“Attitudes Toward Managing Hazardous Waste: What Should be Cleaned up and Who Should Pay for It?”

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Attitudes Toward Managing Hazardous Waste: What Should Be Cleaned Up and Who Should Pay for It?

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Hazardous waste policy in the United States uses a liability-based approach, including strict, retroactive, and joint and several liability. To assess attitudes toward these basic principles of liability, and toward priorities for clean-up of wastes, a questionnaire was mailed to legislators, judges, executives of oil and chemical companies, environmentalists, and economists. The questionnaire consisted of abstract, simplified cases, which contrasted basic principles rather than dealing with real-world scenarios. Subjects were asked how they would allocate clean-up costs between companies and government as a function of such factors as adherence to standards, adoption of best available technology (BAT), and influence of penalties on future behavior. Most subjects felt that, if the company followed government standards or used the best available technology (BAT), it should pay for only a portion of the clean-up cost, with the government paying the rest. In general, responses did not support the principles underlying current law—strict, retroactive, and joint-and-several liability. Most subjects were more interested in polluters paying for damages than in deterrence or future benefit—even to the extent that they would have "harmless" waste sites cleaned up. A bias was found toward complete clean-up of some sites, or "zero risk." Different groups of subjects gave similar answers, although more committed environmentalists were more willing to make companies pay and to clean up waste regardless of the cost.

KEY WORDS: Hazardous waste; liability; risk attitudes; decision biases.

1. INTRODUCTION

The issue of liability allocation is at the heart of hazardous waste policy and is essential to an understanding of its subsequent performance. The intent of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or Superfund) was that highly dangerous hazardous waste sites should be cleaned up quickly. To facilitate this process, the government established a fund from a variety of tax sources that may be used to undertake clean-up. Strict liability and retroactive liability were included in the law to ensure that the government is able to receive compensation for the clean-up expenditures that it undertakes or to induce responsible parties to perform the clean-up. Strict liability means that the government has to prove only a party's involvement at a waste site, not its negligence. Retroactive liability means that any party can be held liable for past actions even if it was following prevailing government regulations at the time.

At some CERCLA sites where there are two or more potentially responsible parties (PRPs), the rule of joint and several liability (JSL) has been applied. This rule implies that the PRPs as a whole, or a subset—even including just a single party—may be held liable for all the costs associated with cleaning up a particular site. In other words, JSL could act to divorce the liability
faced by a firm from its actual conduct and responsibility. Controversy has emerged over the effect of this doctrine on the clean-up process (e.g., see Refs. 1–3; for other recent references on the effectiveness of CERCLA in general, and of the Resource Conservation and Recovery Act of 1976, see Refs. 4–8).

The controversy about Superfund raises a number of questions about attitudes concerning fairness in the allocation of clean-up costs and attitudes about the tradeoff between cost and benefits of clean-up. A few studies relevant to the tradeoff question have been done. The cost-allocation question is related to psychological studies of responsibility for harm. These studies have typically found that average responsibility or liability judgments are greater for negligent harm than for unintentional harm, although some responsibility is assigned even for unforeseeable accidents. (9–11) But none of these studies has assessed the number of subjects who would favor strict liability vs. negligence, none has examined the principles underlying ISL, and none has used an environmental context.

We therefore undertook a survey to sample opinions about both liability allocation and about priorities for clean-up. The survey dealt with attitudes about basic principles, so we used simplified cases in an attempt to make these principles salient. We assume that attitudes about such principles play a significant role in determining attitudes toward specific policies and are therefore relevant to understanding the acceptability of hazardous waste policy.

One aim of the survey was to specify the determinants of perceived responsibility for clean-up of past waste, as indexed by allocation of clean-up costs between a company and the government. We shall describe the determinants examined later. The survey also examined attitudes toward the desirability of cleaning up hazardous waste. It has been argued that the public (compared to expert judgment) puts too much emphasis on waste clean-up and that much of the money spent on clean-up could better be spent on reducing other health and environmental hazards. (6,12) Russell et al. (8) estimated the cost of remediation at $750 billion, but they point out that this figure could change by hundreds of billions in either direction with a shift in policy.

Excessive emphasis on clean-up could result from patterns of judgment that are biased with respect to a consequentialist standard (i.e., the principle of bringing about the best overall consequences). For example, people might prefer zero-risk at one site to a greater reduction in total risk (but nonzero-risk) at two sites. Such biases have been found in other studies of individuals who have no particular stake in the outcomes. (13–15) In the type of mail questionnaire distributed in this study, it is impossible to determine the bases for subjects’ responses, so conclusions about biases must remain tentative, unless they are supported by more careful studies in the laboratory.

2. SAMPLES

The groups sampled were the principal parties interested in the formulation and implementation of Superfund. Efforts to ensure return of the questionnaire met with varying success, so samples were not representative of their respective populations. We examine the various groups primarily to determine the extent to which opinions vary across groups, and our samples may be adequate for that purpose. The groups were as follows, with return rates in parentheses after each group name:

Chief Executive Officers (CEOs) of Oil and Chemical Companies (60 returned out of 418 mailed, 14.4%).

We focused, in particular, on those companies that are already contributing to clean-up efforts through feedstock taxes under CERCLA (even though they may be only a small fraction of the PRPs involved in the clean-up effort). The names of the specific companies were obtained from the Dunn’s and Infotrac databases using Standard Industrial Classification codes of the products subject to the chemical and petroleum feedstock taxes.

Economists (57/200, 28.5%). This sample consisted of 20 responses from a random sample of American Economic Association members and 37 responses from a random sample of a list of scholars provided by the Center for Law and Economics at the University of California, Berkeley.

Environmentalists (94/269, 34.9%). This sample consisted of 71 subscribers to the environmental policy newsletter issued by the Council for Economic Priorities and 23 grassroots environmental activists who attended a 1990 meeting, organized by the Philadelphia branch of Clean Water Action, with the EPA Administrator, William Reilly.

Experts on Hazardous Waste Policy (29/100, 29%). This group consisted of professionals representing the different interested parties concerned with hazardous waste policy. All of them participated in a 1990 conference on “Minimizing Environmental Damage: Strategies for Hazardous Waste Management” in the Philadelphia area under the auspices of the Wharton Risk and Decision Processes Center and the Environmental Associates of the Academy of Natural Sciences.

Judges (89/200, 44.5%). These were members of
Judicate, an organization of retired and semi-retired judges who serve as arbitrators.

Legislators (104/1170, 8.9%). Questionnaires were mailed out to members of the following groups: chairpersons of Environmental Committees of State Legislatures; chairpersons of Natural Resources Committees of State Legislatures; all members of the U.S. Senate; members of U.S. House Ways and Means Committee; members of U.S. House Public Works and Transportation Committee; members of U.S. House Energy and Commerce Committee; 10 state legislators each from the 15 states with the lowest and 13 states with the highest number of hazardous waste sites; a random selection of some of the remaining members of the U.S. House. Since only 67 (9.2%) of these questionnaires were returned, a second mailing was sent to 336 federal and state legislators who were members of committees that dealt with hazardous waste policy. The staffer in charge of hazardous waste policy could fill out the questionnaire reflecting the legislator’s viewpoint on the subject. An additional 27 questionnaires were returned from this sample.

3. WHO SHOULD PAY FOR CLEAN-UP: THE ONE COMPANY SCENARIO

3.1. Nature of Cases

The first part of the questionnaire asked subjects how they would allocate the costs of clean-up between a single company that disposed of waste and the government. The following background information was provided: “In 1990, it has been discovered that there is groundwater contamination around a landfill owned and used solely by a well-established manufacturing company. The Environmental Protection Agency has determined that the site needs to be cleaned up.” Subjects then considered the following cases, quoted below essentially in their entirety. (Subjects were not given the case descriptors, such as “Negligence” and “Standards.”)

Case 1 (Negligence). “The party had started disposing of its wastes in the landfill in 1983, well after hazardous waste legislation was passed. It failed to meet government standards for hazardous waste treatment and disposal.” This case reflects gross negligence by the company.

Case 2 (Standards). “What if the company had followed government standards for hazardous waste treatment and disposal? Although it followed the standards, it did not use the best available technology to avoid pollution.”

Case 3 (Profitability). “What if the company did not make a profit from the products that resulted in the hazardous waste by-products? . . .” The rest of this case was identical to Case 2, so that the two cases could be compared.

Case 4 (Improve) and 5 (Stop). These two cases, printed on the same page, were designed to determine whether respondents were sensitive to the consequences of penalties in determining what proportion of the clean-up cost the company should pay. The conditions were as in Case 2 except for the following:

Case 4. “The company in this case makes products that are highly beneficial to people. . . . The more the company is made to pay, the more likely it is that the company and other companies will adopt the best available technology to avoid pollution in the future.” (Other details were identical to Case 2.)

Case 5. This case is the same as 4 except for the last sentence, which reads, “The more the company is made to pay, the more likely it is that the company and other companies, instead of changing their technology, will stop making the products that led to the waste.”

Those respondents who believe that a penalty should be designed to act as a deterrent will favor a higher penalty in Case 4 than Case 5.

Case 6 (Best Available Technology (BAT)). “Suppose that in the early 1980s the company followed government standards and used the best available technology but there was still groundwater contamination from the landfill. Today there is still no way that this leakage could have been prevented.” This case can be compared to Case 2.

Case 7 (Hindsight). This case was designed to test whether respondents would judge past actions by present standards, ignoring the fact that a company may have done the best thing possible at the time. It was identical to Case 6 except that the last sentence read, “Research developments show that the technology used earlier was flawed and that the leakage from the landfill could have been prevented if today’s state-of-the-art technology had been used in the early 1980s.” (In a second version, given to different subjects, the waste is deposited in 1991 and the contamination is discovered in 1995. The responses to the two versions did not differ, so this distinction was ignored.)

Case 8 (Innocent). “What if the company disposed of all of its waste in a landfill in the 1960s, before any legislation on hazardous waste management was passed? It did not treat its wastes before disposal. The company thought that the waste was not harmful. The company
was in compliance with existing standards.” (In a second version, the company “treated its wastes before disposal, voluntarily, using the best technology available at that time?” The responses to the two versions did not differ so they are combined in the analyses.) Those who feel that the innocent polluter should pay a proportion of the cost would be strong believers in strict liability.

3.2. Results

Table 1 shows the average proportion of the costs that subjects assigned to the company for each case. The groups are ordered by the average percentage that they feel the company should pay across all eight cases. The Experts assigned the company the same or a higher proportion of the clean-up costs than any other group for each case. As might be expected, the CEOs treated the company more leniently on the average, but all significant differences in cost assignment among groups disappeared when the experts were excluded from the analysis. (When the experts were included, significant differences among groups are found by a Kruskal-Wallis analysis of variance in Cases 2, 3, and 4.) In general, then, the CEOs did not differ from the other groups. The Experts (and, in the analysis of liability rules, the Environmentalists) accounted for all the significant group differences.

We classified responses to the eight cases into three different liability rules as follows. We recognize that these definitions are not precisely consistent with existing legal terminology but are useful for distinguishing among individuals’ responses.

Strict. The company pays 100% of clean-up costs for all eight cases.

Negligence. We define this term to mean that, if the company followed existing government regulations and standards, it would not be liable for any of the clean-up costs. Under this rule, the company would pay 100% of the costs in Case 1 only and 0% of the costs in the other seven cases.

Partial. This rule falls between the other two. The company’s liability is partial, and is inversely related to its intent to avoid pollution, as evidenced by obeying government standards, utilizing BAT, and/or taking other precautions not legally required. This rule implies that companies would incur some but not all the costs for Cases 2 through 8. (Nine percent of the subjects assigned less than 100% in Case 1. All of these subjects assigned fell into the Partial category for the other cases, so they were included in it.)

Table 1 shows the percentage of respondents in each of the six groups, as well as the entire sample, who subscribed to each of the three liability rules. Across the eight cases, only 18% of the sample imposed a strict liability rule. Even among the environmental group, only 21% favored this rule. At the same time, there was even less sympathy for a negligence rule, with 10% of the respondents favoring it (24% among the economists, who favored it the most). The expert and environmentalist groups tended to favor the strict rule much more than the negligence rule, but the other groups did not differ in this preference. Groups differed significantly in their relative preference for strict vs. negligence: \( \chi^2 = 12.2, 5 \text{ df}, p = .032 \). When the experts and environmentalists were excluded, however, group differences were no longer significant. By far the most common pattern of responses across the one-company cases was partial liability, with 71% of all the respondents favoring this type of rule.

Specific comparisons of cases shed light on the determinants of cost assignments. Groups of subjects did not differ significantly in the extent to which they showed these effects (as indexed by differences between cases), unless differences are reported. The following effects were found (or not found).

A company should pay less in clean-up costs if it

| Table 1. Mean Allocation of Costs to Company in One-Company Cases, by Group, in Order of Overall Willingness to Make Company Pay |
|---|---|---|---|---|---|---|---|---|
| Case: Group | Negligence | Standards | Profit | Improve | Stop | BAT | Hindsight | Innocent |
| Experts | 100 | 80 | 81 | 82 | 71 | 67 | 67 | 52 |
| Environmentalists | 98 | 69 | 68 | 72 | 70 | 51 | 51 | 52 |
| Economists | 98 | 60 | 60 | 65 | 59 | 45 | 45 | 39 |
| Judges | 97 | 59 | 62 | 63 | 58 | 45 | 45 | 40 |
| Legislators | 97 | 63 | 63 | 67 | 63 | 40 | 40 | 39 |
| CEOs | 99 | 54 | 54 | 55 | 56 | 46 | 39 | 38 |
| All | 98 | 63 | 63 | 66 | 62 | 47 | 47 | 42 |
Table II. Percentage of Subjects in Each Liability Category

<table>
<thead>
<tr>
<th>Group</th>
<th>Liability rule</th>
<th>No. of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strict</td>
<td>Partial</td>
</tr>
<tr>
<td>Experts</td>
<td>31</td>
<td>62</td>
</tr>
<tr>
<td>Environmentalists</td>
<td>21</td>
<td>75</td>
</tr>
<tr>
<td>Economists</td>
<td>20</td>
<td>56</td>
</tr>
<tr>
<td>CEOs</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>Legislators</td>
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<tr>
<td>Judges</td>
<td>12</td>
<td>81</td>
</tr>
<tr>
<td>All</td>
<td>18</td>
<td>71</td>
</tr>
</tbody>
</table>

follows government standards, and less if it exceeds standards. Two thirds of the subjects assigned less to the Standards case (Case 2) than to the Negligence case (Case 1); 53% assigned the same amount; none assigned more ($p = .000$, sign test). Subjects also assigned less to the company that uses BAT (Case 6) than the one that simply follows government standards (Case 2). Twenty-five percent of the subjects assigned no cost to the company in BAT (vs. 15% in Standards) and 27% assigned it the full cost (vs. 35% in Standards). Over 45% of the subjects penalized the company less in Case 6 than Case 2, vs. 6% who penalized the company more for adopting BAT (presumably because they had forgotten their response to Case 2). Groups differed significantly ($\chi^2 = 37.7$, $p = .000$): the majority of judges, environmentalists, and legislators assigned less liability when the company used BAT, but only a minority of the other groups did so. Subjects were still more lenient in Case 8 (Innocent) than Case 6 ($p = .000$, sign test), although 24% still assigned the full cost to the company. Groups differed ($\chi^2 = 21.2$, $p = .020$), with environmentalists and experts being more inclined to make the company pay.

The effect of penalties on future company actions has little effect on clean-up cost allocations. Over 75% of the subjects (317 out of 410) made no distinction in their clean-up cost allocation between the situation where the company was more likely to adopt BAT (Case 4) and the situation where it was more likely to stop producing a beneficial product (Case 5). Fifty-nine subjects assigned less of the burden to the company in Case 5 than in Case 4, and nine did the reverse. Although this difference was statistically significant ($p = .000$, sign test), most subjects were insensitive to the effect of penalties on future company actions. This result is consistent with the findings of Baron and Ritov. (16)

No effects of profitability or hindsight were found. Cases 2 and 3 (Profit) did not differ significantly: failure to profit from the waste did not reduce the company's responsibility. Cases 6 and 7 (Hindsight) also did not differ: discovery of a new technology did not increase responsibility.

4. JOINT AND SEVERAL LIABILITY: THE TWO-COMPANY SCENARIOS

In four cases, subjects had to allocate costs between two companies and the government. The use of two parties, both of whom controlled the disposal site, is a convenience that allows us to focus on some of the underlying principles of allocation. Psychological studies of equity (27) have examined the factors linking cost allocations to different "input" variables. Wilkerson and Church (3) suggest that the proportion of clean-up costs assigned to different PRPs will depend on the dominant rationale guiding the Superfund program. For example, a deep-pocket rationale would imply that large companies ought to pay more than smaller companies, regardless of damage caused. A proportionality rationale, on the other hand, might allocate costs on the basis of the proportion of total hazardous waste that the PRP had deposited, assuming that the firm would still be solvent after settlement.

4.1. Nature of Cases

The background information which provided an introduction to the cases went as follows: "In the next three cases, it has been discovered that there is groundwater contamination around a landfill owned jointly and used only by two companies, Large Co. and Small Co. Both companies generated the same kind of hazardous waste. The Environmental Protection Agency has determined that the site needs to be cleaned up. Small Co. has about one third of the assets of Large Co." After each case, subjects were asked to allocate costs among the two companies and the government. They were then asked to allocate costs on the assumption that the government would pay nothing.

Case 1 (Size). "Both companies disposed of their wastes in a landfill in the 1960s, before any legislation on hazardous waste management was passed. Neither company treated its wastes before disposal. Both companies thought that the waste was not harmful, and both were in compliance with existing standards. The proportion of the waste dumped by each company cannot be determined." If individuals were distributing clean-up costs to the two companies on the basis of size, then one would expect that approximately 90% of the com-
pany expenditures would be allocated to Large Co. In the absence of other information, we might expect size to be a good indicator of both the ability of the company to pay and the amount of waste deposited.

Case 2 (Amount of waste). This case was identical to Case 1 except that the last sentence was replaced with: "Small Co. dumped 75% of the waste, and Large Co. dumped 25% of the waste." If the amount of waste is a determining factor in determining cost allocation then Small Co. would pay 75% of the cleanup expenses assigned to industry.

Case 3 (Orphan firm). The case was identical to Case 2 except that the last sentence was replaced with: "Small Co. which dumped 75% of the waste, has since gone out of business and cannot pay anything." This case was designed for subjects to determine who should pay for the shares of companies that are out of business. In the "government can't pay" question, subjects were simply asked whether they found it acceptable for Large Co. to pay the full damage.

Case 4 (Harm). This case was identical to Case 2 except that the waste dumped by Small Co. was harmless. The waste dumped by Large Co. was still harmful.

4.2. Factors Determining Cost Allocations

Table III shows the average percentages allocated to the large and small company. The main results were as follows.

Company assets influence allocation of costs. In Case 1 (Size), where the amount of waste that each company deposited was unknown, subjects took size into account, allocating an average of 59% to Large Co. vs. 17% to Small Co. when the government paid. When the government did not pay, the allocations were 70% vs. 30%, respectively. Seventy-three percent of the subjects assigned more of the cost to Large Co. than to Small Co.; none did the reverse (p = .000, sign test). Some subjects (39% when the government could pay, 32% when it could not) allocated costs in proportion to size (i.e., 10 times as much to Large Co. as to Small Co.). However, 27% of the subjects assigned equal amounts to the two companies whether or not the government could pay, despite the size differences.

Amount of waste deposited influences cost allocation. As shown in Table III, subjects allocate a larger average cost to Small Co. than to Large Co. for the situation where the smaller company deposited 75% of the waste (Case 2). Only two subjects (0.6%) allocated the costs in proportion to company size, whether or not the government paid any share. The majority of subjects allocated costs according to the proportion of waste deposited (54% when the government could pay, 67% when it could not). Relatively few subjects allocated the costs equally between the companies (12% when the government could pay, 8% when it could not).

Interestingly, many subjects regarded equal shares as a better heuristic for assigning cost when they were uncertain about the proportion of waste dumped by each company (Case 1) than when they had this information (Case 2). This behavior is surprising, since the size of the company should be a proxy for the amount of waste dumped (if it is not explicitly specified) as well as for the firm's ability to pay for clean-up.

The government should assume all or most of the orphan share of companies who have deposited hazardous waste. When Small Co. has gone out of business (Case 3) then, according to the doctrine of JSL, Large Co. is forced to pay the orphan share unless the government takes all or part of it over. When contrasted with Case 2 (which is identical in all respects except for the insolvency of Small Co.), the average cost share paid by Large Co. increases from 21–34%, but so does the government's share (42–66%) as shown in Table III. Only 26% of the subjects subscribed to the JSL doctrine by indicating that Large Co. should bear the full cost burden. At the other extreme, 36% felt that the government should pay all the costs that would have been incurred by Small Co. had they still been in business.

Subjects were also asked whether they would find it acceptable for Large Co. to pay Small Co.'s entire share if the government would not pay, as dictated by JSL. Fifty-seven percent of those who answered this question said that this was "unacceptable even if it is the only option." The rest found it "acceptable" (12%) or "acceptable if it is the only option" (31%). Groups differed here ($\chi^2 = 30.9, p = .001$): judges and environmentalists found it more acceptable for Large Co. to bear
the full share, and CEOs found it less acceptable. But 43% of the environmentalists (the most tolerant group) still found it "unacceptable even if it is the only option."

Companies should pay less for cleanup when waste is harmless. Case 4 (Harm) concerned the harm caused by the waste. When Small Co.'s waste was harmless, its average cost allocation dropped from 37% (Case 2) to 4%, as shown in Table III. Since Large Co.'s waste was harmful, it is not surprising that its share rose from 21–52%. Of the sample, 84% felt that Small Co. should pay nothing for clean-up if it had deposited harmless waste.

5. RELATIVE IMPORTANCE OF CLEAN-UP

5.1. Nature of Cases

The final major part of the questionnaire focused on whether certain waste sites should be cleaned up. Subjects were given the following four cases.

Case 1 (Harmless waste, company pays). "A well-established manufacturing company disposed of hazardous waste in a landfill owned and used only by this company in the 1960s, before any legislation on hazardous waste management was passed. It did not treat its wastes before disposal. The site is far from any human settlements, and there is no chance of it being developed. Further, geological conditions prevent the waste from leaking into groundwater that anyone uses. Hence, the waste is completely harmless to people." Subjects were asked, "Should the company be made to clean up the waste?" The possible answers were: "Yes, regardless of the cost.", "Yes, but only if the cost is reasonable.", and "No, it is not worth spending money to clean up the waste." The first answer suggests an unwillingness to consider other possible uses of the funds spent on clean-up.

Case 2 (Harmless waste, government pays). "Suppose that the company in Case 1 was out of business and could not pay. Should the government clean up the waste?" Subjects were given the same options as in Case 1.

Case 3 (Own waste). "Suppose that there are two sites. The waste in the first site was deposited solely by a well-established company beginning in 1983, well after hazardous waste legislation was passed. The company failed to meet government standards for hazardous waste treatment and disposal. The site is far from any human settlements, and there is no chance of it being developed. Further, geological conditions prevent the waste from leaking into groundwater that anyone uses. Hence, the waste is completely harmless to people."

"The second site is on the outskirts of a fast-growing town. At this site, the identical waste was deposited at the second site by a second company, which is no longer in business and cannot pay for clean-up. The second site can be cleaned up for the same amount of money as the first site. The second site is dangerous to human health."

Subjects were asked to rank the following options:

1. The first company should not be made to do anything.
2. The first company should be made to clean up the first site.
3. The first company should be made to clean up the second site.

A ranking of Option 2 higher than Option 3 suggests an "own waste" bias. This case was inspired by the Exxon Valdez oil spill, in which it was argued that the money spent on attempting to clean up the spill would have done more good for the environment if it had been used in other ways. The own-waste bias is thus an opinion that companies should clean up their own waste even if the money could be more effectively spent on other waste. Of course, the idea that people are responsible for the effects of their own behavior is built into law and custom, and the idea of using penalties for other purposes is a fairly novel one.

Case 4 (Natural). "The groundwater and drinking water in two communities are contaminated by a chemical called XYZ, which causes cancer. XYZ is sometimes found in the ground naturally and sometimes as a component of hazardous waste deposited on the ground. The level of XYZ is the same in both communities, but the cause of the XYZ is different.

"Community A: XYZ got into the groundwater because a company deposited it in a landfill. This company disposed of all of its waste in a landfill in the 1960s, before any legislation on hazardous waste management was passed, and it did not treat its wastes before disposal. The company has since gone out of business. It cannot pay anything.

"Community B: XYZ got into the groundwater through a natural process. It was not produced by any human action." Subjects were asked which community was more important to clean up. They had the option of responding that they were equally important.

This case was inspired by the comparison between the cost-effectiveness of hazardous waste clean-up and remediation of indoor radon. It has been argued that the health benefits per dollar are higher for radon reduction.
than for clean-up of hazardous waste, even though considerably more funds have been allocated for cleaning up waste. Spranca, Baron, and Baron and Ritov found a tendency to give nature the benefit of the doubt in a variety of judgment tasks.

Case 5 (Zero-risk bias). “Two cities have landfills that affect the groundwater in the area. The larger city has 2,000,000 people, and the smaller city has 1,000,000. Leakage from the landfill in the larger city will cause 8 cases of cancer per year. Leakage from the landfill in the smaller city will cause 4 cases of cancer per year. Funds for clean-up are limited. The following options are available:

1. Partially clean up both landfills. The number of cancer cases would be reduced from 8 to 4 cases in the larger city and from 4 to 2 cases in the smaller city.

2. Totally clean up the landfill in the smaller city and partially clean up the landfill in the larger city. The number of cancer cases would be reduced from 8 to 6 cases [7 for half the subjects] in the larger city and from 4 to 0 cases in the smaller city.

3. Concentrate on the landfill in the larger city, but partially clean up the landfill in the smaller city. The number of cancer cases would be reduced to 8 to 3 cases in the larger city and from 4 to 3 cases in the smaller city.” Subjects were asked to rank these options. Subjects who favored zero-risk should favor Option 2. If this bias is strong enough, some subjects will favor this option even when the total reduction in risk is less than it is for the other options. Viscusi et al. and Ritov et al. have found evidence for such a “zero-risk” bias.

5.2. Results

The questions on importance of clean-up were designed to look for biases—that is, decision-making practices that favor options that do not seem to produce the best overall consequences. The main results were:

A few people say they would pay any price to clean up harmless waste. In Case 1 (company), 17% of the subjects said that the waste should be cleaned up regardless of the cost; in Case 2, where government pays, only 14% felt the waste should be cleaned up. Groups also differed significantly: χ² = 42.2 for Case 1, 25.4 for Case 2, p = .000 for both. Environmentalists were most likely to endorse this answer (40% for Case 1, 28% for Case 2); experts were least likely (3% for Case 1, 0% for Case 2). In sum, many subjects seem unwilling to consider other uses of money spent on clean-up, or, at least, they are unwilling to admit doing so. (The case specified that the waste is “completely harmless to people,” so a subject might feel that the clean-up is worthwhile because of the consequences for animals. At least for this reason, we cannot assume that all responses are biased.)

People exhibit an own-waste bias. The critical comparison in Case 3 (own waste) was the ranking of two options: cleaning of harmless waste deposited by the solvent company or cleaning of harmful waste deposited by a defunct company. Those who ranked the first option higher are said to display an own-waste bias. Fifty-one percent of the subjects showed this bias. To our knowledge, no previous study has demonstrated the use of this type of decision rule. We note again, however, that this bias is built into the law, possibly for good reason.

Few people exhibit a naturalness bias. Over 90% treated natural and human-caused waste equally. These individuals did not exhibit a naturalness bias. Approximately 8% of the subjects favored cleaning up the company’s waste; only 1% favored the natural waste (p = .000 by sign test for the difference). The small number of subjects showing the effect suggests that it is not important in practical contexts. However, we took pains to make the effect obvious; in real cases, naturalness bias might play a more important role.

People exhibit a zero-risk bias. Zero-risk bias is defined as a preference for cleaning up a waste site completely, even if the total number of lives saved as a result of this strategy is lower than the number that would be saved if the identical resources had been expended toward cleaning up two different waste sites partially. Two versions of Case 5 (given to different subjects) tested this bias. In both versions, partial cleanup of both sites saved 6 cases of cancer. Complete cleanup of one site combined with partial cleanup of the other saved 6 cancer cases in Version 1 (the same as the other options) and 5 cases in Version 2 (one less than the other options). In Version 2, the zero-risk option is worse than the other two options.

Zero-risk bias in Version 1 was defined as ranking Option 2 (complete-reduction) as the best of the three alternative choices. Eighteen percent of the subjects favored this option over the other two. In Version 2, the bias was defined as not ranking the complete-reduction option as the worst of the three options. (It should be ranked worst because it saves fewer cancer cases.) Forty-two percent of the subjects exhibited this “zero-risk” bias. (Eleven percent ranked the complete-reduction option as best. The bias was related to group in both versions [χ² > 20, p < .01]: legislators, judges, and environmentalists exhibited the bias most frequently, while experts and economists showed it least.)
One of the criticisms that can be leveled against the Superfund program is that its strategy of requiring complete clean-ups at sites results in an inefficient utilization of clean-up resources. The zero-risk bias suggests a psychological basis for this inefficient strategy.

6. ENVIRONMENTALISM

Given their different interests, we expected to find large differences among the six groups of subjects. In fact, very few differences were found. Specifically, there were no statistically significant differences in the effect of the following factors on cost allocations: whether the company followed standards; incentive effects through penalties; the invention of a new technology; the size of the company; the amount of waste; and the harmlessness of waste (for purposes of cost allocation). The percentages of subjects who exhibited the own-waste bias and the naturalness bias were also similar across all six groups.

Those group differences that were found (previously noted) suggest that environmentalists and experts tended to be more inclined to clean up waste and more inclined to make companies pay for it. The attitude of these groups may perhaps be explained by their inclination to support the current law. The questionnaire did give subjects the option to indicate why they responded to difference cases, but subjects gave few such explanations.) In addition, economists and experts were less inclined to display zero-risk bias, as one would expect on the basis of their professional training. (Many of the experts had economic or statistical training.)

We were interested in whether classifying the subjects as a function of their attitude toward environmentalism would show sharper differences. Two questions near the end of the survey asked subjects: “Do you consider yourself an environmentalist?” (312 yes, 81 no) and “Are you a member of any environmental organization?” (152 yes, 242 no). Of the 152 who answered yes to the second question, all but six answered yes to the first as well. Our environmentalism measure was the number of yes answers given to the two questions together. Those who answered yes to both questions were given a score of 2, while those who answered no to both questions were given a score of 0. The mean environmentalism scores of the six groups were (in rank order): environmentalists (1.72); experts (1.31); legislators (1.15); economists (1.08); judges (0.94); and CEOs (0.83). Although the group differences are highly significant statistically, it is apparent that environmentalists can be found in all groups.

Accordingly, we looked for rank-order correlations, as measured by Kendall’s $\tau$ statistic, between this environmentalism score and the use of all the guidelines and decision rules we have described. Although our analyses reported earlier did not show consistent differences between environmentalists and other groups in the assignment of costs to companies, the present analysis found more consistent correlations between environmentalism and assignment to companies across the one-company cases. (Environmentalism was significantly correlated, at $p<.01$, with greater assignment of costs to companies in one-company Cases 2, 3, 4, 5, and 8.) Likewise environmentalism was correlated with greater acceptance of Large Co. paying Small Co.’s share when the latter had gone out of business ($\tau = 12, p = .007$). (But 47% of those with environmentalism scores of 2 still found it totally unacceptable.) And environmentalism was associated with greater willingness to clean up harmless waste regardless of the cost ($\tau = .19$ for two-company Case 1, .18 for Case 2, $p = .000$ for both). 5

7. CONCLUSIONS

Our results suggest that three provisions of the Superfund law—strict, retroactive, and joint and several liability—run counter to the intuitions of most subjects in all groups, even those who are familiar with the current law. Only 18% endorse strict liability consistently, and only 26% endorse JSL in the Orphan case. In place of JSL, most subjects tended to favor proportional liability based on the amount of waste and its harmfulness, allocating costs on the basis of company size only when the amount of waste deposited by each company was unknown.

Most respondents felt that the government should absorb some or all of the costs if companies have followed standards or utilized the best available technology. This result suggests that people would favor a larger role for the government in bearing clean-up costs.

Many subjects, especially environmentalists, say that waste should be cleaned up regardless of the cost. Even if this extreme response is designed to maximize impact, it could lead to an expenditure of funds on one kind of

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5 Environmentalism showed two other correlations. First, it was related to taking BAT into account in assigning costs (Kendall’s $\tau = .0.14$, $p = .006$): environmentalism correlated with assigning lower costs to the company in one-company Case 6 (BAT) than in Case 2 (Standards). Second, environmentalism was correlated ($\tau = .0.15, p = .004$) with a hindight effect in the one-company scenario: environmentalists wanted the company to pay more when a new technology had been discovered after the waste had been deposited; nonenvironmentalists (inexplicably) wanted the company to pay less (15 to 6).
clean-up that could be put to more cost-effective use in other activities that would achieve the same general goals. In addition, many subjects favor the idea that polluters should clean up their own waste, even if the money they pay to do this could be used more cost-effectively elsewhere. A few subjects think that human-caused waste is more important to clean up than otherwise identical natural chemicals. And many subjects favor complete clean-up of some sites rather than greater partial clean-up of several sites at the same or lower cost.

All these biases together—even in different individuals—could work to create public support for ambitious clean-up programs. Given the fact that clean-up is expensive (even putting aside the costs of litigation), it is prudent to ask whether the money could be reallocated to achieve the same general goals at a lower cost. If the public resists such questioning, then education may be helpful in clarifying the relation between decision-making practices and consequences.

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REFERENCES