the Court's findings in *Carhart I*, describing them as “very questionable”⁵² and stating that it was not bound by the Court's earlier findings. Instead, Congress stated: “A

47 Cf. Hill, *supra* note 10, at 294–324 (discussing differing constitutional approaches to medical cases along autonomy versus public health lines, and distinguishing between a number of possible interpretations).

48 *Carhart II*, 127 S. Ct. 1610, 1635 (2007).

49 530 U.S. 914 (2000).

50 NEB. REV. STAT. § 28-328(1) (Supp. 2007).

51 *Carhart I*, 530 U.S. at 932.

52 18 U.S.C. § 1531 (2006).

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.”⁵³ Moreover, Congress made medical findings that D & X would never be necessary to avoid significant health effects for women, except when the choice was between using the procedure and death for a pregnant woman.⁵⁴ This was in contrast to the Nebraska statute, which failed to contain any such medical findings by the state legislature.⁵⁵ As such, the Partial Birth Abortion Act generally prohibited the use of D & X, with the exception that the prohibitions would not apply where “necessary to save the life of a mother whose life is endangered by a physical disorder, physical illness, or physical injury, including a life-endangering physical condition caused by or arising from the pregnancy itself.”⁵⁶

Because of this difference between the statutes, the majority reached a different conclusion in *Carhart II* and rejected the facial challenge to the Partial Birth Abortion Act. In rejecting the challenge, the Court provided some guidance on what Congress can do in the face of medical uncertainty. Although the majority recognized “documented medical disagreement [as to] whether the Act’s prohibition would ever impose significant health risks on women,”⁵⁷ it stated: “Medical uncertainty does not foreclose the exercise of legislative power in the abortion context any more than it does in other contexts.”⁵⁸ Instead, “[t]he Court has given state and federal legislatures wide discretion to pass legislation in areas where there is medical and scientific uncertainty,”⁵⁹ with uncertainty, in this context, shown by the absence of consensus rather than the scientific uncertainties described earlier.

In reaching its conclusion, the majority recognized that certain congressional findings were contradicted by the evidence before the district court.⁶⁰ Indeed, the majority allowed Congress to act even when making some recitations in the Act that the Court stated were “factually incorrect.”⁶¹ As the majority pointed out, Congress errone-

53 *Id.*

54 *Id.*

55 *See* NEB. REV. STAT. § 28-328(1).

56 18 U.S.C. § 1531(a).

57 *Carhart II*, 127 S. Ct. 1610, 1636 (2007).

58 *Id.* at 1637.

59 *Id.* at 1636.

60 *Id.* at 1638.

61 *Id.* at 1637–38.

ously determined that no medical school provided instructions on performing D & X.⁶² Moreover, Congress stated that a medical consensus existed regarding the unnecessary nature of the D & X procedure, when, in fact, none existed.⁶³

The majority, however, considered the incorrect findings and the erroneous existence of uncertainty insufficient to provide grounds to hold the Act unconstitutional. While this view was described as one of “[u]ncritical deference,”⁶⁴ the majority pointed out that it has never treated the existence of scientific uncertainty as providing “no margin of error.”⁶⁵ Such a standard would be “too exacting a standard to impose on the legislative power.”⁶⁶ Accordingly, the majority stated that even where, as here, there was medical “uncertainty over whether the barred procedure is ever necessary to preserve a woman’s health,”⁶⁷ the facial challenge must be rejected.

In applying this approach, the Court drew from a number of earlier cases dealing with legislative actions in the face of scientific and medical uncertainty. Although the majority pointed to these cases as support for its general conclusion that the legislature deserves wide deference in such areas, the cases themselves involved challenges in two somewhat distinct types of legislative contexts involving the use of science: The justificational context, in which legislatures use scientific information (or uncertainty regarding that information) as the justification for their choice of actions, and the ontological shaping context, in which legislatures create certain legal categories that may be based upon, or simply happen to share some overlap with, existing scientific or medical categories. Uncertainty in the justificational context can arise when the science that the legislature uses as its justification is uncertain; uncertainty in the ontological shaping context can arise when the scientific or medical categories upon which the legislative categories are based lack certainty in their definitions. The differences between these types of cases deserve further explanation because, taken as a whole, the Court’s undifferentiated treatment of scientific uncertainty in these contexts misses a deeper distinction between the use of science as justification, and the use of science as an ontological tool. By conflating the use of science as an ontological

62 *Id.* at 1638.

63 *Id.*

64 *Id.*

65 *Id.*

66 *Id.*

67 *Id.*

tool with the use of science as justification, the Court appears to provide even more deference than is perhaps warranted in the purely justificational context.

1. *Clarity in an Institutional Approach Towards Evaluating and Applying Science?*

In affirming Congress's choice to restrict D & X, the majority in *Carhart II* relied on the principle that deference to legislative choices is warranted where a legislature is acting in areas of scientific or medical uncertainty.⁶⁸ But the majority did not purport to apply blind deference. Instead, it characterized the degree to which it defers to legislative choices as not "[u]ncritical."⁶⁹

This level of deference should be highlighted because the rationale provided by the *Carhart II* majority—that legislatures should have room to address risks where science is uncertain—is more related to the justificational use of science than the ontological use of science. This is because, where a legislature does not purport to justify its actions by scientific findings, but instead uses them merely to shape a particular legal definition, critical review of the science is less relevant to evaluating the rationality of the legislature's actions, given that the legislature's rationale was never premised on its assessment of the state of the science.

Indeed, the Court's primary reliance on justificational cases is evidenced in *Carhart II*. In providing "wide discretion" to Congress in enacting the Partial Birth Abortion Act, the majority quoted directly from one of these cases, *Marshall v. United States*⁷⁰: "When Congress undertakes to act in areas fraught with medical and scientific uncertainties, legislative options must be especially broad."⁷¹ In *Marshall*, the Court rejected a plaintiff's argument that the Narcotic Addict Rehabilitation Act of 1966 denied him due process and equal protection by excluding him from consideration for rehabilitative treatment on the ground of his three prior felony convictions.⁷² According to the plaintiff, Congress failed to establish a sufficiently rational nexus between proving treatment for drug addiction to reduce criminal recidivism and his status as a multiple offender.⁷³ In rejecting that ar-

68 *Id.* at 1636.

69 *Id.* at 1638.

70 414 U.S. 417 (1974).

71 *Carhart II*, 127 S. Ct. at 1636 (quoting *Marshall*, 414 U.S. at 427).

72 *Marshall*, 414 U.S. at 421–22.

73 *Id.* at 422.

gument, the Court pointed to the observation that “there is no generally accepted medical view as to the efficacy of presently known therapeutic methods of treating addicts and the prospect for the successful rehabilitation of narcotics addicts thus remains shrouded in uncertainty.”⁷⁴ Indeed, “when courts deal with problems in the administration of criminal law such as those related to drug addiction, alcoholism, mental disease, and the like, they are necessarily confined to the existing limits of human knowledge in those areas.”⁷⁵ And, as even the House and Senate Reports acknowledged with respect to that statute, considerable uncertainty remained as to the ability of rehabilitation efforts to successfully address drug addiction.⁷⁶ Accordingly, the Court held that it was reasonable for Congress to make this sort of policy choice in putting together its experimental program for dealing with drug addiction treatment.⁷⁷

Likewise, *Lambert v. Yellowley*,⁷⁸ also cited by the *Carhart II* majority, addressed a challenge to a statute limiting the amount of alcohol that could be contained in any medication prescribed by a physician. The Court observed that Congress recognized:

[P]racticng physicians differ about the value of malt, vinous and spirituous liquors for medicinal purposes, but that the preponderating opinion is against their use for such purposes; and that among those who prescribe them there are some who are disposed to give prescriptions where the real purpose is to divert the liquor to beverage uses.⁷⁹

Thus, the Court concluded that:

Congress, in deference to the belief of a fraction of the medical profession that vinous and spirituous liquors have some medicinal value, has said that they may be prescribed in limited quantities according to stated regulations; but it also has said that they shall not be prescribed in larger quantities, nor without conforming to the regulations, because this would be attended with too much risk of the diversion of the liquor to beverage uses. Not only so, but the limitation as to quantity must be taken as embodying an implicit congressional finding that such liquors have no such

⁷⁴ *Id.* at 426.

⁷⁵ *Id.* at 426–27.

⁷⁶ *See id.* at 426 (citing H.R. REP. NO. 89-1486, at 51 (1966); S. REP. NO. 89-1667, at 14 (1966)).

⁷⁷ *Id.* at 430.

⁷⁸ 272 U.S. 581 (1926).

⁷⁹ *Id.* at 589–90 (citing H.R. REP. NO. 67-224; *Amendment of National Prohibition Act: Hearing on H.R. 5033 Before the S. Comm. on the Judiciary*, 67th Cong. 15–16, 146 (1921) (statements of Sen. Thomas Sterling, Sen. Thomas Walsh & Rep. Andrew Volstead), *reprinted in* 61 Cong. Rec. 3456, 4035–36, 4038, 8749–57).

medicinal value as gives rise to a need for larger or more frequent prescriptions.⁸⁰

This choice, given the recognized existence of disagreement among physicians, was sufficient to uphold the application of the statute to a physician who wanted to prescribe alcohol in amounts exceeding that allowable under the statute.

In other cases cited by the *Carhart II* majority involving justificational uncertainties, the Court took a similar approach of deference towards legislative options. The Court in those cases, however, provided less analysis of the medical and scientific uncertainties before the legislatures than it did in *Marshall* or *Lambert*. For example, the Court in *Powell v. Texas*⁸¹ did not address whether the Texas legislature had observed any medical uncertainties about whether alcohol addiction is a disease; instead, the Court observed on its own that “the inescapable fact is that there is no agreement among members of the medical profession about what it means to say that ‘alcoholism’ is a ‘disease.’”⁸² Similarly, the Court, in reviewing a challenged compulsory vaccination statute in *Jacobson v. Massachusetts*,⁸³ did not inquire into whether the Massachusetts legislature recognized any uncertainties about the science, but held that the uncertainties in safety raised by the plaintiff did not preclude the legislature from acting to address the risk of smallpox.⁸⁴ Indeed, in *Jones v. United States*,⁸⁵ where the plaintiff complained that Congress failed to “cite any empirical evidence indicating that mentally ill persons who have committed a criminal act are likely to commit additional dangerous acts in the future,”⁸⁶ the Court still held that “reasonable legislative judgments” in the face of actual medical uncertainties should receive particular deference.⁸⁷

The source of the *Carhart II* majority’s “wide” but not “uncritical” discretion is consistent with a view of the legislature as a more appropriate institution than courts for weighing complex scientific medical information, needed to justify a legislature’s actions, such as those about the efficacy of drug addiction treatment for different classes of

80 *Id.* at 594–95.

81 392 U.S. 514 (1968).

82 *Id.* at 522.

83 197 U.S. 11 (1905).

84 *Id.* at 37–38.

85 463 U.S. 354 (1983).

86 *Id.* at 364 n.13 (quoting Reply Brief for Petitioner at 13, *id.* (No. 81–5195)).

87 *Id.* at 365 n.13.

individuals seen in *Marshall*.⁸⁸ Even in those cases where the Court did not discuss whether the legislatures themselves recognized the existence of scientific or medical uncertainties, the Court read into the legislative determinations an implicit weighing of the scientific information before the legislatures and the uncertainties regarding that information, given its reference to the “reasonable” judgments of the legislatures at issue in those cases.

The question of whether legislatures are better suited to weigh scientific determinations and make decisions in the face of uncertainty is of debate among scholars, however. Proponents of such a deferential approach often point to the greater capacity of Congress to gather a broader range of scientific information than that of a court.⁸⁹ Legislatures, after all, receive scientific testimony and input from a number of sources, whereas courts often review only the information provided by the parties⁹⁰ (and amici⁹¹) before them. Moreover, proponents argue that legislatures have greater resources and more time for gathering facts and weighing them, pointing towards enhanced research services, such as greater numbers of staff than judiciary, and the availability of the Congressional Research Ser-

88 See Hill, *supra* note 10, at 332–41, 333–34 n.293 (discussing debates between proponents and critics of deference to legislatures’ factfinding, and citing as a proponent Robin Charlow, *Judicial Review, Equal Protection and the Problem with Plebiscites*, 79 CORNELL L. REV. 527, 578 (1994)); see also Dan L. Burk, *The Milk Free Zone: Federal and Local Interests in Regulating Recombinant bST*, 22 COLUM. J. ENVTL. L. 227, 280 (1997) (observing that “[l]egislatures may consider a wide range of viewpoints, scientific, economic, political, and otherwise”); Philip P. Frickey & Steven S. Smith, *Judicial Review, the Congressional Process, and the Federalism Cases: An Interdisciplinary Critique*, 111 YALE L.J. 1707, 1740 (2002) (“[T]he modern Congress has created information-gathering mechanisms and established some procedures that might seem to establish a lawmaking process that approximates the standards of deliberative due process.”); Victor E. Schwartz et al., *Medical Monitoring: The Right Way and the Wrong Way*, 70 MO. L. REV. 349, 381 (2005) (“Legislatures are better equipped than courts to consider the scientific and medical information necessary to set a ‘trigger’ and to change these ‘triggers’ as scientific knowledge progresses.”).

89 See Frickey & Smith, *supra* note 88, at 1740 (“A wide variety of resources, unmatched by any other legislature in the world, are at the disposal of members and their committees.”).

90 See, e.g., Alice Kaswan, *The Domestic Response to Global Climate Change: What Role for Federal, State, and Litigation Initiatives?*, 42 U.S.F. L. REV. 39, 98–99 (2007) (discussing the lack of transparency in common law cases, which involve only parties, intervenors, and court-sanctioned amici); Margaret H. Lemos, *The Other Delegate: Judicially Administered Statutes and the Nondelegation Doctrine*, 81 S. CAL. L. REV. 405, 447 (2008) (stating that because courts do not have the time to sort through extra-record material, they are forced to rely on “information supplied by the parties and their amici”).

91 See generally Stephanie Tai, *Friendly Science: Medical, Scientific, and Technical Amici Before the Supreme Court*, 78 WASH. U. L.Q. 789 (2000) (discussing the participation of scientific organizations and their members as amici in the judicial process).

vice.⁹² Finally, legislatures may be more accountable to public opinion, or at least the more politically powerful parts of the public, thereby allowing them to take these opinions into account in weighing the scientific information before them.⁹³

If indeed legislatures have the greater capacity and legitimacy to evaluate and apply uncertain science as proponents assert, the deferential approach in situations where legislatures bear the burden of supporting their actions against challenge would allow legislatures to choose to address risks without waiting for scientific certainty, which may never arise.⁹⁴ Such an approach may be especially welcome in addressing environmental and public health risks, where the developing nature of the science may mean that the risks may not be fully assessed by the scientific and medical communities before the ongoing circumstances actually warrant action.⁹⁵ In such circumstances, under the Court's opinion, a legislature may still find justification to act, de-

92 See Frickey & Smith, *supra* note 88, at 1739–40 (discussing the duties of the Congressional Research Service and the wide variety of resources available to Congress); see also Wendy E. Wagner, *Congress, Science, and Environmental Policy*, 1999 U. ILL. L. REV. 181, 200–01 (“Congress makes good use of positive scientific knowledge . . . [because it] can call upon an enviable array of scientific expert advisors to assist in making sense of the unending stream of information that arrives in its offices. . . . Several political scientists confirm this fact and note also that scientific studies often command great respect in congressional deliberations, especially if the source appears neutral and the study findings appear accurate.” (footnotes omitted) (citing BRUCE BIMBER, *THE POLITICS OF EXPERTISE IN CONGRESS: THE RISE AND FALL OF THE OFFICE OF TECHNOLOGY ASSESSMENT* 3 (1996); Sanford A. Lakoff, *Scientists, Technologists and Political Power*, in *SCIENCE, TECHNOLOGY AND SOCIETY: A CROSS-DISCIPLINARY PERSPECTIVE* 355, 355–57 (Ina Spiegel-Rösing & Derek de Solla Price eds., 1977); Dorothy Nelkin, *The Political Impact of Technical Expertise*, 5 SOC. STUD. SCI. 35–54 (1975)).

93 See Charlow, *supra* note 88, at 588 (arguing that “courts defer to legislatures with regard to factfinding in part because they consider factfinding properly to be tied up with policymaking, and thus part of the legislative and not the judicial function”); cf. KOMESAR, *supra* note 11, at 141 (pointing out how judicial “insulation separates judges from a great deal of information about the desires and needs of the public” and that “public officials must understand the wants and needs of the general public or at least powerful parts of the general public to remain in office or obtain higher office,” but ultimately pointing out that under certain circumstances, “these informal channels for presentation or revelation of desires can carry a severely distorted view of public needs”).

94 See Adelman, *supra* note 2, at 937 (2007) (discussing the pervasiveness of scientific uncertainty); see also *Carhart II*, 127 S. Ct. 1610, 1637–38 (2007) (discussing the extent of medical uncertainty concerning the necessity of the D & X abortion procedure to preserve women’s health).

95 Neal F. Lane & Rosina Bierbaum, *Recent Advances in the Science of Climate Change*, 15 NAT. RESOURCES & ENV’T 147, 147 (2001) (“The timeline of policymaking is also not the same as the timeline for science. Science is an open-ended incremental process with occasional breakthroughs, while policymaking is usually sporadic and often proceeds in large steps—such as adopting treaties, reauthorizing environmental laws, or legislating new ones.”).

spite the existence of some uncertainty. Moreover, the deferential approach may avoid embroiling such attempts to address environmental and public health risks in often lengthy judicial disputes over the merits of particular scientific findings, where any or all of the sorts of scientific uncertainties described earlier may arise.

Indeed, a deferential approach avoids some of the problems encountered by Professors Philip Frickey and Steven Smith in evaluating federalism cases where the Supreme Court has required Congress to provide more reasoned explanation for their actions.⁹⁶ As these scholars have argued, by requiring Congress to undergo greater lengths to present justifications for its actions, the Court is assuming that the legislature is undergoing some form of deliberation, “defined as a reasoned discussion in which the outcome is consensus on ends and means.”⁹⁷ Otherwise, an inquiry into the legislature’s justification would be less meaningful. Professors Frickey and Smith challenge, however, whether legislatures actually undergo such deliberation.⁹⁸ Instead, given the dynamics of the legislative process, “[s]trategic disclosure muddies the legislative record and greatly complicates the task of applying a legal standard that asks judges to evaluate the quality of that record.”⁹⁹ Legislative deference in the face of scientific and medical uncertainty, in contrast, arguably avoids such an inquiry by simplifying the court’s determination into asking whether the situation is one in which deference towards the legislature’s actions is warranted, allowing for nondeliberative processes such as strategic disclosure and compromise, rather than an inquiry into the substance of the legislative consideration, thereby assuming deliberation.

Carhart II, therefore, can be read as a solidification of the view of legislatures as a superior body to courts for assessing scientific information and applying it to construct legislative choices in addressing medical and health risks. Whether legislatures in fact deserve such deference is not uniformly accepted, however. Professor Neal Devins has pointed out that legislatures may lack incentives to fully inquire

96 See Frickey & Smith, *supra* note 88, at 1743 (2002) (“At least for policies in which constitutional values must be weighed with care, the Court seems to suggest that deliberation, not simple aggregation, is expected of Congress.”).

97 *Id.* (basing this argument primarily on an examination of the Supreme Court’s federalism jurisprudence, where it has demanded “reasons that *it* finds persuasive, at least when Congress’s actions would otherwise infringe on the rights or powers of states”).

98 *Id.* at 1743–45.

99 *Id.* at 1744.

into all the relevant scientific and medical bases for their decisions.¹⁰⁰ Especially when legislators are aware that their factual determinations would be reviewed by courts, they may face disincentives to avoid addressing scientific findings that undermine their political choices.

Such disincentives may be heightened in situations where the skewed distribution of potential stakeholders “is manifested in either extreme minoritarian or majoritarian bias.”¹⁰¹ As Professor Neil Komesar has pointed out, stakeholders with fewer resources may be less able to recognize their stakes in a given problem.¹⁰² Without such recognition, these potential stakeholders may not provide incentives for legislators to respond to their interests—even interests in obtaining more information.¹⁰³ Stakeholders with more resources, in contrast, will be more able to both recognize their stakes in an issue and lobby legislators more effectively.¹⁰⁴ In such situations, the factual determinations may not be representative of the “science as a whole,” but rather those supportive of a skewed view, depending on the group that has more political force in that circumstance.

Legislative disincentives to consider a full range of available science may also be heightened in situations where the science is particularly complex. Professor Wendy Wagner has observed that gaps in scientific understanding among the public may lead it to be ignorant of both the nature of certain environmental problems, as well as the limits of science in evaluating and treating those problems.¹⁰⁵ Such failures may provide incentives for legislatures to fall back on asserted “scientific determinations” or even asserted “scientific uncertainties” to provide a neutral cover for decisions that are, at their base, policy decisions.¹⁰⁶ As such, both the complexity of the scientific information as well as the distribution of interests with political stakes

100 Neal Devins, *Congressional Factfinding and the Scope of Judicial Review: A Preliminary Analysis*, 50 DUKE L.J. 1169, 1178 (2001).

101 KOMESAR, *supra* note 11, at 148.

102 *Id.* at 71 (“The more complex the social issue the more difficult or expensive it is to recognize one’s position.”).

103 *Cf.* Tai, *supra* note 39, at 688–92 (describing how the lay public is less able to engage in scientific dialogue with agencies than regulated entities and organized regulatory beneficiaries).

104 *See id.* at 688–89 (arguing that “[w]ell-funded and organized entities . . . can more easily afford to generate” technical studies than the “lay public”).

105 *See* Wagner, *supra* note 92, at 225–27 (“[T]he public has a limited understanding of the scientific enterprise . . .”); *see also* Wagner, *supra* note 29, at 1653–54 (“Due to their inadequate scientific training, the public and the media are unlikely to recognize institutional policy choices embedded in hypertechnical scientific justifications.”).

106 Wagner, *supra* note 92, at 225–27; *see also* Wagner, *supra* note 29, at 1653–54.

may significantly affect whether courts or legislatures are more capable of making choices in the face of scientific uncertainty.¹⁰⁷

Furthermore, Professor Douglas Laycock argues that the structure of legislative hearings may limit Congress's ability to receive a thorough discussion of the available medical and scientific research.¹⁰⁸ Although courts often treat legislatures as having more time to deliberate than courts, the large number of issues faced by legislatures means that their time on one particular issue may ultimately be limited.¹⁰⁹ Indeed, the party in the political minority often faces even more constraints, in terms of both the number of witnesses it can call for hearings, as well as the time allotted for that witness testimony.¹¹⁰ This is in contrast to courts, where the rules of civil litigation allow each party in a given case more equal opportunity to present its own evidence and witnesses.¹¹¹

Finally, Professor B. Jessie Hill argues that legislatures may be just as deficient as courts in scientific competency necessary to understand the research before them.¹¹² Legislators themselves are often lay decisionmakers, not trained in fully evaluating scientific discourse or the limits of scientific discourse.¹¹³ And although legislators may have access to research services such as the Congressional Research Service, the General Accounting Office, and the National Academies, the availability of such access does not mean that legislatures actually use those resources in most circumstances.¹¹⁴

107 Neil Komesar identifies a number of other factors in determining how influential concentrated minorities may be, including:

the complexity of the issue involved, the absolute level of the average per capita stakes of the larger group, the unevenness of the distribution of the larger group and the chance that this heterogeneity will produce catalytic subgroups, and the availability of free or low cost information to the larger group.

KOMESAR, *supra* note 11, at 73.

108 See Douglas Laycock, *A Syllabus of Errors*, 105 MICH. L. REV. 1169, 1174–75 (2007) (arguing that legislative hearings are not nearly as effective and comprehensive as some think they are).

109 See *id.* at 1175 (stating that legislators “are spread far too thin”).

110 See *id.* (“The party in the minority often gets fewer than half the witnesses and only one week’s notice of the hearing.”).

111 *Id.* at 1176.

112 See Hill, *supra* note 10, at 337–38 (“There is . . . little reason to believe that legislatures possess—or exercise—superior institutional competency in the context of medical and scientific fact.”); see also *id.* at 335–41 (providing a full discussion of such critiques).

113 See Wagner, *supra* note 92, at 193–96 (describing failures of Congress to fully recognize data gaps in scientific information with respect to constructing environmental statutes).

114 See Hill, *supra* note 10, at 337 n.312 (pointing out that the Congressional Research Service and General Accounting Office does not conduct their own medical or scientific studies); *id.* at 338 n.313 (describing the National Academies as “arguably the equivalent of some of Congress’s other fact-gathering arms,” but stating that “it is unclear how often Con-

These problems are complicated by what Professor Komesar observes as the implications of judicial scale. As either legislation or the public enforcement of legislation grows, so does the “role of courts as implementers of legislation.”¹¹⁵ But because the judiciary, especially the appellate judiciary, is rather limited in size by a number of structural constraints,¹¹⁶ courts may respond by creating litigation disincentives and using gatekeeping mechanisms, from decreasing chances of plaintiff success to imposing decisionmaking rules that allow them to “resolve more disputes at lower cost.”¹¹⁷ What this could mean is that any expansion and greater use of legislative capacity for evaluating and processing scientific uncertainties in constructing legislative choices could have resonating effects. If legislatures were to expand and make greater use of this capacity, as some advocate, or if courts were to scrutinize the substance of legislative determinations, as others advocate,¹¹⁸ litigation could increase because of these greater avenues for challenges. In turn, in response to this greater demand on their resources, courts might adopt differing modes of review to limit such challenges.

Despite well-founded critiques and complexities, the deferential approach may still be welcome among those engaging in scientific research. The dangers of the Court making its own determinations on scientific and medical issues is that such determinations will fix into place “science” that could be ultimately undermined by additional studies. Such a “fixing” may be of concern to the scientific community for two reasons. First, such an approach would conflict with the nature of science as continuously in development.¹¹⁹ While additional

gress, not to mention state legislatures, relies on studies conducted by the National Academies”).

115 KOMESAR, *supra* note 11, at 142.

116 *Id.* at 144–45.

117 *Id.* at 147. Professor Komesar points out these factors not to address specifically the fitness of deferring to the legislative weighing of scientific uncertainties, but rather to challenge the notion that courts can determine whether or not to resolve an issue simply by assessing their own capacities. Instead, he argues:

Courts must consider their own abilities and the impacts on their resources, but they must consider more. In the relevant comparative institutional world, courts may be called upon to consider issues for which they are ill equipped in some absolute sense because they are better equipped to do so in a relative sense.

Id. at 149. Such observed dynamics, however, are relevant to arguments regarding legislative capacities as well, because of the interrelated functions of these institutions.

118 *See generally* Hill, *supra* note 10 (proposing a greater role for review of scientific uncertainties by courts, but acknowledging the critiques of such an approach).

119 *See* Christopher Onstott, *Judicial Notice and the Law’s “Scientific” Search for Truth*, 40 AKRON L. REV. 465, 477 (2007) (describing the application of the *Frye* evidentiary standards to judicial notice as inconsistent with the ever-evolving nature of science); *see also* THOMAS S.

research on a given issue may both refine and change the state of the science on a given issue before a court, judicial decisions—including that on scientific matters—are often treated as permanent, especially by other courts, given the doctrine of *stare decisis*.¹²⁰ Permanent determination of the state of science, however, may create challenges for the legitimacy of courts, especially when later scientific developments call those earlier determinations into question.¹²¹ This danger is not as great for legislative determinations of science, given that legislatures are freer to revisit their determinations.

Indeed, Professor Todd Aagaard and Judge Robert E. Keeton have observed that judicial determinations about the science involved in facial challenges to a statute may operate as legislative factfinding that becomes embedded in precedent, more so than the deferential review of factfinding by legislatures.¹²² This is because such determi-

KUHN, *THE STRUCTURE OF SCIENTIFIC REVOLUTIONS* 79, 92–94 (3d ed. 1996) (describing how the development of science is characterized by “scientific revolutions” that aim to resolve paradigmatic “crises”); KARL POPPER, *CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE* 215–17 (1963); Robert J. Condlin, “*What’s Really Going On?*” *A Study of Lawyer and Scientist Inter-Disciplinary Discourse*, 25 RUTGERS COMPUTER & TECH. L.J. 181, 229–30 (1999) (describing views about the consistent presence of uncertainty in science put forth by scientists at a panel discussion); Deborah M. Hussey Freeland, *Maieusis Through a Gated Membrane: “Getting The Science Right” in Public Decisionmaking*, 26 STAN. ENVTL. L.J. 373, 384 (2007) (explaining that “scientific inquiry generates facts that are expected to be provisional, having an understood and acknowledged potential for revision as other facts are developed”); Allan Sobel, *Foreword: The Intersection of Law and Science Symposium*, 54 DRAKE L. REV. 591, 591 (2006) (“The law strives for truth, justice, and finality, one case at a time, in its own insular way. Science searches for absolute truth by constantly raising questions and testing hypotheses in hopes of finding answers. Science does not recognize finality. Our citizens look to science and law as pathways to truth.”).

¹²⁰ See Brian Stuart Koukoutchos, *Solomon Meets Galileo (and Isn’t Quite Sure What to Do with Him)*, 15 CARDOZO L. REV. 2237, 2254 (1994) (citing *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 598 (1993) (Rehnquist, C.J., concurring in part and dissenting in part) (offering a similar critique)); Onstott, *supra* note 119, at 475 (“Most courts recognize that a previously judicially noticed scientific principle carries precedential value.”).

¹²¹ Cf. Onstott, *supra* note 119, at 486 (“Thus, judges, whose competency in dealing with scientific and technical evidence is already widely questioned, may suffer a net trust loss, even if they manage to get the scientific or technical question right more often than wrong in issuing judicial notice.” (footnote omitted)). This is not to say that courts have not made determinations that later have been found erroneous. As Professor Onstott has pointed out, courts have made determinations—later shown to be erroneous—that sewage can always be rendered innocuous, that tobacco presents few injurious effects, and that X-ray machines present little or no danger in their use. See *id.* at 465–69. Rather, my argument, similar to that of Professor Onstott, is simply that courts should take this “tension” into account before making scientific determinations.

¹²² See Todd S. Aargaard, *Factual Premises of Statutory Interpretation in Agency Review Cases*, 77 GEO. WASH. L. REV. (forthcoming 2009) (manuscript at 19) (“[A] premise fact becomes embedded in the principle of law it supports and therefore becomes, either explicitly or

nations would involve “facts that explicitly or implicitly serve as premises used to decide issues of law,” or what Judge Keeton deems “premise facts.”¹²³ In particular, Professor Aargaard points out:

[W]hereas a determination of an adjudicative fact is binding only to the extent of rules of preclusion—law of the case, *res judicata*, or collateral estoppel—a premise fact becomes embedded in the principle of law it supports and therefore becomes, either explicitly or implicitly, binding precedent. A court in a subsequent case cannot disregard binding precedent announcing a legal principle merely on the ground that the principle is based on an erroneous factual premise.¹²⁴

Thus, in facial challenges such as the ones addressed in this Article, judicial inquiries into the substantive scientific support for a legislative determination present the danger that future courts might be required to apply earlier scientific determinations that have ultimately been undermined.

Indeed, the current application of the super-stare decisis doctrine¹²⁵ to precedents regarding statutory challenges should provide additional reasons for the Court to be wary of reaching scientific determinations where the science is uncertain, rather than deferring to the legislature. Under this doctrine,

Statutory precedents . . . often enjoy a super-strong presumption of correctness. In some cases, the Court says it will overrule statutory precedents only under the most compelling circumstances, such as new constitutional developments. According to many judges and commentators, this heightened adherence to stare decisis “marks an essential difference between statutory interpretation on the one hand and [common] law and constitutional interpretation on the other.”¹²⁶

implicitly, binding precedent.”), available at <http://ssrn.com/abstract=1126730>; Robert E. Keeton, *Legislative Facts and Similar Things: Deciding Disputed Premise Facts*, 73 MINN. L. REV. 1, 26, 28 (1988) (“Legislative-fact determinations by a legislature as a basis for enacting a statute and precedential-fact determinations by a court as a basis for deciding an issue of law are a part of the body of decisions that have a force at least analogous to, if not the same as, the force of law.” (footnotes omitted)).

123 Keeton, *supra* note 122, at 8 (emphasis omitted).

124 Aargaard, *supra* note 122, at 19 (footnote omitted).

125 Lemos, *supra* note 90, at 454 (“The doctrine of stare decisis makes judicial lawmaking more rigid still. Courts purport to apply a ‘super-strong’ version of stare decisis to their interpretations of statutes.” (citing William N. Eskridge, Jr., *Overruling Statutory Precedents*, 76 GEO. L.J. 1361, 1362 (1988))). *But see* Michael Sinclair, *Precedent, Super-Precedent*, 14 GEO. MASON L. REV. 363, 410–11 (2007) (criticizing a bifurcated conception of stare decisis versus super-stare decisis as failing to recognize the broad range of precedential approaches).

126 Eskridge, *supra* note 125, at 1362–63 (alteration in original) (quoting Edward H. Levi, *An Introduction to Legal Reasoning*, 15 U. CHI. L. REV. 501, 540 (1948)). As Professor William Eskridge has observed, “in a significant number of cases the Court has refused seriously to consider overruling or narrowing statutory precedents that might have been vulnerable

Although Professor Eskridge points to exceptions and inconsistencies in the application of this presumption to ultimately argue that the Court should depart from this “rhetoric” of super-strong precedents,¹²⁷ judicial decisions regarding scientific issues in the context of statutory challenges may still fall under this umbrella of “super-precedent,” and thus arguably remain crystallized in the case law.¹²⁸

Second, a judicial determination regarding science may provide disincentives for scientists to engage in the sort of self-critical research that many recognize to be a laudable aspect of scientific development.¹²⁹ A number of scholars have already observed that heightened legal stakes have led to an adversarial development of scientific research.¹³⁰ Such critiques apply to legislative determinations¹³¹ as well as judicial determinations.¹³² I do not, therefore, argue that deference to legislative determinations would remove all adversarial incentives for scientific research. The often interest group-driven nature of the political system means that, to some extent, interest-driven forces will shape the development of scientific research.¹³³ This is es-

had they been common law or constitutional precedents.” Eskridge, *supra* note 125, at 1368.

127 *Id.* at 1425–26.

128 *See* Levi, *supra* note 126, at 523–40 (discussing cases exhibiting this trend).

129 *See* David S. Caudill, *Ethnography and the Idealized Accounts of Science in Law*, 39 SAN DIEGO L. REV. 269, 276 (2002) (describing self-criticism as a factor that may be “conceived as conducive to natural scientific inquiry”); David L. Faigman, *The Law’s Scientific Revolution: Reflections and Ruminations of the Law’s Use of Experts in Year Seven of the Revolution*, 57 WASH. & LEE L. REV. 661, 673 (2000) (“The key to being a good scientist is, of course, to be self-critical.”).

Thomas Kuhn takes a more nuanced view regarding self-criticism, pointing out that, examined as a whole, scientific research is not continuously self-critical. Rather, according to Kuhn, scientific development can be seen as progressing through different phases: “scientific revolutions,” in which large paradigmatic shifts are made. *See* KUHN, *supra* note 16, at 226–27, and “normal science,” which develops in a manner committed (and therefore arguably un-self-critical), to a particular paradigm, *see id.* at 232–37.

130 *See* discussion *supra* note 40.

131 *See* Nicholas A. Robinson, *The ‘Ascent Of Man’: Legal Systems and the Discovery of an Environmental Ethic*, 15 PACE ENVTL. L. REV. 497, 503 (1998) (“Where science is dynamic and displaces old hypothesis [sic] for new and more refined understandings, and where philosophy admits of self-criticism and seeks refinement, our legislation tends merely to accumulate.”).

132 *See* discussion *supra* note 40; *see also* William C. Thompson, *Accepting Lower Standards: The National Research Council’s Second Report on Forensic DNA Evidence*, 37 JURIMETRICS J. 405, 408 (1997) (arguing that the “the desire to be effective in the courtroom causes forensic scientists to stifle some of the open, self-critical discussion of issues that helps root out problems and correct errors in academic science”).

133 KOMESAR, *supra* note 11, at 148.

pecially the case when the provision of funds greatly affects the nature of the research that can be undertaken.¹³⁴

But courts, at least in theory, are less free than legislatures to revisit their determinations,¹³⁵ especially when courts adhere to *stare decisis* generally, and even purport to adhere to a doctrine of *superstare decisis* regarding statutory interpretations. This increased permanency would raise the stakes involved in scientific research such that funding institutions that either have financial stakes or hold particular normative views may become even more reluctant to provide resources for research that raises even the possibility of undermining their interests. Indeed, such funding institutions may hold even greater power to affect the development of science where research funds are tied to nondisclosure agreements, in which sponsors of research have contractual rights regarding the publication of research results.¹³⁶ Individual scientists, too, could be affected by any heightening of legal stakes; an individual scientist who holds a particular normative view as a citizen, as many do, may be less willing to engage in self-critical research where the results of such research present a greater danger of being used to support a permanent decision with which that individual disagrees.¹³⁷

An approach of deferring to legislative decisions in areas where the scientific or medical bases of such decisions are uncertain allows scientists to conduct further independent research, including self-critical research, into areas in which they or their sponsors may have normative considerations without at least the fear that additional findings would create permanent legal problems for legislative efforts, research that may be useful for the future refinement of legisla-

134 See generally Krinsky, *supra* note 36 (discussing how academic funding structure and financial conflicts of interest influence the results of scientific research).

135 See Devins, *supra* note 100, at 1180 (pointing out that “Congress is not constrained by *stare decisis*. . . [because it] can correct its mistakes in ways that the Court cannot”). But see *id.* at 1184–85 (recognizing that legislative inertia may mean that legislatures do not revisit issues as often as theoretically possible).

136 See Justin E. Bekelman et al., *Scope and Impact of Financial Conflicts of Interest in Biomedical Research: A Systematic Review*, 289 J. AM. MED. ASS’N 454, 463 (2003) (describing researchers’ feelings of inability to fully negotiate with their sponsors regarding publication rights and confidentiality); Jacqueline Fox, *Reinvigorating the Concept of Benefit: The Failure of Drug Company-Sponsored Research on Human Subjects*, 38 SETON HALL L. REV. 605, 635–36 (2008) (describing the degree to which at least pharmaceutical sponsors exert control over their funded researchers); see also Krinsky, *supra* note 36, at 48–49 (describing one such example involving a pharmacologist at University of California San Francisco researching the effectiveness of various pharmaceutical drugs in treating hyperthyroidism).

137 Cf. Krinsky, *supra* note 36, at 52 (explaining that “the self-correcting function of science . . . serves as a balancing force” against the individual biases of scientists).

tive and administrative efforts in these areas. By expressly deferring to policy choices made through legislative investigation, the Court, in recognition of its own lesser capacity to assess the scientific information available and determine its weight as justification for a given policy, provides assurance that contrary information developed through such a process would not undermine whatever legislative option is eventually chosen,¹³⁸ leaving the door open for further research in the area to continue to shape legislative options.¹³⁹

This is not to argue that scientific and medical issues are entirely unsuitable for judicial evaluation. As a number of scholars have pointed out, legislatures may be weaker at fully evaluating scientific uncertainties than often assumed.¹⁴⁰ And entirely foregoing such determinations may mean that “serious social problems involving dispersed interests are excluded from the judicial process even though these problems are handled very badly elsewhere.”¹⁴¹ Thus, a court’s inquiry into whether a legislative decision deserves deference could be aided by at least some consideration of whether dispersed interests have been excluded from the judicial process, and, indeed, whether such exclusion has led to the sorts of biases discussed earlier in terms of the scientific information that has been brought before the legislature, or even been developed.¹⁴²

The nature of the scientific uncertainties involved with a given legislative problem, described earlier in this Article,¹⁴³ could also play a role in determining whether a legislative decision deserves deference. Not every situation will present equal dangers that judicial decisions regarding science will be undermined by subsequent developments in scientific research. Parameter uncertainties may be more amenable to characterization through an examination of the existing state of measurement methods and technologies. Model uncertainty, however, may involve deeper uncertainties regarding the scientific understandings of the processes themselves, and thus be more susceptible to being reconsidered in future scientific research. And va-

138 See Devins, *supra* note 100, at 1180 (“Congress’s legitimacy is not at all tied to whether it stands above the hurly burly of politics by adhering to precedent.”).

139 See Rebecca S. Dresser et al., *Breast Implants Revisited: Beyond Science on Trial*, 1997 WIS. L. REV. 705, 772 (“While litigation is not a good way to produce good science, scientific studies are sometimes conducted, as in the DNA cases, in response to litigation, and the breast implant controversy appears to be no exception.” (footnote omitted)).

140 See discussion *supra* Part III.A.1.

141 KOMESAR, *supra* note 11, at 148.

142 See discussion *supra* Part II.B.

143 See discussion *supra* Part II.A.

riability uncertainties and decision uncertainties may never be fully resolved by developing science because they involve either inherent variabilities in the system being studied or normative choices that must be made in the course of research.¹⁴⁴ Courts should pay attention, therefore, to advances in decisionmaking in the context of scientific uncertainties to better assess judicial capacities to evaluate science in a given situation of uncertainty, as well as the likelihood that a judicial decision will be undermined by developing research.

The Court could avoid, for example, creating potentially obsolete scientific precedent by observing, in its decision, that its holding merely reflects its understanding of the existing state of the science, thereby preventing future courts from being forced to treat such determinations as precedential in those future cases, should the weight of developing scientific information undermine the earlier determination.¹⁴⁵ Such suggestions for reforming the substantive judicial treatment of science are beyond the scope of this paper, as the relevant capacities of courts and legislatures in assessing the science may differ, depending on the complexity of the science and the distribution and stakes of the interests involved.¹⁴⁶ Instead, my more limited suggestion is that the presence of such concerns may mean that those who are proponents of a less adversarial development of science may welcome a deferential approach towards legislative decisions where the medical or scientific bases for those decisions are uncertain.

2. *Obscurity on Institutional Approach Towards Evaluating and Applying Scientific Uncertainties*

The debate over whether courts or legislatures are better suited to make choices in the face of scientific and medical uncertainty obscures a deeper problem with the Supreme Court's approach in *Carhart II*: how to determine whether scientific uncertainties rise to a level warranting deference to legislative choices. The question of

144 A disclosure: I am currently a member of a National Academies Institute of Medicine panel advising the Environmental Protection Agency on environmental decision-making under uncertainty. Because the final report has not been issued, I am not at liberty to write about our deliberations. Moreover, the positions taken in this Article do not represent the view of the panel or of the Institute of Medicine.

145 See Onstott, *supra* note 119, at 485 ("A judge deeming a scientific principle to be reliable and relevant that later proves not to be will be less damning than a judge conclusively accepting a principle as unquestionable when that principle later becomes questionable or even manifestly unreliable.").

146 See KOMESAR, *supra* note 11, at 148 (noting the problems that may arise from prohibiting the judiciary to be make decisions in certain areas).

which institution is more appropriate for determining whether scientific uncertainties should allow or even require legislative action is not fully resolved by the Court. Instead, the Court introduced more mud into the waters. On one hand, the Court upheld the congressional decision to prohibit the use of D & X without engaging in its own inquiry into the validity of Congress's justification for finding that D & X is never medically necessary,¹⁴⁷ suggesting that it possessed less capacity than Congress to do so. On the other hand, the Court did not hold back from determining that Congress erred in finding that a scientific consensus existed as to the necessity of the D & X method,¹⁴⁸ suggesting that the Court believed it had adequate capacity to make a determination regarding whether such consensus existed. Such contradiction is not present in the cases upon which the Court relied, given that the legislatures in those instances had not spoken to the certainty of the scientific and medical bases for their actions; instead, they had either discussed the uncertainty of the scientific and medical bases, or failed to address the status of the science entirely. The Court's failure to provide guidance either on how to determine or what institution should get to determine whether scientific uncertainties exist, such that legislative deference is warranted, creates three major concerns: that the accountability of public decisionmaking will be eroded; that courts will be able to reach ends-oriented decisions under the guise of determining whether uncertainty exists; and that the open progress of scientific research will be compromised.

First, from the standpoint of open political debate, this ambiguity over the comparative capacities of judicial and legislative institutions to assess the existence of uncertainty is troublesome. It allows a legislature to frame its decision as somehow based upon science, rather than as a political choice taken in the face of scientific uncertainty—the purported rationale for providing deference in the first place—and still receive deference for taking action in the face of such uncertainty.

As Professor Wendy Wagner observed in her very thorough study of the “science charade” in toxic risk regulation, overreliance on scientific rationales can be detrimental to accountable public decisionmaking.¹⁴⁹ Although the focus of her study was on overreliance on

¹⁴⁷ *Carhart II*, 127 S. Ct. 1610, 1637 (2007).

¹⁴⁸ *Id.* at 1635–36.

¹⁴⁹ *See* Wagner, *supra* note 29, at 1673–88 (1995) (arguing that overreliance on scientific rationales by agencies in setting standards, in order to avoid accountability for the underlying

scientific rationales by federal agencies, a number of her observations are instructive even in the context of legislative decisionmaking. In particular, she points to concerns such as the creation of barriers to democratic participation,¹⁵⁰ as well as adverse impacts on scientific development and legitimacy.¹⁵¹ When science is invoked as the driver for government decisions, members of the public are less able to take part in the dialogue needed to reveal their values.¹⁵² Nevertheless, such input on values may be necessary to provide context for a legislative choice, especially where the science is incomplete or uncertain, because in such instances values must be used to either fill in uncertainties in the data, measurements, or models, or even to better clarify value uncertainties.¹⁵³ And, somewhat ironically perhaps, overreliance on purported “certainties” in science may erode the legitimacy of science by providing incentives for a legislature to frame its debate as one of “purely” scientific disagreement, rather than a disagreement over values. Proponents and opponents of a given action will thus have more incentives to both provide and fund adversarial science, leading to the perception that science is always contradictory and cannot aid in resolving these difficult social issues.¹⁵⁴

Similarly, by claiming that “certain” science dictates a particular legislative action, legislatures are able to avoid the difficult but inherent policy debates involved in legislative choices. As the Supreme Court observed in *Carhart II*, medical certainty that the D & X procedure was never necessary for the health of pregnant women did not exist.¹⁵⁵ Yet, Congress was able to frame a large part of its debate over the legislation as a “neutral” one regarding the nature of the scientific evaluation of the concern, rather than acknowledging that it was

ing policies, can result in distancing the public from major decisions affecting public health and economic well-being).

150 *See id.* at 1674–77.

151 *See id.* at 1685–88.

152 *See* Wagner, *supra* note 92, at 228 (“Research reveals that people are more inclined to participate in decisionmaking when they are both interested in the issue and feel that they can contribute meaningfully to the decision. If the questions ripe for public debate are perceived to be scientific or technical in nature, laypersons may not know how or where policy input is needed.” (footnote omitted)); *cf.* Wagner, *supra* note 29, at 1674 (“Mischaracterization of the entire standard-setting endeavor as resolvable by science results in significant obstacles to democratic participation.”).

153 *See* Wagner, *supra* note 29, at 1674 (“Although some have questioned the benefit or cost-effectiveness of any public involvement in science-policy issues, most commentators conclude that the wide range of public values implicated in these complex problems can and must be ascertained only with the general public’s assistance.” (footnote omitted)).

154 *See id.* at 1688.

155 127 S. Ct. 1610, 1636 (2007).

making a political choice of restricting the D & X procedure given the medical uncertainties of its necessity.¹⁵⁶ Allowing the legislative discourse to focus on the realm of science¹⁵⁷ may have the effect of either misleading the public about the uncertainties involved with the medical information before the legislature, or undermining confidence in the science, as members of the lay public who disagree with the legislative action become skeptical of its purported scientific basis. Ultimately, the danger of providing deference to a legislative decision purported to be based on scientific “certainty” but judicially determined to be warranted because of scientific uncertainty is one of transparency: If a legislative decision is shaped by normative rationales, then the public should be made aware of them, rather than having those rationales obscured by invocations of scientific certainty.

Second, the prevalence of uncertainty with regard to most scientific questions suggests that the Court may retain a significant amount of unstated leeway in determining whether to uphold or overturn a statute, subsumed under a less visible but more unconstrained inquiry into whether scientific uncertainty exists such that deference to the legislature is warranted.¹⁵⁸ This is because, under the Court’s opinion, the determination of whether uncertainty exists is critical in deciding whether to uphold a statute if a challenger argues that the basis of the legislative decision is undermined by contrary science. The broad latitude that the Court has given to the legislature in choosing options when scientific and medical uncertainties exist suggests that a legislature’s options would be curtailed were the science both certain and pointing towards a conclusion other than that relied upon by the legislature. Thus, under *Carhart II*, a challenge to a statute in which a legislature purports to deal with public health and environmental risks will require a court to engage in the determination

156 18 U.S.C. § 1531 notes (2006).

157 As Professor Wagner points out, public choice theory suggests that legislators have incentives to describe their decisions as based upon science: “Rather than debating competing values, lawmakers can defer (in theory) to the objective research of scientists to resolve thorny environmental controversies.” Wagner, *supra* note 92, at 234–35.

158 Cf. Andrew Green, *Climate Change, Regulatory Policy and the WTO: How Constraining Are Trade Rules?*, 8 J. INT’L ECON. L. 143, 167 (2005) (criticizing a similar sort of unstated judicial discretion in the General Agreement on Tariffs and Trade context, stating that “[t]he significance of scientific uncertainty or degree of deference to domestic regulators will . . . be left to a largely non-transparent exercise of discretion by the individual Panel”); *id.* at 187–88 (noting that the World Trade Organization rules impose scientific evidence requirements in certain areas that allow the Appellate Body to grant little deference to nations’ decisions); Walker, *supra* note 2, at 228 (describing how tribunal decisions inherently involve determinations about the degree of uncertainty that is normatively acceptable).

of whether the science is certain or uncertain. But uncertainty is pervasive to science, to some extent, especially in areas involving health and environmental risks.¹⁵⁹ Failure to articulate a principled method for determining whether scientific and medical uncertainties warrant legislative discretion, therefore, would allow a court with a normative bias to either “find” certainty when it wants to uphold a legislative action, or “find” certain science supportive of a contrary decision when it wants to overturn that action.¹⁶⁰

Such potential effects of judicial bias have already been observed in the context of courts’ application of the inquiry under *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*¹⁶¹ for determining whether a federal agency interpretation of a congressional directive warrants deference.¹⁶² The *Chevron* test, outlined by the Supreme Court, is divided into two steps: first, an inquiry into whether the “intent of Congress is clear”;¹⁶³ and if not, whether the agency interpretation is based upon a “permissible construction of the statute.”¹⁶⁴ Thus, the *Chevron* approach presents some similarities to the scientific uncertainty approach in *Carhart II*, where a court must first determine whether the science is certain, and, if not, deference towards the legislative choice is warranted (unless that decision were found to be irrational).¹⁶⁵

Scholars have observed, however, that this seemingly principled test still allows for some degree of political decisionmaking to be subsumed under the two-part test. As various scholars have found through extensive empirical studies, judicial ideology appears to have an impact on courts’ decisions to defer to agency interpretations under *Chevron*.¹⁶⁶ Nor is the application of the *Chevron* test consistently

159 See discussion *supra* Part II.A.

160 Cf. Wagner, *supra* note 92, at 284–85 (describing concerns with “courts’ demonstrated political biases in applying what should be objective procedural rules in reviewing agency rulemakings,” concerns that could also be applied to biases in determining the existence of uncertainty warranting legislative deference).

161 467 U.S. 837 (1984).

162 *Id.* at 842–43 (describing the two-step inquiry into determining whether an agency interpretation of a statutory mandate warrants judicial deference).

163 *Id.* at 842.

164 *Id.* at 843.

165 *Carhart II*, 127 S. Ct. 1610, 1636–38 (2007).

166 See, e.g., Jason J. Czarnecki, *An Empirical Investigation of Judicial Decisionmaking, Statutory Interpretation, and the Chevron Doctrine in Environmental Law*, 79 U. COLO. L. REV. 767, 770 (2008) (finding that judicial ideologies, as keyed to presidential appointments, seem to have an effect on *Chevron* decisions in the environmental context); Thomas J. Miles & Cass R. Sunstein, *Do Judges Make Regulatory Policy? An Empirical Investigation of Chevron*, 73 U. CHI. L. REV. 823, 825–26 (2006) (finding that as a general matter, decisions in *Chevron*

applied; as scholars suggest, the Supreme Court often fails to even reference the inquiry in situations when the issue involved in the case would seem to present a *Chevron* determination of whether to defer to an agency interpretation of a statute.¹⁶⁷

Judicial bias may have an even greater effect in the context of legislative deference based on a finding of scientific uncertainty than in the context of *Chevron*. While long-developed principles of statutory interpretation are available to courts for evaluating whether legislative clarity exists such that deference to agency interpretations is curtailed,¹⁶⁸ these tools are less available in the context of evaluating scientific uncertainty. Moreover, while judges are trained in tools of text and language such as rhetoric and metaphor,¹⁶⁹ they are often less trained in evaluating science, much less its limits and uncertain-

cases correlate with judicial ideologies). *But see* Orin S. Kerr, *Shedding Light on Chevron: An Empirical Study of the Chevron Doctrine in the U.S. Courts of Appeals*, 15 YALE J. ON REG. 1, 48–52, 59–60 (1998) (finding much support for the political model of judicial decision-making under *Chevron*, but little evidence that the likelihood that political factors shape deference to agency decisions “is greater than that fostered under the doctrinal regime that *Chevron* replaced”).

167 See William N. Eskridge, Jr. & Lauren E. Baer, *The Continuum of Deference: Supreme Court Treatment of Agency Statutory Interpretations from Chevron to Hamdan*, 96 GEO. L.J. 1083, 1089–90 (2008) (finding that in only 8.3% of cases evaluating agency statutory interpretations before the Supreme Court from the time *Chevron* came down through the 2005 term did the Court apply the *Chevron* analysis); Thomas W. Merrill, *Judicial Deference to Executive Precedent*, 101 YALE L.J. 969, 970, 980 (1992) (stating that “the *Chevron* framework is used in only about half the cases that the Court perceives as presenting a deference question” and “has not produced anything like a complete revolution in the Court’s jurisprudence”).

168 See *Chevron U.S.A. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 843 n.9 (1984) (“If a court, employing traditional tools of statutory construction, ascertains that Congress had an intention on the precise question at issue, that intention is the law and must be given effect.”). Whether such tools of statutory interpretation necessarily provide more principled results, however, is a matter of debate. As Professor Czarnecki points out, “depending on what a judge considers to be legitimate ‘traditional tools of statutory interpretation,’ he or she may reach a different conclusion under *Chevron*.” Czarnecki, *supra* note 165, at 773–74 (footnote omitted).

169 See Francis J. Mootz III, *Vico’s “Ingenious Method” and Legal Education*, 83 CHI.-KENT L. REV. 1261, 1293 (2008) (“When lawyers argue and judges reason about matters that require deliberation rather than demonstration, the *result* of these activities is properly termed ‘rhetorical knowledge.’ The common law tradition—developed over centuries by a casuistic practice premised on analogic reasoning by means of metaphor and other rhetorical tropes—is properly considered a body of knowledge, even though it cannot generate uniquely correct results in given cases by means of deduction.”); *cf.* Lin, *supra* note 40, at 1467 (“In contrast, judges and juries tend to be generalists, who lack the scientific competence to critically assess expert testimony.” (citing Peter S. Menell, *The Limitations of Legal Institutions for Addressing Environmental Risks*, 5 J. ECON. PERSP. 93, 100 (1991))).

ties.¹⁷⁰ Indeed, future empirical studies that I am undertaking may be useful for assessing the extent that judicial ideologies affect determinations regarding the uncertainty or certainty of science. But at least an initial review of the issue suggests that in the context of determining whether the existence of scientific uncertainties warrants judicial deference, judges have even fewer traditional constraints on their ability to reach ends-oriented judgments.

Indeed, the *Carhart II* majority fails to discuss how it and future courts are to determine whether certainty exists such that legislative options are curtailed. Instead, its only guidance on the matter is to inquire into whether the overall legislative choice is “rational,”¹⁷¹ which in and of itself sets no standards for any legal determinations regarding the existence of uncertainty. Rather, any inquiry into the existence of uncertainty seems centered on the existence of scientific consensus on a particular determination as a placeholder for an inquiry into the types of scientific uncertainty described earlier. Such a surrogate inquiry may be necessary, because courts are generally composed of judges who, as lay people, must evaluate science from the outside, albeit with their own expertise in recognizing “conflicting claims, elitist assumptions, unjustified certainty, and a lack of reflexivity or self-awareness on the part of experts.”¹⁷² The lack of any coherent standard, however, leaves considerable room for a court that desires to act in an ends-oriented fashion to use a determination of the existence of certainty, or uncertainty, to compel a decision to uphold, or reverse, a decision. The availability of ends-oriented determinations regarding uncertainty may even ultimately leech into the development of scientific research by creating incentives to characterize scientific issues as “certain” or “uncertain,” depending upon whether the probable policy contemplated by a legislature is preferred or not. Such an incentive may color scientific discussions of knowledge uncertainties, thereby reducing the level of self-criticality

170 See Onstott, *supra* note 119, at 484 (describing science as “specialized knowledge . . . often outside of the realm of judicial experience”).

171 *Carhart II*, 127 S. Ct. 1610, 1638 (2007); *Marshall v. United States*, 414 U.S. 417, 422 (1974).

172 David S. Caudill, *Ibsen’s An Enemy of the People and the Public Understanding of Science in Law*, 16 GEO. INT’L ENVTL. L. REV. 1, 19 (2003). For a somewhat less generous approach towards the capacity of judges, as lay people, to evaluate science, see Stephen Breyer, *Introduction to FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE* 1, 4 (2d ed. 2000) (“[M]ost judges lack the scientific training that might facilitate the evaluation of scientific claims or the evaluation of expert witnesses who make such claims.”).

involved with a study.¹⁷³ And it could lead to even less open discourse about the limits of science, misleading the public into continuing to make unrealistic demands on science to resolve various policy issues.¹⁷⁴

A number of comprehensive studies of the Supreme Court's use of empirical evidence in general provide even more cause for concern. As scholars such as Professors David Faigman, Dean Hashimoto, and Timothy Zick have found, the Supreme Court's decision to apply empirical tests is often inconsistent, incomplete, and possibly ideologically driven.¹⁷⁵ Professor Faigman, for example, points out that "even a cursory inspection of the Court's constitutional cases demonstrates an uneven use of empirical research."¹⁷⁶ The Supreme Court has, for example, rejected empirical data as having little constitutional import without providing any explanation regarding why they lack empirical import or elaborating on what facts would have such import.¹⁷⁷ The Supreme Court has also called for the development of empirical studies in earlier cases but failed to apply those studies in later cases after those studies have arisen.¹⁷⁸

Professor Faigman uses this inconsistent history to ultimately argue that the Supreme Court should apply empirical information more consistently in order to provide a welcome constraint on its de-

173 See Katie Steele, *The Precautionary Principle: A New Approach to Public Decision-Making?*, 5 LAW, PROBABILITY & RISK 19, 23 (2006) (arguing that a transparent discussion of uncertainties "promotes a self-critical attitude among scientists, in terms of the judgments and practices that are incorporated in their work").

174 Cf. Wagner, *supra* note 29, at 1652–53 ("[T]he public appears to demand almost absolute safety from toxic risks, a demand which can be attributed at least in part to a series of biases that plague the lay person's perception of risk and are exacerbated by serious deficiencies in the scientific education of the general public." (footnotes omitted)).

175 See generally David L. Faigman, "Normative Constitutional Fact-Finding": *Exploring the Empirical Component of Constitutional Interpretation*, 139 U. PA. L. REV. 541 (1991) (examining how the Supreme Court's reliance on empiricism restrains constitutional decisionmaking); Dean M. Hashimoto, *Science as Mythology in Constitutional Law*, 76 OR. L. REV. 111 (1997) (arguing that the Court's reliance on empiricism serves primarily as a means of a persuasion, not as a significant means of interpretation); Timothy Zick, *Constitutional Empiricism: Quasi-Neutral Principles and Constitutional Truths*, 82 N.C. L. REV. 115 (2003) (arguing that the Court's reliance on empiricism in determining constitutional issues does not provide neutrality in interpretation).

176 Faigman, *supra* note 175, at 549.

177 See *id.* at 581–88 (citing, as examples, *Barefoot v. Estelle*, 463 U.S. 880 (1983) (involving a challenge to a death sentence conviction based on disputed psychiatric testimony), and *Parham v. J.R.*, 442 U.S. 584 (1979) (involving a due process challenge to the "voluntary commitment" of a child to a state mental hospital)).

178 See *id.* at 588–93 (pointing to a number of criminal cases where the Court has suggested that empirical research could cause it to revisit its decision, but failed to do so).

cisionmaking.¹⁷⁹ But Professors Hashimoto and Zick go further to suggest that the incoherent use of empirical information by courts, which they also both observe,¹⁸⁰ may mean that the Court invokes science either entirely for rhetorical purposes,¹⁸¹ or to draw attention away from a subtle return to legal formalism.¹⁸²

While this Article does not attempt to fully resolve this longstanding debate over whether the Supreme Court is able to apply, should apply, or should even purport to apply empirical studies to constitutional claims,¹⁸³ these observations about the Court's uneven history of applying empirical studies suggests that an open-ended evaluation of the existence of scientific or medical uncertainty, such as that of *Carhart II*, presents an even greater challenge to interpretive consistency. Uncertainty, as a concept, is even further from the Court's terrain of familiarity than scientific discourse.¹⁸⁴ And while the Court could make use of a deeper understanding of the differing natures of scientific uncertainties, examining, for example, whether the pervasiveness of parameter uncertainties means that future research could resolve an issue, or whether the pervasiveness of value uncertainty means that such issues can never be fully resolved without making a normative judgment at some point in the research process,¹⁸⁵ there is little evidence that the Court actually engages in this sort of inquiry. As such, the context of scientific uncertainties entails an even greater risk that such inquiries will be both engaged in and applied inconsistently.

Finally, the failure of the majority opinion of *Carhart II* to articulate any standard for determining whether the existence of scientific uncertainties warrants legislative deference is troublesome for the development and discussion of scientific research. Especially in areas such as these, where a legislature has made a finding of certainty, yet a court upholds a legislative choice premised on its own finding that

179 *See id.* at 605–13.

180 *See* Hashimoto, *supra* note 175, at 128–31; Zick, *supra* note 175, at 145–79.

181 *See* Hashimoto, *supra* note 175, at 152–53.

182 *See* Zick, *supra* note 175, at 195–202.

183 Instead, in the context of evaluating whether legislatures should receive deference in the face of scientific and medical uncertainties, I observe both strengths and weaknesses in allowing courts to make scientific inquiries. *See* discussion *supra* Part III.A.1.

184 *See* Wagner, *supra* note 92, at 193 (“[D]etermining the nature and importance of . . . various knowledge gaps is an unusually esoteric inquiry, which often depends on an expert consensus that is unwritten or even unspoken. Developing policy on the basis of these mixed, science policy issues presents a great challenge to lay decisionmaking.” (footnote omitted)).

185 *See* discussion *supra* Part II.A.

the science is uncertain, researchers are left unable to predict whether an open discussion of the uncertainties involved with their research would have any legal impact on policy chosen to address that problem.¹⁸⁶ Instead, researchers might frame their discussion of the uncertainties involved in their research in ways supportive of the policy choice they prefer, a danger that already exists in the legislative context,¹⁸⁷ but strengthened under the *Carhart II* approach. While this might not ultimately deter researchers from tackling particular problems, it creates a cloud that could have been avoided through a more detailed articulation of the Court's approach to uncertainty.

This ambiguity over the appropriate institution to determine whether uncertainty warrants legislative deference was not dictated by the case law. Instead, it may have arisen from the Court's failure to differentiate between cases where legislatures invoked science for the purposes of justification, and cases where they used science for purposes of ontological shaping. In challenges arising in the ontological shaping context, the Court has extended an even greater deference towards the legislative policy choice than the "wide discretion" approach taken in *Carhart II*. It is likely that the Court's somewhat contradictory approach towards its capacity to weigh and assess uncertainty stems from its homogeneous incorporation of ontological shaping cases alongside cases where science is used as justification.

For example, in *Collins v. Texas*,¹⁸⁸ also cited by the *Carhart II* majority, the Court dealt with a challenge to the application of a legislative definition of medical practice. Ira Collins, an osteopath, had been convicted of practicing medicine without a license under a statute which stated that "any person [who] shall be regarded as practicing medicine within the meaning of this act . . . [o]r [those] 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."¹⁸⁹ Collins argued, however, that despite the

186 Cf. Wagner, *supra* note 29, at 1687 ("A less obvious but nevertheless important consequence of the agencies' science charade is the failure to provide proper direction or incentives for scientific research. . . . Although in some cases the uncertainties can only be resolved with policy choices because of the current limitations of scientific knowledge, in other cases uncertainties may be capable of being resolved by scientific studies.")

187 See Wagner, *supra* note 92, at 238–45 (arguing that scientists already face a number of disincentives for being open about the limits of their research).

188 223 U.S. 288 (1912).

189 *Id.* at 295.

statute's inclusion of all those who treat diseases for compensation, he should have been under no obligation to obtain a medical license on the grounds that he did not administer drugs as a medical practitioner would.¹⁹⁰ The Court, however, affirmed his conviction, stating that because osteopaths purport to treat medical ailments "by scientific manipulation affecting the nerve centres[, i]t is intelligible therefore that the State should require of him a scientific training."¹⁹¹ Furthermore, the state had the right to adopt such a policy even if the definitions were in dispute, and even if the definition were "arbitrary or irrational," because the statute's "only object is to explain who fall [sic] within the purview of the act."¹⁹²

The Court took a similar approach in *Kansas v. Hendricks*,¹⁹³ where the Court addressed the inclusion of "any person who has been convicted of or charged with a sexually violent offense and who suffers from a mental abnormality or personality disorder which makes the person likely to engage in the predatory acts of sexual violence" within the Kansas civil commitment statute.¹⁹⁴ Among other arguments, including constitutional due process arguments, Leroy Hendricks claimed that "'mental abnormality' is *not* equivalent to 'mental illness'"—with "mental illness" being allowable for civil commitment under the Court's case law—given the lack of meaning that "mental abnormality" has within the psychiatric community.¹⁹⁵ The Court rejected this argument, explaining that it has "traditionally left to legislators the task of defining terms of a medical nature that have legal significance."¹⁹⁶

Hendricks thus more expressly addressed the distinction suggested in *Collins*: that when it comes to ontological shaping, legislatures have considerably greater leeway in choosing definitions for their legal categories, even when the legal categories differ from the scientific and medical categories they resemble. This greater deference to legislative options is warranted in the ontological context because these legal categories are intended to operate in a different sphere from the science;¹⁹⁷ scientific accuracy—much less scientific cer-

190 *Id.* at 296.

191 *Id.*

192 *Id.*

193 521 U.S. 346 (1997).

194 *Id.* at 351–52 (quoting KAN. STAT. ANN. § 59-29a02(a) (1994)).

195 *Id.* at 358–59.

196 *Id.* at 359.

197 *Cf.* *United States v. Fifty-Three Eclectus Parrots*, 685 F.2d 1131, 1137 (9th Cir. 1982) (upholding use of statutory definition of "wild" as creatures "normally found in a wild state"

tainty—is less necessary because the scientific determinations are not as significant a part of the “rational basis” of the statute. Moreover, additional scientific research would add little, as the Court has recognized that in such instances the legislature can rationally engage in the act of creating its own definitions, rather than in relying upon science to support its actions.

In the justificational context, however, where the legislature *is* purporting to rely upon the science in creating its statutes, scientific uncertainty—and the extent of that uncertainty—would seem to make a difference in the rationality of the legislature’s choice of policy options. But while the Court in *Carhart II* reached an appropriate balance by allowing legislatures latitude to choose options where the science is uncertain, it also gave deference to the legislative choice. Such deference, where the Court found that the legislature erroneously found certainty in the science supporting its actions, and where the Court itself acknowledged its own capacity to evaluate the state of the certainty by actually doing so,¹⁹⁸ is incoherent without further elaboration on how courts are to determine whether such certainty exists. What the Court should do, therefore, is outline a more principled way for future courts to determine whether the presence of scientific uncertainties warrants deference to the policy choices of a legislature.

B. Approaches Towards Regulatory Findings: Substantive and Process-Based Approaches Towards Science

As this Article has argued, while some support exists for the Supreme Court’s decision in *Carhart II* to defer to the legislature when it takes action in the face of scientific and medical uncertainties,¹⁹⁹ the Court’s failure to clarify how future courts are to determine whether the presence of uncertainties warrant this legislative deference raises concerns for accountability in public decisionmaking, consistency in judicial decisions, and transparent progress of scientific research.²⁰⁰ So how can courts develop ways to address uncertainties (and certainties) in the legislative context? To develop a fuller answer to this question, the Court could draw from its own approaches in reviewing

despite evidence presented that the particular parrots at issue could have been domesticated, thereby presenting an example of the permissibility of divergence between statutory, but ontologically-shaped, definitions and those purported to reflect scientific use).

198 *Carhart II*, 127 S. Ct. 1610, 1636 (2007).

199 See discussion *supra* Part III.A.1.

200 See discussion *supra* Part III.A.1.

agency decisions where the science used to support the agency's choice was arguably uncertain. The Supreme Court has approached such questions more along the substantive and explicative lines described earlier by engaging in further substantive or procedural inquiry into the agency's decision.

1. Constitutional Avoidance and Other Substantive Considerations

The Court's treatment of potential uncertainties—both scientific and other factual uncertainties—in the Commerce Clause context illustrates a substantive approach towards the treatment of scientific uncertainty. Although such challenges often involve scientific and medical uncertainties regarding the connection between an agency's action and interstate commerce, the Court does not take the *Carhart II* approach of generally deferring to an institution's choice of options in the face of such uncertainties. Rather, the Court has resolved such challenges by focusing on substantive constitutional concerns raised by the agency decisions, rather than looking to the weight of the science itself or the capacities of institutions in making the certainty determination at issue.

In two decisions—*Rapanos v. United States*²⁰¹ and *Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers* (“SWANCC”)²⁰²—the Court, among other things, applied a statutory canon of interpretation to the decisions of the U.S. Army Corps of Engineers to exercise jurisdiction over wetlands under the Clean Water Act. Although scientific information was provided by both parties regarding the hydrological connection (or lack thereof) between those wetlands and both “waters of the United States”—the language of the Clean Water Act²⁰³—and to interstate commerce, the Court's plurality in *Rapanos* and majority in *SWANCC* focused on a statutory canon as its primary guide.²⁰⁴ As the Court in *SWANCC* explained, applying the Corps' regulations would raise serious questions of Congress's authority under the Commerce Clause in light of the states'

201 547 U.S. 715 (2006).

202 531 U.S. 159 (2001).

203 33 U.S.C. § 1362(7) (2000) (defining “navigable waters” as “the waters of the United States, including the territorial seas”); *see also* 33 U.S.C. § 1311(a) (2000) (prohibiting the discharge of pollutants in general); 33 U.S.C. § 1342(a) (2000) (authorizing the Corps to “issue a permit for the discharge of any pollutant, . . . notwithstanding section 1311(a) of this title”); 33 U.S.C. § 1362(12) (2000) (defining discharge as including “any addition of any pollutant to navigable waters from any point source”).

204 *See Rapanos*, 547 U.S. at 737–38; *SWANCC*, 531 U.S. at 174.

traditional power over land-use regulation.²⁰⁵ The Court suggested that it found the regulation constitutionally troublesome, although the dissent pointed to the existence of scientific evidence attesting to the connection between regulation of the types of wetlands at issue and migratory birds.²⁰⁶ Similarly, in *Rapanos*, the plurality found that substantive concerns over Congress's infringement of traditional state powers weighed against deferring to the U.S. Army Corps' decisions to apply the Clean Water Act to permit requirements to wetlands intermittently connected to navigable waters.²⁰⁷ Under these decisions, the statutes should not be interpreted as "result[ing] in a significant impingement of the States' traditional and primary power over land and water use"²⁰⁸ unless Congress had provided a "clear and manifest" statement to authorize such an intrusion.²⁰⁹ This is in contrast to *Carhart II*, where uncertainty in the medical and health context was held to require deference to legislative choice of options, despite constitutional considerations about the health of pregnant women.

In other Commerce Clause cases, too, the Court has resolved legal challenges using substantive considerations despite what seem to be contravening natural and social science evidence—that is, uncertainty, at least in the manner that courts use the term—about the connection between the regulated activity and interstate commerce. For example, in *United States v. Lopez*,²¹⁰ the Court overturned Congress's attempt to protect the health of children in schools through the Gun-Free School Zones Act of 1990, which forbade "any individual knowingly to possess a firearm . . . at a place that [he] knows, or has reasonable cause to believe, is a school zone."²¹¹ Although the empirical information was arguably "uncertain," and although Congress was purporting to address a health risk, the Court nevertheless rejected Congress's choice of options when confronted with a constitutional challenge. As Justice Breyer pointed out in his dissent, "reports, hearings, and other readily available literature" attested to both the "widespread and extremely serious" nature of the "problem of guns in and around schools"²¹² and to the "the link between secon-

205 531 U.S. at 174.

206 *Id.* at 194 (Stevens, J., dissenting).

207 547 U.S. at 737–38.

208 *SWANCC*, 531 U.S. at 174.

209 *Rapanos*, 547 U.S. at 738.

210 514 U.S. 549 (1995).

211 18 U.S.C. § 922(q)(2)(A) (2000).

212 *Lopez*, 514 U.S. at 619 (Breyer, J., dissenting).

dary education and business.”²¹³ But rather than giving any weight to such social science information and deferring to Congress’s attempt to address economic safety concerns in the presence of such uncertainties, the Court determined that “[t]he possession of a gun in a local school zone is in no sense an economic activity that might, through repetition elsewhere, substantially affect any sort of interstate commerce.”²¹⁴

Some might regard the differences between the approach taken in the Commerce Clause cases and that taken in *Carhart II* as misleading. After all, in neither the Clean Water Act nor the Gun-Free School Zones Act did Congress point towards the “certainty” of the science in support of its decisions, as Congress did in the Partial Birth Abortion Act. Indeed, much of the social science evidence provided to the Court in *Lopez* through the parties and amici in support of the Gun-Free School Zones Act was never before Congress originally.²¹⁵ Yet the same could be said about the lack of consideration that the state gave to the nature of alcohol addiction as a disease in the statute addressed in *Powell*²¹⁶ and the dangers of compulsory vaccination in the statute addressed in *Jacobson*.²¹⁷ Moreover, the deference given in *Carhart II* stemmed from the Court’s own independent determination that medical uncertainty existed regarding the nature of the health risks at issue such that the legislative option warranted deference—a determination that seems available with respect to both wetlands and their connection with waters of the United States, and handguns and their connection with adverse economic effects as well. This underscores how a decision to overturn or uphold an attempt to address risks to public health and the environment could be subsumed in an inconsistent and under-theorized judicial approach to determining whether or not scientific certainty exists.

Indeed, some of these tensions were acknowledged by Justice Thomas in *Carhart II*. As he explained in his concurrence, his decision to join the majority in *Carhart II* was premised on his belief that the Court’s current abortion jurisprudence has no basis in the Constitution, rather than because he believed that Congress’s choice of

213 *Id.* at 620.

214 *Id.* at 567.

215 *See id.* at 563 (“But to the extent that congressional findings would enable us to evaluate the legislative judgment that the activity in question substantially affected interstate commerce, even though no such substantial effect was visible to the naked eye, they are lacking here.”).

216 *See* 392 U.S. 514, 517 (1968).

217 *See* 197 U.S. 11, 21–22 (1905).

action warranted some sort of deference.²¹⁸ He also stated, however, that his concurrence was not to be taken as support for Congress's authority to regulate D & X under the Commerce Clause.²¹⁹ This statement emphasizes some of the tensions raised by the *Carhart II* majority opinion with the Commerce Clause jurisprudence described above.

More similar to the *Carhart II* approach is Justice Kennedy's concurrence in *Rapanos*, which, as the narrowest common ground in the opinion, some regard as the holding of *Rapanos*.²²⁰ It is similar to *Carhart II* in the sense that Justice Kennedy suggests that, given the different sorts of scientific findings available in this context, scientific support, if made in the appropriate circumstances, could provide grounds for a court to defer to a decision made by another institution. He seems to extend, however, the scope of such institutions that might receive deference regarding their choice of actions in the face of scientific uncertainty to include both trial courts and agencies.²²¹ And although his opinion does not explicitly reference scientific uncertainties, his discussion regarding the science before the Court suggests that his decision was made with consideration of uncertainties in mind.

In particular, Justice Kennedy pointed towards scientific evidence regarding the hydrological connection between intermittent wet-

218 See *Carhart II*, 127 S. Ct. 1610, 1640 (2007) (Thomas, J., concurring).

219 *Id.*

220 Currently, circuit courts are split over which *Rapanos* opinion provides the controlling definition of the term "navigable waters." Compare *United States v. Robison*, 505 F.3d 1208, 1219–21 (11th Cir. 2007) (describing circuit split, but ultimately holding that the concurrence of Justice Kennedy controls *Rapanos*), and *N. Cal. River Watch v. City of Healdsburg*, 496 F.3d 993, 999–1000 (9th Cir. 2007) (holding that the concurrence of Justice Kennedy controls *Rapanos*), and *United States v. Gerke Excavating, Inc.*, 464 F.3d 723, 724–25 (7th Cir. 2006) (same), with *United States v. Johnson*, 467 F.3d 56, 64 (1st Cir. 2006) (noting that because the dissent in *Rapanos* would have found jurisdiction under either the plurality test or the test in Justice Kennedy's concurrence, "the United States may elect to prove jurisdiction under either test" (quoting *Rapanos*, 547 U.S. at 810 n.14 (Stevens, J., dissenting))). See generally *Marks v. United States*, 430 U.S. 188, 193 (1977) ("When a fragmented Court decides a case and no single rationale explaining the result enjoys the assent of five Justices, 'the holding of the Court may be viewed as that position taken by those Members who concurred in the judgments on the narrowest grounds . . .'" (alteration in original) (quoting *Gregg v. Georgia*, 428 U.S. 153, 169 n.15 (1976))).

221 See *Rapanos*, 547 U.S. at 780–81 (Kennedy, J., concurring) ("Through regulations or adjudication, the Corps may choose to identify categories of tributaries that, due to their volume of flow (either annually or on average), their proximity to navigable waters, or other relevant considerations, are significant enough that wetlands adjacent to them are likely, in the majority of cases, to perform important functions for an aquatic system incorporating navigable waters.").

lands, such as those at issue in *Rapanos*, and health effects, discussing how “nutrient-rich runoff from the Mississippi River has created a hypoxic, or oxygen-depleted, ‘dead zone’ in the Gulf of Mexico that at times approaches the size of Massachusetts and New Jersey,” and how “[s]cientific evidence indicates that wetlands play a critical role in controlling and filtering runoff.”²²² Rather than interpreting the Clean Water Act facially to avoid intrusion into state regulatory authority over water,²²³ as the plurality would have done, Kennedy would have remanded the decision to the district court to weigh the science regarding the existence of a significant nexus between the wetlands at issue and navigable waters.²²⁴ He also raised the possibility that in the future, the Corps itself could promulgate more specific regulations that would satisfy his concerns about the establishment of the necessary significant nexus.²²⁵

The approach of Justice Kennedy in his *Rapanos* concurrence, if taken in other Commerce Clause cases addressing risks to human health and the environment, would seem to put them more in line with the jurisprudence of *Carhart II* and other legislative deference cases. But even following an analogous approach in cases involving scientific uncertainties in the legislative context is not enough to provide adequate guidance to future courts. Justice Kennedy’s concurrence still leaves open the issue of how courts are to determine whether the U.S. Army Corps has provided information regarding the connection between either a specific wetland at issue in an enforcement action or the given wetlands addressed in a rulemaking regarding the scope of its enforcement authority sufficient to warrant deference. This open issue, of course, could be and is being addressed by lower courts experimenting with various standards of determination.²²⁶ But these gaps mean that Justice Kennedy’s concurrence

²²² *Id.* at 777.

²²³ *Id.* at 783 (“The possibility of legitimate Commerce Clause and federalism concerns in some circumstances does not require the adoption of an interpretation that departs in all cases from the Act’s text and structure.”).

²²⁴ *Id.* (“[T]he end result in these cases and many others to be considered by the Corps may be the same as that suggested by the dissent, namely, that the Corps’ assertion of jurisdiction is valid. Given, however, that neither the agency nor the reviewing courts properly considered the issue, a remand is appropriate, in my view, for application of the controlling standard.”).

²²⁵ *Id.* at 782.

²²⁶ *See, e.g.*, *United States v. Robison*, 505 F.3d 1208, 1222 (11th Cir. 2007) (remanding a case on appeal back to the trial court to provide instructions to the jury that “a water can be considered ‘navigable’ under the [Clean Water Act] only if it possesses a ‘significant nexus’ to waters that ‘are or were navigable in fact or that could reasonably be so made’” (quoting *Rapanos*, 547 U.S. at 759 (Kennedy, J., concurring)); *N. Cal. River Watch v. City*

alone cannot provide guidance for determining how to evaluate the existence of sufficient scientific uncertainty to support deference to a legislative choice. A fuller discussion is still warranted on how to resolve whether or not uncertainty exists such that legislative deference is warranted.

2. *Procedural Approaches and Providing Reasonable Explanations*

What I call the Court's procedural approach towards the treatment of scientific uncertainty seems more promising in providing guidance for the evaluation of scientific uncertainty. *Massachusetts v. EPA*²²⁷ illustrates this approach. In that case, the Supreme Court addressed a challenge by a group of states to the Environmental Protection Agency's ("EPA") decision to reject their petition to regulate greenhouse gas emissions from new motor vehicles under the Clean Air Act's endangerment provision. That provision stated:

The [EPA] Administrator shall by regulation prescribe (and from time to time revise) in accordance with the provisions of this section, standards applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines, which in his judgment cause, or contribute to, air pollution which may reasonably be anticipated to endanger public health or welfare.²²⁸

The EPA had based its rejection of the states' petition both on the ground that it lacked authority to regulate in this area, and also on the ground that if it did have such authority, any decision to set greenhouse gas emission standards would not be wise because no causal link between increased anthropogenic emissions of greenhouse gases and the increase in global surface air temperatures had been unequivocally established.²²⁹ This latter argument could be read as either an argument that existing scientific uncertainty cut in favor of not regulating at that time, or that in the face of scientific uncer-

of Healdsburg, 496 F.3d 993, 1000–01 (9th Cir. 2007) (determining that the U.S. Army Corps presented sufficient information to establish jurisdiction when it presented information that an actual surface connection existed between the water at issue and a navigable-in-fact water, an underground hydraulic connection between the two bodies, significant ecological connection between the two bodies, and a chemical connection between the two bodies). Scientists are also attempting to address these gaps. See, e.g., Scott G. Leibowitz et al., *Non-Navigable Streams and Adjacent Wetlands: Addressing Science Needs Following the Supreme Court's Rapanos Decision*, 6 FRONTIERS IN ECOLOGY & ENV'T 364, 364–71 (2008) (proposing metrics to help determine whether waters are protected under the Clean Water Act in light of the *Rapanos* decision).

227 127 S. Ct. 1438 (2007).

228 42 U.S.C. § 7521(a)(1) (2000).

229 *Massachusetts v. EPA*, 127 S. Ct. at 1450–51.

tainty, an agency should receive at least an additional degree of deference towards its decisions. The EPA supported this defense by pointing to the concerns that regulating greenhouse gases would hinder the President's negotiating position with developing nations for greenhouse gas reductions, and that any attempt to regulate new vehicle emissions would be inefficient and piecemeal.²³⁰

The Supreme Court rejected both arguments of the EPA,²³¹ but its holding on EPA's discretion is more relevant to this Article. Although the Court recognized that agencies should have considerable discretion to postpone decisionmaking to a different time, the Court found that the reasons that the EPA had actually provided for postponing actions were invalid under the Clean Air Act. Rather than take the approach of *Carhart II* of deferring to the government's decision to choose options in the face of scientific uncertainty, the Court held that the EPA's choice was constrained and that the EPA's decision, at least on the grounds that it provided, exceeded those constraints. In particular, the Court stated that the policy rationales raised by the agency conflicted with the considerations allowable under the Clean Air Act, which were limited to the extent to which greenhouse gas emissions endangered public health and welfare.²³² In the Court's words, the policy rationales put forth by the EPA were "reason[s] divorced from the statutory text."²³³ This holding points to a vision of agencies as implementers of Congress's policy choices, rather than as independent policymaking bodies themselves.

Moreover, the Court held that the EPA was required to articulate the basis for its choice of action, stating that:

Under the clear terms of the Clean Air Act, EPA can avoid taking further action only if it determines that greenhouse gases do not contribute to climate change or if it provides some reasonable explanation as to why it cannot or will not exercise its discretion to determine whether they do.²³⁴

Only if the uncertainty in the science were so extreme as to preclude an endangerment finding would the EPA be able to avoid action on the grounds of uncertainty.²³⁵ Moreover, any such use of uncertainty as a ground for inaction must be clearly stated: "If the scientific uncertainty is so profound that it precludes EPA from making a reasoned judgment as to whether greenhouse gases contribute to global

²³⁰ *Id.* at 1462–63.

²³¹ *See id.*

²³² *Id.* at 1462 (citing 42 U.S.C. § 7521(a)(1) (2000)).

²³³ *Id.*

²³⁴ *Id.*

²³⁵ *Id.* at 1463.

warming, EPA must say so.”²³⁶ Without such an explanation regarding the nature of the uncertainty, the Court would consider the agency’s decision “arbitrary” and “capricious” in violation of the Administrative Procedure Act.²³⁷

This articulation approach is useful for judicial evaluation of agency actions by eliciting information helpful for courts in assessing an agency’s decision.²³⁸ One of the premises behind deference to agencies is an understanding that agencies, like legislatures, are exposed to a wider variety of scientific information than courts and can independently obtain information without relying on the parties before them.²³⁹ Furthermore, agencies are understood to have more experience with issues in their purview, and more dedicated scientific staff and researchers than even legislatures.²⁴⁰ But agencies also face the constraint of operating under authorizing statutes enacted by legislatures. Thus, in reviewing an agency decision, a court faces the secondary inquiry of determining whether an agency’s use of its discretion falls within the bounds of that authorizing statute or not, through the two-part *Chevron* test described earlier.²⁴¹

²³⁶ *Id.*

²³⁷ 42 U.S.C. § 7607(d)(9)(A) (2000); *see EPA*, 127 S. Ct. at 1463.

²³⁸ *See* Elizabeth V. Foote, *Statutory Interpretation or Public Administration: How Chevron Misperceives the Function of Agencies and Why It Matters*, 59 ADMIN. L. REV. 673, 710–11 (2007) (arguing that *Massachusetts v. EPA* provides a welcome return to approaching agencies as experts on technical matters, rather than as merely statutory interpreters).

²³⁹ *See* Bernard W. Bell, *Using Statutory Interpretation to Improve the Legislative Process: Can It Be Done in the Post-Chevron Era?*, 13 J.L. & POL. 105, 145 (1997). Agencies, however, may be more susceptible to systematic influence and bias given their relative permanence and exposure to “lobbying, propaganda, graft, and influence.” KOMESAR, *supra* note 11, at 182.

²⁴⁰ *See* Bradley C. Karkkainen, *Bottlenecks and Baselines: Tackling Information Deficits in Environmental Regulation*, 86 TEX. L. REV. 1409, 1422 (2008) (suggesting that expert government agencies have significant resources, but arguing that they should devote more of those resources to undertaking studies necessary to fill in data gaps); Lin, *supra* note 40, at 1467 (“Administrative agencies are likely better suited than courts to determine the optimal level of deterrence because agencies possess the in-house expertise to evaluate the complex and conflicting scientific evidence in environmental tort cases. In contrast, judges and juries tend to be generalists, who lack the scientific competence to critically assess expert testimony.” (footnote omitted)); Bradford C. Mank, *Is a Textualist Approach to Statutory Interpretation Pro-Environmentalist?: Why Pragmatic Agency Decisionmaking Is Better than Judicial Literalism*, 53 WASH. & LEE L. REV. 1231, 1278–90 (1996) (describing the competence of agencies in evaluating scientific questions); *see also* *Chevron U.S.A. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 844–45 (1984) (justifying deference to agency interpretations of statutes concerning matters subject to regulation on the basis that agencies have superior understanding of such matters).

²⁴¹ *See Chevron*, 467 U.S. at 842–43.

Requiring additional explanation, therefore, allows a court to receive the sorts of information helpful for engaging in that inquiry into whether an agency has acted within its bounds. The existence of scientific uncertainty might be relevant to such an inquiry, but only to the extent that it relates to the factors set forth in the statute itself, which may or may not explicitly or implicitly include the uncertainty of the science. Indeed, these statutory factors may be viewed as preliminary policy choices—deserving of deference under *Carhart II*—by legislatures to select policy options in the face of uncertainty. In other words, Congress may create normative considerations—such as the importance of clean air—that agencies are to evaluate despite the presence of some degree of scientific uncertainty. This subsidiary role of the agency is recognized in *Massachusetts v. EPA* by virtue of its holding that only “profound” uncertainty described by the EPA would be sufficient to avoid application of those statutory factors.²⁴²

The articulation approach applied by the Court for the EPA’s decision is still instructive in the legislative context. Although Congress does not face the same constraints as agencies, which operate under legislative mandates, it still has some bounds—namely the bounds of the Constitution and court decisions interpreting the Constitution. Thus, where constitutional concerns arise regarding the basis for a legislature’s decisions, an articulation approach can still provide some utility. As with the question of whether an agency is operating under its statutory constraints, an articulation approach can aid courts in evaluating whether a legislature is operating under its constitutional constraints. But such an approach, especially in light of the deference due to legislatures given their additional fact-finding capacities, fulfilled or not, should be more limited. In particular, I suggest that by requiring Congress to articulate whether it is acting in an area of scientific certainty, and providing a brief discussion of the nature of uncertainties involved, a court can more fully evaluate whether the constitutional limitations are being approached by the legislatures themselves.²⁴³

²⁴² See 127 S. Ct. at 1463.

²⁴³ Such an approach would differ from that of courts towards evidence in cases involving evidentiary admissions standards in individual common law claims or as-applied statutory or regulatory challenges. See Davis, *supra* note 5, at 365 (arguing that evidentiary standards before agencies and courts should differ, pointing out that “[e]vidence rules predicated on the assumed inexpertness of judges and juries in specialized fields cannot be transferred blindly to adjudicators who are specialists”); Holly Doremus, *Data Gaps in Natural Resource Management: Sniffing for Leaks Along the Information Pipeline*, 83 IND. L.J. 407, 441 (2008) (arguing that traditional concerns embodied in rules of evidence are not

Such a requirement, however, appears absent in *Carhart II*, where Congress not only failed to make findings about the existence or nature of the scientific uncertainty, but even treated the science as certain.²⁴⁴ While the Court itself made a finding that the area in which the legislature was acting involved medical uncertainties,²⁴⁵ the Court failed to provide any guidance to lower courts for how to determine whether such uncertainty exists and how much certainty is needed in order for legislatures to deserve any heightened deference.

Requiring a legislature, which wants to receive deference for its actions, to articulate at the least that it was acting in an area of scientific or medical uncertainty regarding the support for its actions would address some of the transparency problems described earlier in this Article. Rather than allowing a legislature to receive deference for its normative choices despite using the “charade” of scientific certainty,²⁴⁶ a legislature that bases its choice of action on challengeable scientific support would have to be open about the fact that its actions were not dictated by science alone, but were instead normative choices made in the face of uncertain science. Legislative debate could then focus less on the merits of the scientific studies, and instead be acknowledged as debates over values (albeit one informed by the science)—a debate in which the public is more able to take part.²⁴⁷ Moreover, legislatures would have additional incentives to in-

applicable in an agency context, where the agency is an expert body and capable of giving the appropriate weight to expert testimony and documents). While such hearings involve individual disputes (and future similar disputes, given the application of *stare decisis*), facial challenges to statutes or regulations embroil courts in more polycentric matters. See Flournoy, *supra* note 2, at 368; Lon L. Fuller, *The Forms and Limits of Adjudication*, 92 HARV. L. REV. 353, 394 (1978). See generally Davis, *supra* note 241, at 365 (arguing that evidentiary standards before agencies and courts should differ). Both statutes and regulations apply broadly to large classes of parties, from criminals convicted under various statutes to industries engaging in regulated activities. Thus, while scientific determinations made regarding the admissibility of certain types of expert testimony may affect the parties in a case, or even future similarly situated parties, they have less effect than if such determinations were made regarding the scientific underpinnings of statutes or regulations.

²⁴⁴ 127 S. Ct. at 1638.

²⁴⁵ *Id.*

²⁴⁶ See Wagner, *supra* note 29, at 1674–77 (1995) (arguing that overreliance on scientific rationales by agencies in setting standards can create a barrier to public, democratic participation).

²⁴⁷ See Wagner, *supra* note 92, at 228 (“If the questions ripe for public debate are perceived to be scientific or technical in nature, laypersons may not know how or where policy input is needed.”).

form both themselves and the public about the limitations of science.²⁴⁸

Providing deference to legislative decisions only when the legislature has acknowledged it was acting in an area of scientific uncertainty would also address concerns that an open-ended inquiry into the existence of uncertainty would allow judicial bias to play a significant role in determining whether deference towards a legislative choice is warranted. An articulation requirement could constrain courts from substituting their own possibly biased determinations of uncertainty; instead, courts would first inquire into whether the legislature was sufficiently open about the uncertainties in the scientific or medical support for their choice of action. This does not mean that a court could never reevaluate the reasonableness²⁴⁹ of the legislature's actions or the adequacy of its support. The requirement would simply mean that a court would apply a less deferential standard of review when a legislature has failed to articulate that its actions were based on a choice taken in the face of uncertain science.²⁵⁰

Finally, a limited articulation requirement would be more consonant with the uncertainties involved with scientific research discussed earlier in this Article.²⁵¹ Rather than treating uncertainty as either existing or not, it would recognize the variety of ways in which scientific

²⁴⁸ See *id.* at 269–74 (“Over time, however, as federal lawmakers who are willing to be educated become more knowledgeable about the limits of science, it will be increasingly difficult for members of Congress to remain blissfully ignorant of the knowledge gaps or for scientifically sophisticated legislators to exploit the ignorance of their colleagues.” (footnote omitted)).

²⁴⁹ See *Jones v. United States*, 463 U.S. 354, 364 (1983) (evaluating the reasonableness of Congress's determination that a finding of insanity at a criminal trial is sufficient to justify commitment).

²⁵⁰ Skeptics of this proposal might argue that legislatures would respond to such an articulation requirement by simply defaulting to claims of scientific uncertainty. Even were legislatures to do so, such statements would still have the positive effect of bringing normative deliberations out into the open, rather than having them subsumed by discussions of scientific bases. See Wagner, *supra* note 29, at 1674–77. It would also combat the current “use” of claims of uncertainty by legislators as reasons for delay, rather than to initiate action. See Wagner, *supra* note 92, at 229–31.

This is merely an initial proposal to tackle some of the concerns raised by *Carhart II*. It is possible, of course, that in time such legislative references to uncertainty would become so prevalent as to create significant barriers to judicial review. If this should happen, courts may have to develop more sophisticated ways of examining the role of scientific uncertainty in the decisionmaking process, drawing for guidance, perhaps, from the developing literature for institutional decisionmaking under uncertainty. See, e.g., INSTITUTE OF MEDICINE OF THE NATIONAL ACADEMIES, WORKSHOP SUMMARY, ENVIRONMENTAL HEALTH SCIENCES DECISION MAKING: RISK MANAGEMENT, EVIDENCE, AND ETHICS 21–33 (2009).

²⁵¹ See discussion *supra* Part II.A.

uncertainties can arise in a given legal or policy problem and require a legislature to provide its own evaluation of the scientific and medical uncertainties relevant to its decision.²⁵² It may turn out that legislatures, if required to do so in order to receive deference, will elaborate further on the nature of the relevant uncertainties, be they more measurement-related or variability-related. This, in turn, will educate courts further about sources of uncertainty and allow them at least to begin to address uncertainty in a more sophisticated manner, rather than subsuming it all under one category. This approach would also enhance the dialogue between courts, legislatures, and the scientific community. If legislatures were urged to explain how they chose to factor in the relevant scientific uncertainties into their decisions,²⁵³ then scientific researchers would have a better idea of both the impact of their findings, as well as relevant areas in which further research would aid legislatures.

Finally, a limited articulation approach would balance some of the concerns raised by critics of legislative deference. As described earlier, courts, as lay institutions, should be even more hesitant to make determinations regarding the nature or non-existence of uncertainty when addressing facial challenges to statutes or regulations.²⁵⁴ An articulation approach would accommodate such developments by emphasizing that the court's decision was based on the legislature's articulated understanding of the science and its uncertainties at the time of the decision, rather than inadvertently fixing into place judicial understandings that would remain stagnant as scientific research progresses.²⁵⁵

IV. EXPLORING ADDITIONAL WAYS TO APPROACH A MORE COMPREHENSIVE ARTICULATION OF THE EXISTENCE OF SCIENTIFIC CERTAINTY AND UNCERTAINTY

As I have argued, the Supreme Court's approach in *Massachusetts v. EPA* can provide a starting point for the Court to address some of

252 Cf. Beecher-Monas, *supra* note 31, at 1656–57 (urging courts to be more explicit in discussing their unstated scientific assumptions, thereby providing scientific and intellectual “due process”).

253 Cf. *id.* (urging a similar sort of articulation requirement for courts themselves in the context of tort litigation).

254 See discussion *supra* Part III.A.

255 Cf. Wagner, *supra* note 92, at 276–78 (arguing that greater deference to agencies would reduce the overemphasis of legislation on scientific support, thereby allowing more space for creative administrative approaches to address environmental problems).

the concerns raised by *Carhart II* for public accountability, consistent judicial decisionmaking, and the openness of scientific research. While the Court has support for its decision to defer to legislative choices in the face of scientific and medical uncertainties, it fails to provide guidance to future courts on how to assess the existence of sufficient uncertainty. Following a limited articulation approach and requiring legislatures to at least acknowledge and discuss the uncertainties involved with the scientific support for their actions could provide a starting point for addressing some of these problems. Moreover, it would better harmonize the Supreme Court's case law regarding legislative decisions to address health and environmental issues with other cases addressing scientific uncertainty in the administrative decisionmaking context and provide a more meaningful way for courts, legislatures, and agencies to interact with developing scientific research.

I have mostly focused on ways for the Court to reform its approach to scientific uncertainty to improve the dialogue between courts, legislatures, the public, and the scientific community. But legislatures and the scientific community can play roles enhancing this dialogue as well. Legislatures could be more open about the scientific support behind their actions. This could mean drawing from the scientific literature on the kinds of scientific uncertainties that exist,²⁵⁶ taking into account the nature of the uncertainties relevant to supporting their actions. This could mean evaluating whether the uncertainties posed by a given problem involve uncertainties that could be resolved through additional research and technological development, as epistemological uncertainties may be, or whether the uncertainties are deeper or more inherent and may never be resolved, as variability uncertainties may be. It could also mean recognizing that some research uncertainties come from uncertainties in normative choices made in the context of research itself. And it could involve discussing and explicitly weighing whether the risk posed by a given problem is so great that it would be unfeasible to wait for further research before taking action.

Legislatures could also begin to draft statutes specifically taking uncertainties into account such that implementers, such as administrative agencies, and courts have different options in the face of dif-

²⁵⁶ See generally Weiss, *supra* note 22, at 25 (providing a proposed "scale" of scientific uncertainties drawing from existing legal terminology and complimentary Bayesian statistics).

fering degrees and types of uncertainties.²⁵⁷ This not only would provide further support for the reasonability of a legislature's actions, but would also create some middle ground between action and inaction in the face of varying degrees and types of uncertainties. It would also create ways for agencies to provide additional relevant information, developed through their greater numbers of dedicated staff and resources, to the legislature for future efforts on a given problem.

Finally, the scientific community can become more engaged in discourse with courts and legislatures regarding the uncertainties and limitations in their research. This could be done through greater communication regarding the general nature of scientific uncertainties with legislatures and the public,²⁵⁸ perhaps through groups such as the American Association for the Advancement of Science.²⁵⁹ It could also be done through a more accessible discussion of scientific uncertainties in policy-relevant scientific articles. And it could be done through amicus briefs to courts explaining both the limitations of scientific uncertainties as well as the contextually relevant science.²⁶⁰

Making societal decisions in the face of scientific and medical uncertainty is difficult. Scientific and medical uncertainties, however, arise in numerous areas of societal concern, including abortion regulation, environmental and public health regulation, and criminal punishment. The Supreme Court's attempt to tackle this problem in *Carhart II* is welcome. Yet further clarification is still needed to create sufficient incentives for courts, legislatures, the public, and the scientific community to engage in an open dialogue about the role of scientific uncertainties in societal decisions. Providing deference to legislatures only when they at least articulate that their actions were taken in the face of scientific uncertainty, rather than based on scientific certainty, would be a helpful first step in enhancing this dialogue.

257 See Flourmoy, *supra* note 2, at 386–89 (arguing that Congress could draft environmental statutes specifically to provide different available options to agencies when they face different degrees of scientific uncertainties).

258 See Wagner, *supra* note 92, at 273–75.

259 See American Association for the Advancement of Science, About AAAS, <http://www.aaas.org/aboutaaas>.

260 See Tai, *supra* note 91, at 838.

