POLICY FORUM

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The challenge of climate-change neoskepticism

Decision science and risk management are underutilized

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Opponents of policies to limit anthropogenic climate change (ACC) have offered a changing set of arguments—denying or questioning ACC's existence, magnitude, and rate of progress, the risks it presents, the integrity of climate scientists, and the value of mitigation efforts (*1*). Similar arguments have characterized environmental risk debates concerning arsenical insecticides in the late 1800s (*2*), phosphates in detergents in the 1960s (*3*), and the pesticide DDT in the 1960s and '70s (*4*). Typically, defenders of business as usual first question the scientific evidence that risks exist; then, they question the magnitude of the risks and assert that reducing them has more costs than benefits. A parallel rhetorical shift away from outright skepticism (*5–7*) led us to identify "neoskepticism" as a new incarnation of opposition to major efforts to limit ACC (*8*). This shift heightens the need for science to inform decision making under uncertainty and to improve communication and education.

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In the historical cases above, dispute resolution rested on both finding new, less-risky practices and applying policy judgment to science. In the DDT case, the administrator of the U.S. Environmental Protection Agency (EPA) stated that he was "convinced by a preponderance of the evidence" (*4*). Today, neoskepticism accepts the existence of ACC but advocates against urgent mitigation efforts on various grounds, such as that climate models run "too hot" (*5*) or are too uncertain to justify anything other than "no-regrets" policies as having net benefits (*6*). Mainstream climate scientists are well aware of uncertainty in climate projections (*9, 10*). But neoskeptics' citing of it to justify policy inaction marks a shift of focus in climate debates from the existence of ACC to its import and to response options.

LEGITIMATE QUESTIONS, UNJUSTIFIED INFERENCES

Neoskeptical claims may be driven more by ideology or economic interests than by science (*11*), but they cannot be dismissed as confidently as pure denial or skepticism. By focusing attention on risks and highlighting uncertainty, they raise important questions about ultimate impacts and response options. These are questions about (i) the nature and probabilities of crossing climate "tipping points" that would greatly change the profile of the risks (*12*); (ii) the varied harms climate change may produce (e.g., to businesses, ecosystem integrity, political stability, or human lives); (iii) the vulnerability and resilience of potentially affected social and ecological systems; and (iv) the benefits and costs of efforts to limit climate change, reduce vulnerability, and increase resilience. Such questions have received scientific and economic analysis before (*9*) but deserve greater emphasis as attention focuses increasingly on risk management.

Although neoskeptics claim to accept the reality of ACC, their inference that inaction is justified seriously underemphasizes some well-established characteristics of ACC that are important for informing choices: that the risks of extreme and damaging outcomes are continually increasing, so that waiting for certainty has increasing costs; that inertia in the system may result in its crossing major tipping points without timely warning; and that there is value to insuring against worst cases, especially when they are likely to be worse than those of the past. Only by presuming that the risk profile is static can neoskeptics plausibly argue that uncertainty justifies postponing action and that mitigation efforts that do not pay off well now will be regretted later. A more appropriate inference is that efforts that look overly costly now may well appear in retrospect to have been low-cost insurance.

SCIENCE FOR DECISION MAKING

Science for climate decisions under uncertainty requires shifts in research agendas. For informed responses to ACC, science must not only assess climate trends and project their consequences for diverse affected parties but also (i) identify specific technological and institutional options; (ii) analyze the time and resources required for mitigation and adaptation strategies; (iii) analyze the effects of each and of ways to increase effectiveness; (iv) identify and assess cobenefits and indirect costs of mitigation; and (v) evaluate the financial costs and other risks of delay. The science of decision processes is also needed. Much of the needed research must come from the social, behavioral, and economic sciences integrated into a science of human-environment interactions (*9, 13*).

By acknowledging ACC but questioning the value of mitigation efforts, neoskepticism highlights the need for science to inform adaptive risk management (*9*) and for serious risk analysis. Deterministic analysis has limited potential for comparing the costs of actions versus delay because the probabilities of occurrence of the most damaging conditions, although changing and increasing with delay, will long remain uncertain, and these probabilities are the main physical variable affecting climate risks. The science must consider known and potential risks and uncer-

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tainties and must assess options for reducing risks and for altering plans and strategies as new information becomes available.

The science needed to integrate information about decision options and climate risks has not been well represented in the Intergovernmental Panel on Climate Change (IPCC) process (*14*) or adequately supported in research budgets. For example, despite continued calls from independent reviews for increased support for "human dimensions" research in the U.S. Global Change Research Program, funds devoted to social science declined from 3 to 2% between 1990 and 2007 (*15*). The program's most recent strategic plan embraces science to inform timely decisions on adaptation and mitigation, but resources commensurate with the needs have not been achieved.

Decision science is particularly needed, both because of uncertainties about risks, costs, and benefits and because of differing information needs and value judgments within societies about the relative importance of different outcomes, affected populations, and time horizons. Catastrophic outcomes are the most uncertain and will likely elicit conflicts about priorities. The decision sciences offer useful guidance for informing decisions under these conditions. With input from decision participants, these sciences can assess—in ways relevant to citizens—the costs, feasibility, and side effects of the response options, including inaction. Decision sciences can also suggest ways of organizing decision making to integrate scientific analysis and social deliberation and to consider trade-offs that might otherwise go unaddressed. In addition, they can incorporate issues of equity and value conflict in supporting adaptive risk management (*16*).

The decision sciences suggest broad principles for uncertainty management, such as (i) adopting policies that will perform robustly across various plausible futures, (ii) pursuing a variety of policy strategies to increase the likelihood that some will yield good results, and (iii) organizing decision-making processes for flexibility and responsiveness (*16*). Monitoring and assessment of results are essential for identifying policy improvements for adaptive management. All these activities of decision science help the public and decision makers assess the options for action and the consequences of inaction—the main challenge unaddressed by neoskepticism.

IMPLICATIONS FOR SCIENCE COMMUNICATION AND EDUCATION

Neoskeptical arguments implicate but do not appropriately address the cognitively difficult issues of understanding scientific uncertainty and weighing value trade-offs. To cope with such difficulties, most people use simple mental models (*17*). They need simple models that incorporate the key elements of the current mixture of established knowledge and uncertainty, can suggest decision strategies, and can adapt to emerging knowledge and experience. Skeptics and neoskeptics, however, often suggest simple models that are misleading because they do not take into account the continually increasing costs of waiting for certainty.

Neoskepticism thus challenges climate educators and communicators to supplement the teaching of climate facts and processes with mental models of ACC that (i) are factual and not misleading, (ii) use a familiar domain to explain the unfamiliar, (iii) capture interest, and (iv) allow for extrapolations consistent with current science. Because risks and value trade-offs are key, simple mental models should also (v) acknowledge and incorporate uncertainty, (vi) encourage choices about risks in the face of uncertainty, (vii) highlight unresolved issues for discussion among people who may initially disagree, and (viii) highlight the accumulating cost of waiting for certainty (*18*).

> ***"Neoskeptical arguments ... do not appropriately address ... scientific uncertainty and weighing value trade-offs."***

Citizens and nonscientist policy-makers are quite capable of considering serious hazards whose probabilities are uncertain, as they do with hazards as diverse as fires, floods, extreme storms, airline crashes, infectious disease outbreaks, terrorist attacks, and impending wars. Many of these risks are managed to reasonable levels of public satisfaction even though neither their probabilities of occurrence nor the benefit-cost ratios of risk management options can be estimated with precision and confidence.

Some familiar decision-making settings may capture fundamental attributes of climate change and serve as helpful analogs. For example, coping with risks of progressive medical conditions, such as hypertension or atherosclerosis, involves choosing whether to mitigate risks through changes in diet, smoking, and exercise without knowing how much change is needed. Like climate change, these medical conditions are progressive, can lead to catastrophic tipping points (stroke or heart attack), and are only slowly reversible. Decisions about the purchase of insurance against catastrophic life events (illness, fires, floods, and others) also offer a useful analog.

Each analogy will suggest choice options. Although there is no perfect familiar analog for climate change, we suggest that some simple mental models, by making key fundamentals of climate change more understandable, can facilitate thinking about the choices facing society. They may also have potential to improve public discourse addressing risks of climate change by making clear that certain kinds of policy disagreements should be expected, even with improved knowledge.

CONCLUSION

We do not presume that empirical analysis of risks, techniques for informing decisions under uncertainty, or better mental models will end skepticism, neo- or otherwise, about climate change. Some skepticism is motivated by ideological and financial interests tied to the continued use of fossil fuels, and debates will continue over the risks and how best to manage them. Nevertheless, improved understanding of the issues raised here can assist decision making in the face of the risks of climate change and can perhaps help focus policy debates more productively. ■

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