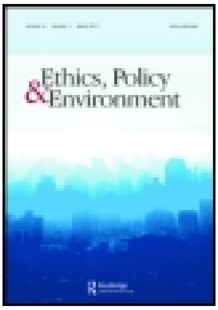

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The Ethical Significance of Language in the Environmental Sciences: Case Studies from Pollution Research

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The Ethical Significance of Language in the Environmental Sciences: Case Studies from Pollution Research

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ABSTRACT *This paper examines how ethically significant assumptions and values are embedded not only in environmental policies but also in the language of the environmental sciences. It shows, based on three case studies associated with contemporary pollution research, how the choice of scientific categories and terms can have at least four ethically significant effects: influencing the future course of scientific research; altering public awareness or attention to environmental phenomena; affecting the attitudes or behavior of key decision makers; and changing the burdens of proof required for taking action in response to environmental concerns. The paper argues that deliberative forums, research-ethics training, and conceptual work by environmental philosophers could all promote more ethically sensitive responses to these features of scientific language.*

Introduction

The concepts of broadly based deliberation, public participation, and upstream engagement have become increasingly popular in the areas of environmental policy making, technology assessment, and risk characterization (Fiorino, 1990; Fischer, 1993; Sclove, 1995; NRC, 1996; Norton, 2005). Part of the motivation behind this surge of interest is the recognition that important assumptions and values can be embedded in seemingly straightforward technological or policy developments. Therefore, proponents of upstream engagement argue that it is important for concerned citizens to enter the policy making process as early as possible in the course of making decisions. They emphasize that an adequate range of stakeholders should be involved in the framing of significant environmental problems or policies, because it is often more difficult to reverse or alter policies after a problem has already been characterized than to influence its initial framing.

This paper examines how ethically significant assumptions and judgments are embedded not only in environmental policies but also in the scientific research that informs those decisions. In particular, it considers how the language employed by environmental researchers can frame subsequent decision making in ethically relevant ways. It therefore supports efforts to bring ethical analyses to bear on these scientific judgments that are even farther 'upstream' than environmental

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policy decisions. Of course, the notion that environmental research incorporates significant values is not entirely new. For example, Bryan Norton (1998) has criticized what he calls the 'sequential model' for the relationship between environmental science and policy, according to which the ethical and societal values associated with policy making can be largely excluded from research in the environmental sciences (see also Wilsdon & Willis, 2004). Moreover, he has emphasized that the values implicit in linguistic choices—not only in the physical sciences, but also in the social sciences and the policy domain—are particularly important to consider (Norton, 1998, 2005, 2007).[1] Nevertheless, despite Norton's enthusiasm for highlighting the role of values in scientific language, there has been relatively little attention to this project in the environmental-ethics literature.[2] This paper attempts to draw renewed attention to this task. Moreover, it focuses on the role of linguistic choices in public-health research concerning pollution, which has received less scrutiny than other areas of the environmental sciences, such as ecology.

The next section introduces three case studies: endocrine disruption, multiple chemical sensitivity, and hormesis. It examines the significance both of the ways that scientists categorize these phenomena and of the terms that they use for describing them. The third section describes four ethically relevant effects of those categorizations and terms: (1) influences on the future course of scientific research; (2) effects on public awareness or attention to scientific phenomena; (3) influences on the attitudes or behavior of decision makers; and (4) effects on the burden of proof required for taking action in response to environmental concerns. In response to these significant influences, the fourth section considers how to promote further societal reflection on these linguistic decisions. It argues that deliberative forums, while somewhat promising, are sometimes difficult to apply to judgments associated with scientific research. Therefore, these sorts of forums should be supplemented with sensitive research-ethics training for environmental scientists, as well as efforts by philosophers to highlight ethically significant linguistic judgments in the environmental sciences.

Case Studies

This section examines three case studies associated with contemporary pollution research: endocrine disruption, multiple chemical sensitivity, and hormesis studies. It is striking that, in all three cases, researchers are forced to make significant judgments both about how to categorize the phenomena and about what terms to use for describing them. These cases are noteworthy because they have the potential to challenge current government policies regarding the regulation of toxic chemicals and carcinogens. For example, present risk-assessment policies in the US Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the Occupational Safety and Health Administration (OSHA) all presuppose that the toxic effects of chemicals are greater at high doses than they are at lower doses. When extrapolating the low-dose effects of pollutants from tests that employ higher doses, they assume that there is no dose at which carcinogens are completely safe but that there is some threshold below which non-carcinogenic toxins cease to be harmful. Moreover, these agencies presuppose that the physiological effects of specific toxins do not vary widely from person to person, even though some individuals may suffer ill effects at lower doses than others do. Each of the following case studies challenges one or more of these assumptions that are central to current public policy.

Endocrine Disruption

The phenomenon of endocrine disruption is one of the most well known contemporary challenges to traditional regulatory policies. It occurs when pollutants or other toxins mimic hormones such as estrogen or otherwise interfere with the endocrine system. Many scientists claim that this interference could result in human reproductive cancers, low sperm counts in male organisms, alteration of immune function and animal behavior, and decline in species populations (see Colborn *et al.*, 1996; Krimsky, 2000). The occurrence of endocrine disruption is of great interest to the regulatory community, partly because it could imply that some toxins have low-dose effects on the endocrine system that do not appear in tests at higher dose levels.

Although this phenomenon has been the subject of growing research interest over the past 20 years, it has been a challenge to conceptualize. For example, scientists did not initially regard diverse cases of what we now call 'endocrine disruption' as instances of a single phenomenon. Instead, they noticed a variety of strange effects in wildlife species, including weakened eggshells, lowered reproduction rates, abnormal mating behavior, and developmental abnormalities (Colborn *et al.*, 1996). Theo Colborn, a researcher with the World Wildlife Fund, integrated information from a variety of scientists in order to arrive at a unifying concept involving effects of environmental pollutants on organisms' hormonal systems.

Even after Colborn developed the endocrine-disruption concept, it has continued to be difficult to define. For example, when the EPA developed its Endocrine Disruptor Research Program in 1996, it defined an endocrine disruptor as 'any exogenous agent that *interferes* with the production, release, transport, metabolism, binding action, or elimination of natural hormones in the body . . .' (Krimsky, 2000, p. 82; italics added). At an important meeting in 1996 that was organized by the International Organization for Economic Cooperation and Development (OECD), the European Union, and the World Health Organization, however, endocrine disruptors were defined somewhat differently, as 'any exogenous substance that *causes adverse health effects* in an intact organism, or its progeny, consequent to changes in endocrine function' (quoted in Krimsky, 2000, p. 88; italics added).

The differences between the EPA and OECD definitions of ED appear to be significant. Whereas the EPA merely requires interference with the endocrine system, the OECD explicitly requires *in vivo* evidence that a substance actually causes harm to the organism. Therefore, as Sheldon Krimsky (2000, p. 88) emphasizes, one might think that the OECD definition sets too high a standard of proof for identifying endocrine disruptors, especially for the purposes of formulating public policy. Because of this worry, the US Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC) failed to arrive at a consensus when it tried to develop a definition for the term 'endocrine disruptor'. One of the primary sticking points was the issue of whether an endocrine-modulating substance had to produce observable adverse effects in order to count as an endocrine disruptor (Krimsky, 2000, p. 214).

In addition to the challenge of formulating an acceptable definition, the term 'endocrine disruptor' has also been a subject of debate. Some stakeholders have worried that the language of 'disruption' unjustifiably encourages the notion that any interference or influence on the endocrine system is harmful or 'disruptive'. Therefore, when a National Academy of Sciences panel analyzed the issue, it chose to use the term 'hormonally active agent' (HAA) instead. The panel claimed that 'the term [endocrine disruptor] is fraught with emotional overtones and was tantamount to a prejudgment of potential outcomes' (NRC, 1999, p. 21). Evidently the members of the panel felt that it would be less prejudicial if chemicals were merely labeled as hormonally 'active'.

Multiple Chemical Sensitivity

Another phenomenon that challenges current regulatory policies is often called 'multiple chemical sensitivity' (MCS). Individuals affected by this disorder appear to experience an initial 'sensitization' caused either by chronic exposure to toxic chemicals or by an acute exposure to one particular toxin. These individuals subsequently become extremely sensitive to a wide variety of chemicals and suffer chronic neurological, respiratory, and digestive problems (Ashford & Miller, 1998). 'Gulf-War Syndrome' provides a particularly well publicized example of the sorts of symptoms associated with MCS. Because the phenomenon does not accord with standard toxicological responses (especially the presupposition that a particular toxic chemical should have roughly the same physiological effects on all individuals), some researchers insist that it is most likely a psychological phenomenon akin to 'post-traumatic stress disorder'. Nevertheless, there is a growing body of evidence that could point to a physiological basis for MCS (Gilbert, 1995; Joffres *et al.*, 2005).

Given the anomalous features of the MCS phenomenon, it is perhaps not surprising that it has been a challenge to conceptualize. Initially, various 'syndromes' were defined in terms of the distinctive causes that appeared to initiate the intolerances of some chemically sensitive patients. These diseases include sick building syndrome (SBS), Gulf War syndrome (GWS), or wood preservative syndrome (WPS) (Ashford & Miller, 1998). Based on the similar effects associated with these syndromes, they are now often grouped under the more general category of MCS, but it has been difficult to define. For example, Nicholas Ashford and Claudia Miller (1998, pp. 314–315) have presented six different case definitions that various organizations and individuals have proposed. They vary in terms of the precise number of organ systems that must be affected in order to satisfy the definition, whether instances in which other accepted clinical or psychological conditions are present can also count as instances of MCS, and whether a provocative challenge or environmental exposure must be documented.

In addition to the difficulty of conceptualizing this phenomenon, researchers have proposed a wide range of names for it, including idiopathic environmental intolerance, mass psychogenic illness, universal allergy, twentieth-century illness, environmental maladaptation syndrome, immunologic illness, and chemical AIDS (Ashford & Miller, 1998, p. 28). One of the most controversial aspects of these different terms is their alleged potential to incline policy makers and members of the public toward the conclusion that MCS is either psychologically or physiologically based. For example, at an important 1996 conference in Berlin (sponsored by the International Program on Chemical Safety, or IPCS), the participants proposed that MCS be renamed 'idiopathic environmental intolerances' (IEI). According to the conference's final report, the term 'multiple chemical sensitivities' is problematic, because 'it makes an unsupported judgment on causation [of the phenomenon]' (Anonymous, 1996). As Ronald Gots, one of the key participants at the conference, argued, 'The premature use of the term multiple chemical sensitivities has hampered effective exploration of and response to this phenomenon, because it suggests, to the lay person, a physiological explanation' (Gots, 1996). The conference participants felt that the label of IEI would be less likely to be misconstrued, and they defined it as:

– an acquired disorder with multiple recurrent symptoms;
– associated with diverse environmental factors tolerated by the majority of people;
– not explained by any known medical or psychiatric/psychologic disorder. (Anonymous, 1996, p. S188)

In contrast, other scientists have expressed opposing concern about how the label of IEI could be misinterpreted:

> Soon after the Berlin meeting, certain workshop participants reported to the media and at scientific meetings that the 'idiopathic' in IEI meant 'self-originated' rather than 'being of unknown etiology' (a more familiar meaning of the term as it is used in medicine)—and they erroneously proclaimed that IEI had become WHO's official name for the condition . . . (Ashford & Miller, 1998, p. 284)

Thus, Ashford and Miller worry that the IEI label may have problems of its own that are the opposite of those associated with the term MCS; in other words, it may facilitate an unjustified interpretation of the phenomenon as psychogenic. Because of similar concerns, a number of prominent scientists wrote a letter to the IPCS, denouncing what they perceived as significant conflicts of interest that may have caused the participants at the Berlin Meeting to be biased in favor of corporate interests (Ashford & Miller, 1998).

Hormesis

Researchers are also exploring the hypothesis that low doses of many chemicals may actually have beneficial biological effects. Toxicologist Edward Calabrese claims that a variety of toxic substances may have effects at low doses that are the opposite of those produced at higher doses (Calabrese & Baldwin, 1998, 2003). For example, consumption of alcohol at low doses appears to decrease human mortality rates below the levels of those who do not consume alcohol at all, whereas high levels of alcohol consumption increase human mortality. Calabrese claims that these sort of reverse effects (at low versus at high doses) are characteristic of numerous toxic substances. For example, he argues that substances like dioxins, which are carcinogenic at high doses, may actually reduce the incidence of cancer (below control levels) when they are present at low doses. Therefore, he suggests that the phenomenon of hormesis could justify widespread weakening of current regulatory standards (Calabrese & Baldwin, 2003; Calabrese, 2008). In sharp contrast, other researchers insist both that the generalizability of hormesis remains disputable and that it is unlikely to justify regulatory changes (Axelrod *et al*., 2004; Thayer *et al*., 2005; Mushak, 2007).

As in the cases of endocrine disruption and multiple chemical sensitivity, current literature incorporates multiple distinct concepts for the hormesis phenomenon (Elliott, 2000, 2006). Although there are a variety of reasons for this confusion, one important factor is that scientists disagree about whether it is advisable to employ a definition that employs 'normative' language (e.g. defining hormesis as the production of low-dose *beneficial* effects by substances that are *harmful* at higher doses). On the one hand, some argue that evaluating whether chemical effects are beneficial or harmful depends too much on contextual considerations and could open up hormesis to political debates (Calabrese & Baldwin, 2002; Chapman, 2002). On the other hand, this approach could backfire if it forces important judgments to enter the discussion surreptitiously rather than in a transparent fashion. For example, although Calabrese and his colleagues acknowledge that hormetic effects are not always beneficial, they appear to assume that hormetic effects are frequently beneficial. Otherwise, it would not make sense for them to claim in some of their publications that hormesis has significant economic implications for chemical regulations and that it could turn current risk-communication messages to the public 'upside down' (Calabrese & Baldwin, 2003).

Another issue that involves both the categorization of the phenomenon and the choice of terms for describing it is the decision whether to use the label 'hormesis' at all. Kristina Thayer and her coauthors argue that 'many examples used to support the widespread frequency of hormesis are better described by the more general term "nonmonotonic" dose responses. Nonmonotonic is used to describe dose–response relationships in which the direction of a response changes with increasing or decreasing dose' (Thayer *et al*., 2005, p. 1271). In other words, they suggest that Calabrese is trying to create an unnecessary concept. They point out that we already have the concept of biphasic or nonmonotonic dose responses (i.e. effects that do not uniformly increase or decrease in response to changing dosages). Although they do not fully develop the argument, one way of supporting their position would be to argue that it is unnecessary to create an additional concept unless it carves out a highly distinctive and uniform phenomenon. Although Calabrese would argue that hormesis meets these criteria, others remain unconvinced.

Scientists are also currently debating whether it is appropriate to describe hormesis using the terms 'adaptive' or 'generalizable'. On the one hand, it seems plausible that hormesis could be the consequence of evolutionary pressures that favored biological mechanisms for gleaning benefits from low levels of stressors in the environment. On this basis, Calabrese goes so far as to include the adaptiveness of hormesis as part of his preferred definition for the phenomenon (Calabrese & Baldwin, 2002). Others question whether there is convincing evidence for the notion that hormetic effects are adaptive (Axelrod *et al*., 2004; Thayer *et al*., 2005). At the very least, it may be difficult in many cases to determine whether alleged examples of hormesis are adaptive or not. The notion that hormesis is highly 'generalizable', which Calabrese emphasizes frequently (Calabrese & Baldwin, 1998, 2003), is also ambiguous and controversial. The claim could mean, for example, that for each biological model, endpoint, and chemical class, there is at least one example of a hormetic dose–response relationship. Or it could mean that a particular percentage (say, 50%) of toxic chemicals exhibit hormetic dose–response relationships (on at least some endpoints, in at least some biological models). It could also mean that, if one were to formulate a comprehensive list of the dose–response relationships for every toxic chemical on every endpoint in every biological model, some percentage of those relationships (again, say 50%) would be hormetic. Moreover, even if the 'generalizability' label could be made precise, some researchers worry that it is too difficult to provide evidence for the generalizability of hormesis unless it is defined in terms of a well-understood mechanistic process (Van der Woude *et al*., 2005).

The Ethical Significance of Scientific Language

The previous section's descriptions of the categories and terms associated with endocrine disruption, multiple chemical sensitivity, and hormesis already hinted at some of the ethically significant effects of scientific language. This section organizes those effects into four groups: (1) influences on the future course of scientific research; (2) effects on public awareness or attention to scientific phenomena; (3) influences on the attitudes or behavior of decision makers; and (4) effects on the burden of proof required for taking action in response to environmental concerns. These categories are neither mutually exclusive nor exhaustive. For example, in addition to the four effects described here, scientific language could also be ethically significant because it is overly vague (thereby facilitating misuse by interest groups), or because its categories fail to convey information that is particularly useful to policy makers (Norton, 1998), or because it inhibits (or promotes) fruitful dialogue between scientists and members of the public (Pickett & Cadenasso, 2002). The four categories discussed in this section are chosen because they are particularly obvious in the paper's three case studies and because they illustrate a wide range of language's important effects.

The first significant consequence of scientific language is to influence the course of future research. For example, Sheldon Krimsky (2000) emphasizes that the phenomena associated with endocrine disruption received little sustained attention until Theo Colborn developed a unifying concept that could unite anomalous findings that had crossed a number of different fields. Similarly, Ronald Gots (1996) argues that use of the term 'multiple chemical sensitivity' has hampered efforts to pursue psychological accounts of the phenomenon. Along the same lines, part of the motivation for proponents of hormesis to oppose the more general concept of 'nonmonotonic dose responses' is that the hormesis concept encourages the notion that there is a relatively unitary low-dose phenomenon that merits closer scrutiny. In contrast, speaking only of nonmonotonic dose responses encourages the impression that there may be a wide variety of mechanisms responsible for a range of low-dose effects, with no single type of effect meriting extra research emphasis.

Ecologists Steward Pickett and Mary Cadenasso have shown that similar sorts of linguistic effects are also visible in other areas of environmental science, such as ecology. For example, they argue that one of the virtues of the ecosystem concept is that it can be elaborated in terms of models that integrate work from multiple disciplines. One of the most exciting developments that they cite in this regard is the human ecosystem framework (HES), which helps to integrate work from the biological, physical, and social sciences (Pickett & Cadenasso, 2002, 2006). These influences of scientific language on the course of future research are ethically significant, because policy actions can often be steered in one direction or another depending on the body of available information at a specific point in time (Elliott & McKaughan, 2009). Interest groups are not oblivious to this phenomenon. For example, Frederick vom Saal (2007) argues that the chemical industry was motivated to study hormesis partly because they wanted to counteract growing evidence (especially from research on endocrine disruptors) that very low doses of toxins could be more harmful than previously thought.

A second ethically significant influence of scientific language is to increase public attention, awareness, and action in response to particular phenomena. As illustrated in the famous Alar case—in which the sales of apples and apple juice plummeted in response to concerns about the carcinogenicity of the growth regulator Alar—public action can be dramatic when it is mobilized. The strategic use of language can play an important role in these public responses. For example, communications scholars have shown that audiences interpret news stories differently (even if they have the same content) based on the framing associated with visual or terminological tools (Scheufele & Lewenstein, 2005). As a result, politicians have become increasingly interested in using language that has specific framing effects on public opinion. For example, US Republican Party memos have encouraged the use of terms like 'climate change' and 'conservationist' rather than 'global warming' and 'environmentalist', because of alleged connotations of the terms (Pielke, 2007, p. 44).

Scientists and political actors involved with the pollution case studies discussed in the previous section of this paper appear to have been at least implicitly aware of these issues. For example, we saw that scientists on a National Academy of Sciences panel were worried about the 'emotional overtones' of the label 'endocrine disruptor' (NRC, 1999, p. 21). Commentators also worried that the label 'multiple chemical sensitivity' might unjustifiably incline the public toward physiological explanations for the phenomenon (Gots, 1996). These same effects are visible in other areas of environmental science as well. For example, Pickett and Cadenasso emphasize that the ecosystem concept incorporates metaphorical overtones of connectedness, resilience, diversity, and adaptability. They argue that the flexibility and richness of these connotations can help to bring together a wide variety of stakeholders behind environmental initiatives (Pickett & Cadenasso, 2002).

These influences of scientific language on people's beliefs, attitudes and actions are not limited only to members of the 'lay' public. The third ethically significant effect of language in the environmental sciences is to shape the perspectives of important decision makers, such as judges, medical professionals, or policy makers. Ecologists have previously emphasized that concepts like 'ecological footprint', 'ecosystem services', and 'natural capital' are valuable not only because of their effects on the public but also because they can help policy makers to see environmental problems in a new light (Pickett & Cadenasso, 2002). Similar effects are visible in this paper's case studies. For example, descriptions of the hormesis phenomenon as 'adaptive' and 'generalizable' are at least partly inspired by the goal of encouraging regulators to conclude that hormesis represents a (or perhaps *the*) dominant dose–response relationship for toxic chemicals. Proponents of using the 'IEI' label instead of 'MCS' also appear to be trying to influence important decision makers to take physiological characterizations of the phenomenon less seriously. To the extent that these linguistic strategies are successful, they could make judges and regulators less likely to force the accommodation of public places to the requests of MCS patients or to hold manufacturers legally liable for their symptoms (Gots, 1996, p. S9).

Many of those suffering from MCS also think that labels like 'IEI', to the extent that they are more supportive of psychological conceptualizations of their illness, encourage dismissive or otherwise derogatory attitudes by physicians (Kroll-Smith & Floyd, 1997). These concerns of MCS patients are mirrored in the struggles of numerous other patient groups. According to David Tuller of the *New York Times*, many of those with 'chronic fatigue syndrome' worry that this name for their ailment (not to mention the informal, derogatory label 'yuppie flu') 'has discouraged researchers, drug companies and government agencies from taking it seriously' (2007). These patients frequently prefer the British term 'myalgic encephalomyelitis' because, according to psychologist Leonard Jason, 'You can change people's attributions of the seriousness of the illness if you have a more medical-sounding name' (Tuller, 2007). Those suffering from endometriosis have similarly complained that the alternate label 'career woman's disease' has inclined medical professionals toward dismissive and inaccurate conclusions about their illness (Capek, 2000).

A fourth influence of linguistic decisions in the environmental sciences is to shift the burden of proof for taking various sorts of actions in the policy arena. This constitutes a more formal avenue through which the language of environmental science can influence the behavior of societal decision makers. We have seen that a significant conceptual issue is whether to define the term 'endocrine disruptor' so that it refers to any chemical that interferes with some element of the endocrine system or whether to define it more narrowly so that it refers only to chemicals that cause observable adverse health effects as a result of their endocrine-modulating properties. On the one hand, choosing a definition that refers to any chemical interference with the endocrine system could make it easier to classify agents as endocrine disruptors, thereby potentially placing the burden of proof on industrial manufacturers and users of those chemicals to show that their chemicals should not be regulated as stringently as other endocrine disruptors. On the other hand, choosing a definition that requires evidence of adverse health effects could potentially place the burden of proof on consumer and public-health organizations to show that chemicals are actually harmful before they could be regulated as endocrine disruptors.

These sorts of linguistic effects on burdens of proof in the policy arena have already been documented by Edward Schiappa (1996) in the context of wetland preservation. He notes that a variety of federal policies have been enacted with the goal of preserving wetlands. For example, the 'Swampbuster' provision of the 1985 Food Security Act limits the ability of farmers to sell acreage to commercial developers if the land meets the criteria of a 'wetland'. Moreover, the elder President

Bush instituted a policy of 'no net loss' of wetlands to development. As a result, interest groups have exerted enormous efforts to influence the definition of 'wetlands'. One of the debated issues was whether wetlands need to meet all of several criteria (related to hydrology, soil type, and vegetation) or only some of those criteria. The standards for judging whether those criteria are met have also been controversial matters. Thus, just as Carl Cranor (1993, 2008) has previously shown that statistical methodologies, standards of scientific inference, and legal statutes can shift the burden of proof between environmentalists and their opponents, these examples show that linguistic judgments can have similar effects.

Responses

It would be impractical in an article of this size to try to develop a systematic approach for responding to the values embedded in the language of the environmental sciences. Nevertheless, this section provides rough sketches of three interrelated strategies that are worth considering further: deliberative forums, research-ethics training, and linguistic analyses by environmental philosophers (or other academics and stakeholders). The purpose of pursuing these strategies is at least two-fold: (1) to identify cases in which the choice of categories or terminology is ethically significant; and (2) in those cases, to promote linguistic decisions that are responsive to a range of ethical considerations.

Deliberative Forums

The strategy of pursuing deliberative forums has already been pursued in response to a number of decisions associated with risk characterization, environmental policy making, and technology assessment. In the case of risk characterization, for example, the US National Research Council report *Understanding Risk* suggests a variety of formats that can facilitate deliberative interaction between a range of interested and affected parties: public hearings, citizen advisory committees and task forces, alternative dispute resolution, citizens' juries and citizens' panels, surveys, focus groups, and interactive technology-based approaches (1996, pp. 199–205). Many commentators have suggested that, when applied under appropriate circumstances, these approaches can make decisions more democratically legitimate, alleviate conflict, and even improve the quality of decisions (Fiorino, 1990; Fischer, 1993; Beierle, 2002). Thus, one way to highlight ethically significant features of language in controversial areas of environmental science would be to create some form of advisory committee or citizen panel, perhaps including representatives of interest groups who would be sensitive to the potential for linguistic choices to challenge their interests.[3]

Unfortunately, deliberative forums are not without weaknesses. Under some circumstances, they can result in increased cost; wasted time; inadequate knowledge on the part of participants; poor decisions, especially if dueling interest groups exert too much control; failure to provide adequate representation of all stakeholders, especially disadvantaged groups; and creation of increased rather than decreased hostility among stakeholders (see e.g. Irvin & Stansbury, 2004; Kleinman, 2005). One might worry that some of these problems are especially likely to afflict efforts to create deliberation in response to scientific research. For example, it is less clear that non-experts can contribute intelligently to technical scientific debates than to discussions about policy making. Moreover, considering that decisions about scientific language often occur when research programs are just beginning to develop, it may be difficult to predict when an area of research will become sufficiently important to merit the cost of deliberative exercises.

These are serious concerns, but they do not completely rule out deliberation as an effective strategy for addressing values in the language of the environmental sciences. They indicate that those seeking to institute deliberative forums need to consider the contextual details of particular research areas and 'diagnose' appropriate formats (see NRC, 1996; Elliott, 2008). For example, MCS might constitute a more promising case for instituting formal mechanisms of deliberation than many other areas of research, because there are already organized groups of people who suffer from the disease and who are passionately interested in research concerning it. Existing evidence suggests that, when citizens are particularly concerned about a specific area of science or technology, they can 'bring themselves up to speed' and contribute to surprisingly technical aspects of research design and interpretation (Brown & Mikkelsen, 1990; Epstein, 2000; Kleinman, 2005).

Deliberative forums can also vary in their formality and in the relative degree of participation from experts as opposed to 'lay people'. For example, the *Understanding Risk* document suggests that 'broadly based deliberation' should meet the following conditions:

> [I]n addition to the involvement of appropriate policy makers and specialists in risk analysis, participation from across [the spectrum of interested and affected parties must be] . . . sufficiently diverse to ensure that the important, decision-relevant knowledge enters the process, that the important perspectives are considered, and that the parties' legitimate concerns about the inclusiveness and openness of the process are addressed. (NRC, 1996, p. 77)

As long as experts bring an adequate range of stakeholder perspectives to deliberative proceedings, and as long as the interested and affected parties regard the decision process as sufficiently inclusive and open, it would appear that deliberations among experts could sometimes satisfy the NRC's criteria for being 'broadly based'. Thus, in technical areas of research where citizen involvement might seem to be unnecessary or problematic, consideration by bodies such as the EPA Science Advisory Board or by National Academy of Science panels might constitute adequate deliberative approaches. For example, the previous section of this paper noted that a panel sponsored by the National Research Council (under the auspices of the National Academy of Sciences) successfully highlighted important linguistic judgments associated with endocrine disruption.

It is also important to remember that 'top-down' deliberative forums are not a substitute for the sorts of 'bottom-up', grass-roots deliberation associated with informal discussions among scientists or political action by concerned citizens. Therefore, it is advisable to regard formal deliberative mechanisms such as advisory bodies or citizen panels as starting points for further democratic deliberation that cannot be easily engineered or controlled from the top down. Formal, organized deliberative forums can be advantageous because of their capability to promote relatively balanced deliberation fairly early in the research process. Nevertheless, one of the goals of these approaches should be to facilitate subsequent stages of more informal discussion, public participation, and political action. In cases where formal deliberative forums are not feasible, the following two strategies discussed in this section can provide alternative ways to promote bottom-up, informal deliberation about significant linguistic judgments in the environmental sciences.

Research-Ethics Training

A second strategy for addressing the ethical significance of language in the environmental sciences is to increase the sensitivity of researchers to this issue in the course of their training in ethics. Heather Douglas has previously argued that scientists need to take increased ethical responsibility for the value-laden judgments that they are forced to make in the course of doing policy-relevant research (Douglas, 2003).[4] Although she is quite sympathetic to the goal of using deliberative forums to incorporate lay people's perspectives concerning these decisions (see Douglas, 2005), she emphasizes that policy-relevant science is so deeply permeated with ethically significant judgments that scientists themselves also need to be prepared to address these issues. Unfortunately, scientists' social responsibilities have generally received less analysis in research ethics than ethical issues 'internal' to scientific practice (e.g. management of data, relationships among researchers, or treatment of human and animal research subjects) (Pimple, 2002).[5]

The good news is that scientists in some of the case studies considered in this paper have already illustrated that they can recognize and address ethically significant decisions associated with scientific language. Consider, for example, that a number of prominent researchers in the MCS case took the initiative to write a letter to the IPCS in order to challenge what they considered to be a biased effort to promote terminology that had significant societal ramifications (Ashford & Miller, 1998). Similarly, scientists such as Deborah Axelrod, Paul Mushak, and Kristina Thayer have challenged a variety of claims about hormesis that could potentially threaten public health (Axelrod *et al.*, 2004; Thayer *et al.*, 2005; Mushak, 2007). Some of their criticisms involved linguistic judgments mentioned earlier in this paper.

More broadly, a growing number of publications in scientific journals have been calling for careful attention to scientific language. Some have highlighted how widespread terms and metaphors, such as 'the struggle for survival', 'selfish genes', or 'biological invasions', can strengthen social ideologies and influence the way the public perceives natural processes (Larson, 2005, 2006; Herbers, 2007). Others warn researchers about significant ways that their work on socially relevant topics like climate change, embryonic stem-cell research, and evolutionary theory can be framed in popular discourse (Nisbet & Mooney, 2007). Still others point out the power of well-chosen concepts and metaphors to facilitate interaction between scientists from a variety of fields as well as the public (Pickett & Cadenasso, 2002, 2006). Thus, incorporating attention to the ethical and societal ramifications of scientific language in research-ethics training addresses concerns that many scientists already have about policy-relevant research. One example of an innovative strategy to promote the ethical sophistication and sensitivity of scientists who work in policy-relevant fields is to 'link' students in the natural sciences with students in the humanities or social sciences so that they can pursue joint research projects on ethical and social issues during their graduate training.[6] Programs of this sort could not only advance scientific education but also provide humanists with an increased understanding of policy-relevant areas of science, which suggests a third approach for addressing the ethical significance of scientific language.

Philosophical Analyses

A third strategy for identifying ethically significant linguistic judgments and for promoting decisions that are responsive to a wide range of ethical considerations is to encourage a broader range of academics and stakeholders, especially environmental philosophers, to analyze the language of the environmental sciences. Many environmental ethicists have been trying to encourage a 'policy turn' in recent years (see Light, 2002a; Frodeman, 2006), but it is sometimes difficult to tell how and whether philosophers can make a distinctive contribution in the policy arena. Nevertheless, if there are any tasks that philosophers are particularly well trained to do, analyzing language is surely high on that list. For example, philosophers of science have previously worked with concerned researchers to highlight a range of sexist biases in scientific language (see Keller & Longino, 1996; Kincaid *et al.*, 2007). Therefore, identifying and analyzing ethically significant linguistic judgments in the environmental sciences would appear to be an excellent way for environmental philosophers to contribute to 'upstream decisions' that ultimately affect the policy realm.

There are already some promising examples of efforts by philosophers to analyze language in the environmental sciences. As mentioned previously, Edward Schiappa (1996) has provided fascinating analyses of the ways in which the definitions of terms like 'wetlands' can shift the burden of proof between environmentalists and developers. Gregory Mikkelson (1997) has not only analyzed various definitions for ecological 'stability', but he has also pointed out that these definitional choices are socially significant, given that the diversity–stability hypothesis has played a major role in conservation initiatives. Kristin Shrader-Frechette and Earl McCoy (1994) have argued that crucial ecological concepts (e.g. 'community', 'ecosystem', and 'stability') are underdetermined and that this underdetermination creates avenues for ethical or societal values to play a major role in resolving policy disputes. Baird Callicott (1996) is more optimistic about the current scientific status of these concepts, but he agrees that the cogency of these categories has significant ramifications for environmental ethics. And, although much of Bryan Norton's recent work has involved the effort to develop appropriate terminology for environmental policy (see Norton, 2005), he has also analyzed ecological science and argued that it needs concepts and terms that communicate information about societal concerns more effectively (Norton, 1998).

This sort of work by environmental philosophers has much in common with the vision of some bioethicists to serve as 'architects of moral space' (Walker, 1993;

Robert, 2008). According to this image, ethicists should 'create and maintain literal and figurative spaces for moral discussion and debate' (Robert, 2008, p. 237). In other words, philosophers can highlight issues (such as the linguistic judgments discussed in this paper) that merit deeper societal discussion and facilitate needed deliberation about them. This approach to practical ethics also has much in common with what Andrew Light (1996) has called 'metaphilosophical environmental pragmatism' or what I have dubbed 'political' (as opposed to 'metaphysical') work in environmental ethics (Elliott, 2007). Rather than attempting to develop controversial theoretical conclusions about debated environmental issues, scholarship of this sort elucidates ethically significant questions and promotes critical reflection, shared understanding, and informed decision making in response to them. This sort of work could also incorporate attempts to clarify how particular linguistic frames affect the attitudes of public groups toward environmental initiatives (see e.g. Light, 2002b). While this need not be the only kind of scholarship that environmental ethicists pursue, one of the goals of this paper is to encourage philosophers, in conjunction with scientists and concerned stakeholder groups, to pursue research of this sort.

Conclusion

This paper has argued, using three case studies from contemporary pollution research, that the language of the environmental sciences (both the categorization of phenomena and the terms employed by researchers) merits ethical scrutiny. Scientific language can influence the future course of scientific research, alter public awareness or attention to scientific phenomena, affect the attitudes or behavior of decision makers, and alter the burden of proof required for taking action in response to environmental concerns. Therefore, contemporary efforts at upstream engagement in the environmental-policy arena may not always move far enough upstream. One way of addressing the ethically significant linguistic decisions in environmental research is to formulate deliberative forums that address not only policy issues but also significant judgments associated with related areas of research. In many cases, however, it may seem unrealistic to initiate proceedings of this sort in response to technical areas of research. Therefore, it is important for scientists and environmental philosophers to be 'on the lookout' for uses of scientific language that are of particular ethical significance. This may constitute one of the important ways in which environmental philosophers can achieve their goal of making substantive contributions to the policy arena.

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Notes

[1] The role of ethical and societal values in scientific research as a whole has been analyzed in great detail by many philosophers of science; see e.g. Douglas (2000), Keller and Longino (1996), Longino (1990) and Kincaid *et al*. (2007). Nevertheless, the significance of scientific language and

categories in particular has received somewhat less attention than many other aspects of scientific practice.

[2] As the final section of this paper discusses, there has been a notable body of work on the ethical significance and conceptual coherence of concepts like stability, the balance of nature, ecological communities, and ecosystems; see e.g. Callicott (1996), de Laplante and Odenbaugh (forthcoming), Mikkelson (1997), Pickett and Ostfeld (1995) and Shrader-Frechette and McCoy (1994).

[3] For a more extensive discussion of how value judgments associated with scientific research might be subjected to deliberative scrutiny, see Douglas (2005).

[4] Douglas focuses especially on scientific judgments that influence the likelihood for researchers to make false positive or false negative errors in their claims about policy-relevant topics. Nevertheless, her concerns apply to a range of other scientific judgments, including decisions about language.

[5] One potential objection to this strategy (i.e. introducing scientists to the significance of linguistic judgments in the course of their research-ethics training) is the suggestion that scientists have no ethical responsibilities to consider the social effects of their linguistic choices. For example, some commentators have claimed that the pursuit of knowledge is so valuable that scientists should not be held responsible for the social consequences of their work. Nevertheless, even though the precise extent and foundation for scientists' ethical responsibilities is a very complex issue, Douglas (2003) has argued convincingly that scientists should not be excused completely from the basic ethical responsibilities that moral agents share, such as the obligation not to act in a negligent fashion to put others at risk of harm. Thus, researchers have at least minimal responsibilities to consider how their judgments, including linguistic ones, might affect other people.

[6] The Center for Nanotechnology in Society at the University of California, Santa Barbara (CNS–UCSB), reported very positive experiences with this approach, as discussed by Barbara Harthorn in a presentation on 'Formal and Informal Nanotechnology Education' at the National Science Foundation Societal Dimensions of Nanotechnology Grantees Meeting in July 2008. It is noteworthy, given the focus in the present paper, that one topic of research for the graduate fellows was 'issue framing'. For a description of the fellows program, see the CNS–UCSB annual reports available at: http://www.cns.ucsb.edu.

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