

# The Effects of Hindsight Bias and Causal Attribution on Human Response to Environmental Events<sup>1</sup>

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This research examined the influence of hindsight bias and causal attribution on perceptions of a technological disaster. After reading a fictitious account of a toxic substance spill near a populated area, subjects were provided with information that disease rates had either increased or had remained stable (hindsight conditions), or were presented with no outcome information (control condition). Subjects were then asked to predict the likelihood of increases in disease rates and to make causal attributions regarding the target company and residents of the disaster community. When compared to subjects provided with either no outcome information or with information that disease rates remained stable (positive-outcome condition), subjects told that disease rates had increased (negative-outcome condition) showed elevated predictions regarding future disease rates, ascribed greater responsibility for the accident to the target company, and reported more anger toward the company and greater sympathy for the residents. Subjects receiving positive outcome information and no outcome information did not significantly differ on these measures. In addition, results from a path analysis supported the efficacy of attribution theory to account for the cognitive, affective, and behavioral consequences resulting from hindsight bias following a negative environmental event.

Findings from hindsight bias (Fischhoff, 1975) and causal attribution research (Weiner, 1986) are especially informative in understanding some relevant kinds of cognitive processing that individuals perform on information related to tragic or near-tragic occurrences. These information processing activities can lead to a variety of observer reactions to negative events. Hindsight bias documents how persons advantaged with knowledge of an outcome may be more certain in retrospect that they would have accurately predicted the event than are individuals without this knowledge (e.g., Fischhoff & Beyth, 1975; Wood, 1978). Attribution theory specifies the cognitive, affective, and behavioral consequences of assigning particular causes to events (Weiner, 1985, 1986). Although hindsight bias research has mostly addressed the

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cognitive implications of this processing activity (e.g., individuals' inability to remember accurately what they knew about the likelihood of an event prior to its occurrence; Powell, 1988; Synodinos, 1986), the potential effects of hindsight bias on emotion and behavior, as well as the causal relations between these response modalities, remain largely unexplored. In the research reported in this article, we test the efficacy of attribution theory to specify systematically the nature of observer thoughts, feelings, and actions, and the potential causal links between these variables, that result from hindsight bias following negative events.

### *Hindsight Bias*

That the possession of outcome knowledge can bias retrospective probability estimates is well documented (for reviews see ChristensenSzalanski & Willham, 1991; Hawkins & Hastie, 1990). Hindsight bias has been demonstrated to affect the ability of individuals to recall accurately their estimates of event probabilities prior to their occurrence in a variety of domains including medical diagnoses (Arkes, Saville, Wortmann, & Harkness, 1981), political election outcomes (Powell, 1988), and legal judgments (Bodenhausen, 1990; Sue, Smith, & Caldwell, 1973). With regard to political election outcomes, for example, Synodinos (1986) asked subjects to estimate the percentage of votes going to each of three candidates either before or after the 1982 Hawaiian gubernatorial election. Despite instructions to respond as if they did not know election results, subjects polled after the election were more confident in their predictions than were subjects questioned before the election.

In an investigation that was to become a prototype for future hindsight bias studies, Fischhoff (1975) examined the influence of outcome information regarding historical events on postdicted likelihood appraisals and subject awareness of these influences. Subjects were given descriptions of unfamiliar events, for example the 19th-century British-Gurka war, followed by four possible outcomes and data relevant to determining the outcomes. Subjects assigned to hindsight conditions were told that one of the four possible consequences was the actual outcome. Subjects in the non-hindsight condition were given no outcome information. Next, subjects indicated their predictions regarding the probability of each outcome on the list and, in the hindsight conditions, to respond as if they had not been told what happened. Results showed that subjects given an outcome were mostly unable to ignore this information when making probability judgments. These subjects indicated greater certainty that they would have predicted the outcome, and that antecedent data was important in determining its realization, than did subjects not given an outcome.

Fischhoff (1975) labeled as creeping determinism, the tendency for

persons cognizant of an outcome to unconsciously assimilate information preceding the event into knowledge structures related to it. This tendency can result in the perception of antecedent events as being inexorably linked to the outcome such that the outcome was largely inevitable; the “knew-it-all-along” comment is a prototypical phrase that often accompanies retrospective insight. An unexplored implication of creeping determinism is the extent to which target agents are blamed for failing to see the likelihood that certain earlier events lead to a negative outcome and the consequences stemming from this perceived negligence. For example, following a technological disaster such as a toxic chemical spill resulting from a train derailment, certain conditions existing prior to the accident may be perceived as its cause. Through hindsight bias and the mechanism of creeping determinism, observers may hold the railroad company liable for not foreseeing the causal relations between particular antecedent conditions such as training protocols of railroad workers, policies regarding loading of materials on flatcars and the like, and the accident. This perceived lack of foresight, in turn, may have implications for observers’ emotional and behavioral responses regarding the railroad company and persons injured or property damaged because of the derailment. For example, interested parties may become angry and seek retribution from the railroad company for failing to train rail workers properly or to implement safer loading procedures. At the same time, sympathetic responses and increased efforts to obtain compensation may be forthcoming for persons injured because of the derailment.

Although hindsight bias (creeping determinism) can explain potential biases in retrospective probability estimates, it does not by itself offer a theoretical account of the possible cognitive, affective, and behavioral consequences arising from them. To the extent that hindsight bias stimulates a search for reasons why a negative event has happened (e.g., what should have been known or foreseen prior to an outcome), it is necessary to identify the process whereby observers’ causal ascriptions give rise to affective and behavioral responses. To account for these potential reactions, we relied on attribution theory (Weiner, 1985, 1986) to supply the theoretical constructs to forge the connection between hindsight bias and observer responses.

### *Attribution Theory*

Observers may ascribe innumerable causes for negative outcomes; an automobile accident may be attributed to alcohol consumption, driver carelessness, hazardous road conditions, mechanical failure, and so on. Regardless of their surface or manifest characteristics, Weiner (1986) has proposed three underlying or latent properties of causes: Locus of causality refers to the perception of a cause as internal or external to the actor; stability refers to the extent a

cause is seen as fixed or changeable over time; and controllability refers to the amount of volitional influence associated with the cause of an outcome. Carelessness, for example, is internal to the driver whereas road condition is external. Alcohol consumption may be seen as a stable cause, especially if the driver is viewed as an alcoholic, or as an unstable cause, if drinking reflects uncharacteristic behavior. The accident may be due to the motorist's willful neglect of proper maintenance, a controllable cause, or because of unforeseen tire failure, an uncontrollable cause. Further, each of these underlying properties or causal dimensions are associated with distinct cognitive, affective, and behavioral ramifications. For example, heightened attribution of blame, greater anger, and increased likelihood of lawsuits are expected from injured pedestrians if the automobile accident is ascribed to a controllable cause (e.g., driver carelessness) than to an uncontrollable cause (e.g., hazardous road conditions). At the same time, increased sympathy and greater financial compensation is anticipated from jurors who ascribe plaintiff injuries to causes controllable by others.

We proposed that attribution theory (Weiner, 1985, 1986) potentially offers a systematic explication of how perceptions resulting from hindsight bias elicit specific thoughts and emotions, and particular actions. For example, referring to the aforementioned train derailment, hindsight bias may lead observers to perceive that it was highly likely for the accident to occur, and to attribute that increased likelihood to the railroad company's previous negligent activities. To the extent that negligence is categorized as a controllable rather than as an uncontrollable cause, observers are expected to react with more anger and with increased willingness to inflict punishment on the target company and to feel sympathy and seek financial compensation for the victims. Several investigations support this expectation (see review in Weiner, 1993). To test this, we examined the variability of perceived likelihood of the event among subjects given a hypothetical scenario depicting an environmental event where the outcome was either presented or was withheld and, when presented, varied with respect to valence (either positive or negative outcome). We then examined the attributions made by the subjects predicated on these perceptions of event likelihood.

## Method

### *Overview and Hypotheses*

Subjects read about a company that disposed of hazardous waste material near a community. Some subjects read that groundwater in the community became contaminated and that cancer rates either subsequently increased (negative-outcome information condition) or stayed the same (positive-outcome

information condition). A third group was given no information about groundwater contamination or cancer rates (control condition). In comparison to subjects presented with either positive or no outcome information, subjects given negative outcome information were expected to show hindsight bias effects (perceive increases in cancer rates as more likely), heightened perception of company responsibility, increased anger and harsher punitive action directed at the company, and more sympathy and greater financial compensation for the alleged victims. Conversely, in comparison to the control group, subjects given positive outcome information were expected to perceive increases in cancer rates as less likely, view the company as less responsible, report a reduction in both anger and willingness to take punitive against the company, and offer less sympathy and lower financial compensation for the alleged victims.

### *Subjects*

The subjects were 39 male and 56 female students at the University of California, Los Angeles (UCLA), whose mean age was 20.10 years ( $SD = 3.56$ ). Subjects participated as part of an introductory psychology course requirement. Participants were randomly assigned to negative outcome information ( $n = 32$ ), positive outcome information ( $n = 32$ ), or control conditions ( $n = 31$ ) and were tested in groups ranging in size from 1 to 8 persons.

### *Materials and Procedure*

Upon arrival in the experimental room, subjects were informed that they were participating in an experiment regarding perception of environmental events. Subjects were instructed to read a scenario about an environmental event and to answer the questions that followed. Regardless of condition, all subjects read the following paragraph:

For ten years, from 1972 to 1982, the Sherdon landfill operated legally about 5 miles outside the small community of Hanville Station. Many companies used the Sherdon site to dispose of a variety of hazardous materials. The Williams Corporation produced toxins as a byproduct of their production processes, stored those toxins in 55-gallon sealed containers, and buried them ten feet deep in the Sherdon landfill. The Williams Corporation was in compliance with all regulations throughout the entire course of their dumping materials at the Sherdon site, and was not in violation of any environmental guidelines established at that time.

Only subjects presented with outcome information read two additional paragraphs in which information regarding cancer rates was varied. The first additional paragraph provided information to subjects in both the negative- and positive-outcome conditions that the groundwater was contaminated. In the second additional paragraph, subjects in the negative-outcome condition read that cancer rates increased whereas the positive-outcome group read that cancer rates remained stable:

In 1982, the Sherdon site was closed and all dumping at the landfill was halted. In 1992, the Environmental Protection Agency (EPA) called for an investigation on the impact of all hazardous waste landfills which had operated within the past twenty years on the water supplies of neighboring communities. As a result, the EPA determined that the water supply was contaminated.

A few years later, EPA called for another analysis, including the health effects that hazardous waste landfills may have on the residents of neighboring communities. Investigators looked at Hanville Station community health records for ten years immediately prior to the opening of the Sherdon site (1962-1972), the ten years the site operated (1972-1982) and the ten year period following the closure of the site (1982-1992). They found that there *was more (no increase in)* cancer among Hanville Station residents since the opening of the Sherdon site. This was true for Hanville Station, and for all of the other communities nearby.

### *Dependent Measures*

After reading the scenario, subjects responded to three sets of dependent variables using 9-point Likert scales:

*Set 1* = 3 questions measuring hindsight, that is, at the time of disposal company operations, how likely and foreseeable was it that disease would increase, ranging from *not at all* (1) to *very* (9): (a) likelihood of cancer; (b) likelihood, other diseases; and (c) foreseeability of health effects.

*Set 2* = 14 questions measuring attributions with respect to the Williams Corporation, ranging from *no or not at all* (1) to *very* (9); in regard to cancer rates, degree of: (a) responsibility, (b) fault, (c) control, (d) blame, (e) negligence, (f) anger directed at company, (g) sympathy, (h) annoyance, (i) sorrow, (j) mad, (k) irritated, (l) pity, (m) likelihood of revoking operating license, (n) amount of fine levied against company, ranging from *nothing* (1) to *as much as possible* (9).

Set 3 = 13 questions measuring attributions with respect to residents. The first 12 questions were identical to those in set 2 measuring attributions regarding the Williams Corporation. Question 13 asked how much subjects would award residents in a lawsuit (1 = *nothing*; 9 = *as much as possible*).

Upon completion of the dependent measures, subjects were thoroughly debriefed on the purpose of the experiment. Subjects were then thanked for their cooperation and dismissed.

## Results

### *Initial Analyses*

Analysis of variance (ANOVA) revealed a significant main effect of hindsight condition on perceived likelihood of cancer,  $F(2, 92) = 6.56, p < .002$ . Planned comparisons showed that subjects who received outcome information that cancer rates had increased predicted that future cancer rates would increase to a greater extent ( $M = 7.03, SD = 1.15$ ) than did either subjects who received information that cancer rates had remained constant ( $M = 5.59, SD = 2.09$ ),  $t(62) = 3.41, p < .001$ , or subjects given no outcome information ( $M = 5.94, SD = 1.59$ ),  $t(61) = 3.13, p < .003$ , thus supporting the presence of a hindsight bias in the negative-outcome condition. Although the means for the positive-outcome information and control conditions were in the predicted direction (5.59 and 5.94, respectively), their difference was not reliable. Thus the hindsight bias was more robust among subjects presented with negative-outcome information.

### *Indices*

To facilitate additional analyses, indices of cognition, affect and action were constructed. The means for fault, negligence, control, and blame were combined to form an overall index of *responsibility*, with internal consistency reliability ( $\alpha = .93$ ). Measures of anger, mad, irritation, and annoyance were summed to form a composite of anger ( $\alpha = .96$ ), and the means for pity, sorrow, and sympathy were added to form an index labeled *sympathy* ( $\alpha = .91$ ). A final index gauging actions was constructed by combining the means of subjects' willingness to revoke The Williams Corporation's license to operate, the amount of fine levied against the company, and the amount of award given to the residents in the lawsuit ( $\alpha = .86$ ).

Analyses of variance were carried out on the constructed indices for the negative outcome, positive outcome, and control conditions. As Table 1 shows, differences between the groups on responsibility inferences regarding The Williams Corporation and sympathy for the residents reached statistical

significance. Although there was a trend toward differences in anger at The Williams Corporation, it failed to reach an acceptable level of significance. However, planned contrasts of the indices between the negative-outcome and positive-outcome conditions revealed a number of significant findings. In comparison to subjects with knowledge that cancer rates remained stable, subjects presented with information that cancer rates increased attributed greater responsibility to the corporation,  $t(62) = 3.17, p < .003$ , reported feeling more anger for the corporation,  $t(62) = 2.48, p < .02$ , and greater sympathy for the residents,  $t(62) = 3.59, p < .002$ . The negative-outcome group also indicated more willingness to take punitive action against the corporation, but this difference was only marginally significant,  $t(62) = 1.67, p < .10$ . Compared to the control group, subjects in the negative-outcome condition showed more sympathy for the residents,  $t(61) = 3.49, p < .001$ , but differences in perception of responsibility and in anger toward the company were not reliable. Additional analyses comparing the positive-outcome and control conditions revealed means in the expected direction, but differences in responsibility, anger, sympathy, and action did not reach conventional levels of significance, thus confirming a lack of effect for the hindsight bias in the positive-outcome condition.

### *Path Analysis*

Figure 1 shows the proposed causal relationships between perceived likelihood of cancer and responsibility, affect, and action. The variables used in the path analysis include: (a) outcome information; (b) the single-item question regarding perceived likelihood of cancer; (c) the index of responsibility regarding The Williams Corporation; (d) the index of anger at The Williams Corporation; (e) the index of sympathy for the residents of Hanville Station; and (f) the index of actions comprised of the subjects' willingness to revoke The Williams Corporation's license to operate, the amount of fine levied against the company, and the amount of compensation awarded to the residents in the lawsuit. These variables were chosen because they bring together the variables of interest in hindsight bias research (perceived likelihood) and the cognitive, affect, and action variables of interest to attribution theory (responsibility, anger, sympathy, and actions).

Path analysis provided support for the model in Figure 1. Subjects' perceived likelihood of cancer, which was increased because of hindsight bias in the negative-outcome condition and decreased (marginally) in the positive-outcome condition, significantly influenced cognitions regarding The Williams Corporation, path coefficient = .38;  $R^2 = .14, F(1, 93) = 15.25, p < .0002$ . Increasing the perceived likelihood of cancer led to ascriptions of greater control, negligence, responsibility, fault, and blame regarding the company. To separate the effect that outcome information has on these cognitions

Table 1

*Means, Standard Deviations, and Group Comparisons of Indices*

Index	Negative outcome ( <i>N</i> = 32)		Positive outcome ( <i>N</i> = 32)		Control ( <i>N</i> = 31)		Total ( <i>N</i> = 95)		Analysis of variance	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i> <
Cognitions re: Williams Corporation	25.31	9.84	17.34	10.29	22.07	10.43	21.42	10.60	4.99	.009
Cognitions re: residents	12.66	6.77	16.44	9.53	15.57	8.96	14.79	8.56	1.73	.183
Sympathy for Williams Corporation	11.69	5.53	11.03	5.25	10.73	5.67	11.16	5.44	0.25	.781
Sympathy for residents	20.59	4.80	15.31	6.79	16.07	6.08	17.24	6.36	7.44	.001
Anger at Williams Corporation	20.28	8.91	14.78	8.83	18.13	9.52	17.72	9.27	2.98	.056
Anger at residents	10.91	6.28	13.61	7.63	12.70	7.60	12.43	7.20	0.92	.403
Actions	14.25	6.97	11.34	6.93	13.47	6.31	13.01	6.79	1.58	.211

from the influence of the perceived likelihood of cancer, an additional regression equation was tested using outcome information and perceived likelihood of cancer to predict responsibility.<sup>3</sup> This equation was significant,  $R^2 = .18$ ,  $F(2, 92) = 10.02$ ,  $p < .0001$ . Of specific interest here is that perceived

<sup>3</sup>The authors are grateful to an anonymous reviewer for suggesting that responsibility may be based on the valence of outcome information, thus prompting this analysis to control for this possible effect.

likelihood of cancer remained a significant predictor of cognitions regarding responsibility, path coefficient = .31,  $p < .003$ , even while controlling for the more modest influence of outcome information, path coefficient = .21,  $p < .05$ . Given the significant influence of outcome information on predicting responsibility, this variable has been retained in the model. Additional analyses including outcome information showed no effect for this variable on anger toward The Williams Corporation, sympathy for the residents, or actions undertaken by the subjects; thus this variable was excluded from further analyses and discussion.

In addition, perceptions of disease likelihood had affective ramifications. Perceived likelihood of cancer was a significant predictor of both anger at The Williams Corporation and sympathy with respect to residents of Hanville Station, respective path coefficients are .16 and .26, both are significant,  $p < .02$  and  $p < .004$ , respectively. These results show a direct effect of perceived likelihood of cancer on these affects, over and above the influence of perceived cancer likelihood as mediated by perceived responsibility.

In general, the findings support the cognitive-affect-action model of attribution theory (Weiner, 1985, 1986). A regression equation reflecting the paths predicting anger toward The Williams Corporation with cognitions of responsibility and perceived likelihood of cancer was significant,  $R^2 = .67$ ,  $F(2, 91) = 92.62$ ,  $p < .0001$ . Additionally, these variables were significant in predicting sympathy for the residents of Hanville Station,  $R^2 = .38$ ,  $F(2, 92) = 28.46$ ,  $p < .0001$ . Specifically, cognitions regarding The Williams Corporation were shown to influence anger at The Williams Corporation, path coefficient = .74;  $p < .0001$  and sympathy with respect to residents of Hanville Station, path coefficient = .47;  $p < .0001$ . Further, these affects led to actions. The equation reflecting the paths predicting actions using responsibility, sympathy and anger toward The Williams Corporation, and sympathy for the residents of Hanville Stations as predictors was highly effective,  $R^2 = .67$ ,  $F(3, 90) = 59.71$ ,  $p < .0001$ . The most powerful predictor of actions in the model was the degree of anger directed at The Williams Corporation, path coefficient .49;  $p < .001$ . Sympathy for residents of Hanville Station was less powerful, but nevertheless was a significant predictor of subjects' actions, path coefficient .18;  $p < .02$ .

These influences were compounded by the direct influence of cognitions on actions, that is, the extent to which beliefs of responsibility influence willingness to revoke the company's operating license, the magnitude of fines levied against the defendant in a civil lawsuit, and the size of a financial award given to civil tort plaintiffs. Although the cognitive-affect-action model does not posit this direct relationship between cognitions and actions, these data support that model. The influence of cognitions on actions as moderated by affect

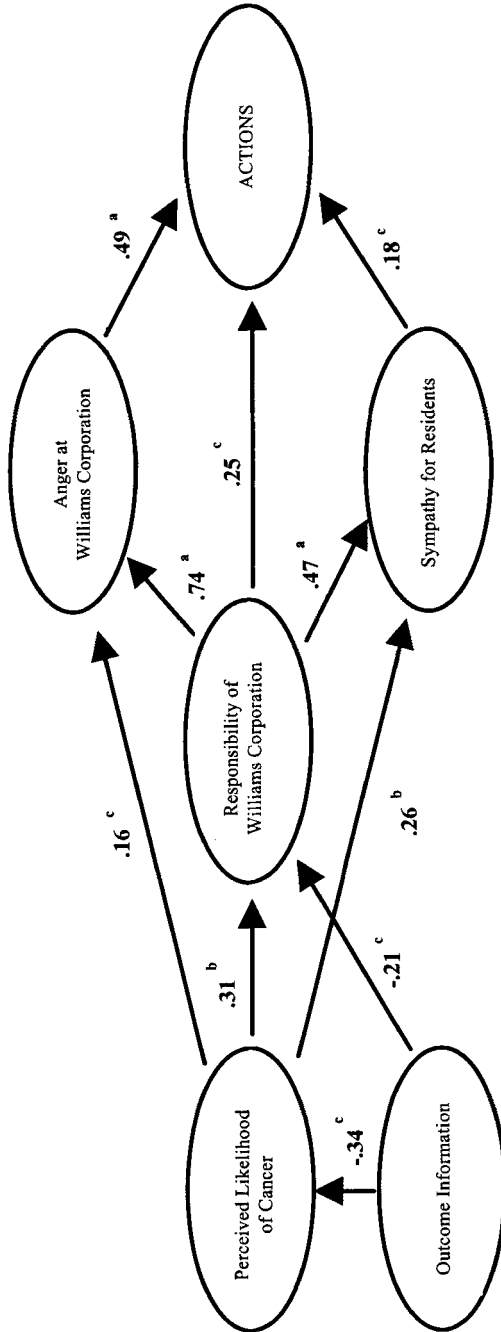


Figure 1. Path analytic model linking perceived likelihood of cancer with the cognitive, affective, and behavioral aspects of attribution theory. Superscripts indicate the significance levels of the path coefficients: a =  $p < .001$ , b =  $p < .01$ , c =  $p < .05$ .

$[(.74)(.49) + (.47)(.18)] = .50$  is much stronger than the direct influence of cognitions on these actions (.25).

### Discussion

The data support the link between hindsight bias, causal attributions, and the quality of cognitive, affective, and behavioral reactions. Following receipt of information about a potential environmental disaster, subjects with knowledge of increased cancer rates exhibited greater hindsight bias (i.e., saw cancer as having been more likely) than did subjects with knowledge that cancer rates were unchanged. Additionally, subjects presented with the more negative outcome judged the waste disposing company as more responsible for cancer, reported more anger at the company, greater sympathy for community residents, and were increasingly willing to take punitive action against the company, than were subjects with knowledge of stable cancer rates.

Results from the path analysis were consistent with predictions from Weiner's attribution theory regarding the cognition-emotion-action process underlying behavior: Subjects' retrospective predictions that increases in disease were likely (hindsight bias) were linked to increments in perception of company responsibility; these cognitions, in turn, were linked to anger at the company and to sympathy for the residents; the influence of cognitions on willingness to revoke the company's license, and disposition to award compensation to victims, were directly and indirectly mediated by affect. Thus, our hypotheses regarding the influence of hindsight bias on the attributional process following a negative environmental event were supported.

Findings showed that anger played a prominent role in predicting action. This was especially the case when the outcome was negative. That is, anger and willingness to fine and revoke the target company's operating license were greater when subjects had knowledge of increased rather than stable cancer rates. This is consistent with Weiner's view regarding the link between negative outcomes, responsibility inferences, anger, and retribution. As Weiner (1993) put it:

... external causality and responsibility for a negative event elicit anger...Affects then function as goads that evoke response tendencies. Specifically, anger directs the experiencer of this emotion to "eliminate" the wrongdoer (i.e., retaliate with some form of aggression or withhold a desired object). In so doing, there is moral retribution, the likelihood that the act will be repeated may be diminished, and observers as well as the transgressor are provided with a "moral education."  
(p. 959)

Hence it is not surprising that knowledge of increased cancer rates, certainly a more negative outcome than stable rates, would lead to elevated responsibility inferences. The belief that the disposal company neglected to foresee the inevitable consequences of their actions aroused anger. Anger, in turn, spurred subjects to retaliate by enrolling the target company in a course of "moral education" through fines and confiscation of operating license. This is the process that environmental activists perhaps unwittingly engage in, for example, when they attempt to arouse anger among observers for alleged transgressors. Likewise, those accused of causing environmental degradation and disease may attempt to mitigate perceived culpability and defuse anger by offering excuses and appealing for sympathy. Aside from cold presentation of alleged offenses or mitigating circumstances, infusing the debate with emotion increases the likelihood that desired actions will be taken, either to condemn or to exonerate.

There are limitations, however, to what can be inferred from the present study and applied to real-world situations. Due to the implicit assumptions of path analytic techniques, we presume to have included all relevant and salient predictor variables in the model. For purposes of a laboratory experiment, where extraneous variables are controlled and subjects are randomly assigned to condition, this assumption is not problematic. Yet, in situations involving actual residents and real-life toxic exposures, the sterility of the laboratory is missing, and other potential influences on cognitions, affects, and actions should also be investigated.

In addition, although this study seems to indicate that the hindsight bias is more robust when the outcome information provided is negative in nature, the results reported here may also be the product of the congruence between outcome information and expectations. That is, subjects may have expected a negative-outcome in this situation which enhanced the hindsight bias in the negative-outcome condition. It is equally plausible that in a situation where the expected result is of a positive nature, more hindsight is manifested in the outcome condition consistent with this expectation. The present study was not designed to investigate this issue, but poses the question for future researchers.

Nevertheless, the current study offers much to those interested in understanding the cognitive, affective, and behavioral responses of individuals following negative environmental events. With the increasing proliferation of litigation resulting from environmental issues, and the continued contamination of the environment by various industries, the government, and private individuals providing extensive opportunity for future lawsuits, information regarding how individuals perceive causation and responsibility following negative environmental events can assist the courts in rendering appropriate decisions.

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