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Incomplete Information, Inferences, and Individual Differences: The Case of Environmental Judgments

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A model for inference of missing information is explicated and tested in two studies (*N*s = 74, 76) of judgments about two environmental issues (endangered species reintroduction and the siting of a waste processing facility). Participants made judgments of scenarios in which information relevant to the judgment was varied orthogonally and, in some cases, relevant information was missing. The results showed individual differences—as well as intraindividual differences—in the assumptions participants made about missing information and in the tendency to infer missing cues. Reported assumptions about missing information predicted some aspects of the judgments. The data for only a small minority (15%) of the participants were consistent with the inferred values model. Participants may use different methods for dealing with missing information at different times or may not generally follow either an inference or averaging model in such contexts. Less favorable judgments were given for scenarios with incomplete information (the "penalty" effect), and this effect showed individual and intraindividual variation that was related to reported assumptions about missing information. We discuss the implications of these results for societal conflicts over controversial issues and for understanding the sources of individual differences in judgments.

Vice President Al Gore (1992), in his influential book *Earth in the Balance,* notes that "We must acknowledge that we never have complete information.

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Yet we have to make decisions anyway; we do this all the time . . . a choice to 'do nothing' in response to the mounting evidence is actually a choice to continue and even accelerate the reckless environmental destruction . . ." This quote illustrates not only the difficulty of making decisions about environmental issues, but also the fact that making such decisions with partial information is ultimately inevitable. It therefore behooves social scientists to investigate the character of judgments made about environmental issues, for, as Gore also notes, "It is the human factor . . . that is critical to saving the global environment." The "human factor" in any sort of judgment and decision making is highly complex. There are large individual differences in judgments (cf. Payne, Bettman, & Johnson, 1993)—and these differences lie not only between individuals but also within individuals, as will be demonstrated in this investigation. This complexity has particular implications for judgments in the arena of political or social issues, where policymakers and analysts may be prone to oversimplify both differences of opinion and decision processes (e.g., Dawkins, 1997; McCausland, 1987; Staples, 1997).

Individual differences in judgments have been found to depend on anything from mood (Halberstadt & Niedenthal, 1997) to long-standing personality traits (Mikulincer, 1997) and can take a variety of forms: the importance people place on cues of information (Goldstein, 1990; Surber, 1985; Wills & Moore, 1996), the amount of information sought to make a judgment (Mikulincer, 1997), the perceived relationships between different cues (Broniarczyk & Alba, 1994; Jagacinski, 1991, 1994), the way incomplete information is interpreted (Wills & Moore, 1996), just to name a few (see Payne, Bettman, & Johnson, 1993). The implications of these individual differences are significant—when faced with the exact same set of information, two people may arrive at very different judgments, because, in fact, either the information is not subjectively the same to both of them or they differ in how they use the information. Therefore, we examined two sources of individual differences: cue importance and response to incomplete information.

Inference of Incomplete Information

As the opening quote by Gore (1992) argues, incomplete information is the normal state of affairs with most judgments in life, including environmental issues. Several authors have proposed inference of missing cues from the available information (Anderson, 1982; Johnson & Levin, 1985; Singh, Gupta, & Dalal, 1979; Yamagishi & Hill, 1981). Depending on the whether a positive or negative relationship between two cues is assumed, different results are expected. First, if participants assume there is a positive relationship between cues (or the cues are manipulated to be positively related as in Jagacinski, 1991, 1994), then the net effect of one cue (when a second cue is missing) will be larger than when the same cue is combined with the second cue ("information dilution"). For example, if the price of a product is assumed to be positively correlated with its quality, when information about quality is absent, price information by itself will have a larger effect because it will be thought to also provide information about quality; when the given cue has a high value, the missing cue is inferred to have a similarly high value (and vice versa). When the inferred value of the missing cue is combined with the given cue, the result is as if the given cue received a functionally larger weight and the responses are more extreme. In contrast, when a negative relationship between cues is assumed (e.g., dealer service is inferred to be negatively related to price), the net effect of a single cue will be smaller than when it is combined with the second cue (Jagacinski, 1991, 1994; Johnson, 1987). This is the opposite of the information-dilution effect and is presumed to occur because when the given cue has a high value, a low value is inferred for the missing cue.

The "information-dilution" effect (i.e., that a cue has a smaller effect when combined with other information than when other information is missing) does not provide unambiguous evidence of cue inference because it is also consistent with a weighted averaging process without inference of the missing cue (Anderson, 1982). The dilution prediction of the averaging model assumes that participants give zero weight to information that is omitted. Because the sum of weights in the denominator of the averaging model will be smaller when a cue is missing (and is given zero weight), the slopes of the main effects of the cues should be ordered inversely to the number of cues given. Thus, in an averaging process, removing information enhances the impact of other information, and adding information dilutes the effect of other information. If the information dilution effect is not consistently obtained, the averaging process with zero weight for missing information can be ruled out as a strategy that people use across situations.

Three ways of testing for inference of incomplete information have been used in the research literature. The first is to ask the participants for self-reports about what they assumed when information was missing. The second method is to examine the pattern of judgments for evidence of cue inference. The third method is to have the participants make judgments of each cue based on the other cues. In the present research we used the first two methods. We tested whether the pattern of judgments showed evidence of inference of incomplete information by testing the ordinal consistency of the judgment patterns with a model for cue inference. In addition, we looked for individual differences in judgments as a function of self-reported assumptions about missing information. We chose not to collect judgments of each cue based on the other cues. Although judgments of one cue based on another do provide information about *how* the participants *would* infer one cue from another, such judgments do not tell us *whether* cue inferences tend to be made when judging the outcome variable to which the cues pertain. The test of the model and the self-reports are more appropriate methods for answering the latter question. This methodology, like those used in many other studies, implicitly assumes consistency of strategy over time and situation. In other words, seeking a pattern consistent with an inferred values and/or averaging model assumes that people will use the same strategy across different judgments. Evidence of an inconsistent pattern may therefore indicate the untenability of these missing information models or the untenability of this consistency assumption.

The majority of studies that have tested for inference of missing information have used only two cues (e.g., Jagacinski, 1994; Johnson, 1989; Levin et al., 1984; Yamagishi & Hill, 1981). Wills and Moore (1996), however, studied perspective taking for judgments of medication acceptance based on three cues. They considered two-cue models for inference of missing information and concluded that the models were unsuccessful in describing their findings. In the present study we explicate a three-cue model for inferred values of missing information. The model is tested in two studies of judgments of environmental issues. In contrast to the assumption made by Wills and Moore (1996), we show that certain kinds of apparent inconsistency in the effects of missing information across cues could be due to consistent inference of missing values.

A THREE-CUE MODEL OF INFERRED VALUES OF MISSING INFORMATION

An additive model for integrating three cues into a judgment can be written as

$$J = w_1 s_1 + w_2 s_2 + w_3 s_3, \tag{1}$$

where J is the judgment, the w are weights, and the s are subjective values of the three cues. The w values are assumed to be positive. If Cue 1 is missing, then an inferred value, s'_1, replaces s_1 in Eq. (1). For two cues,

$$s'_1 = b_{12} s_2 + k, \tag{2}$$

where s'^1 represents the inferred value of s_1, b_{12} represents the strength and direction of the assumed relationship between the cues (e.g., a subjective regression slope or subjective correlation), and k is an additive constant (see Johnson & Levin, 1985). (The additive constant, if negative, could represent a “penalty” for missing information, as will be explored in a later section, or could be regarded as a scaling constant.)

The model assumes that at least the *signs* of the b_{ij} are consistent across the same pair of cues. For example, if b_{12} is positive for inferring Cue 1 from Cue 2, then b_{12} should also be positive for inferring Cue 2 from Cue 1, although they need not be identical in size. For example, price and quality may be assumed to be positively related, but one might assume a stronger positive relationship for inference of quality from price than vice versa. Without this restriction on the signs, the inferred values model cannot be used to derive any useful predictions. Also, assuming different signs on b_{ij} for a single pair of cues is obviously incoherent. It is analogous to saying simultaneously that “less expensive products are higher quality” and that “higher quality products are more expensive.” Such incoherence may exist, and the model tests for it. Of course, the signs of the b_{ij} may differ across different pairs of cues. For example, b_{12} may be positive and b_{13} may be negative.

Case 1: Two Cues Given, One Cue Inferred

Assume that Cue 1 and Cue 2 are both given, that the value of Cue 3 is inferred from each given cue, and that those inferred values are combined additively to form an overall inferred value of s_3:

$$s'_3 = b_{13}s_1 + k_1, \text{ (inferred value of Cue 3 from Cue 1)}$$

$$s''_3 = b_{23}s_2 + k_2. \text{ (inferred value of Cue 3 from Cue 2)}$$

Therefore,

$$J = w_1s_1 + w_2s_2 + w_3(b_{13}s_1 + k_1 + b_{23}s_2 + k_2)$$

or

$$J = (w_1 + w_3b_{13})s_1 + (w_2 + w_3b_{23})s_2 + w_3(k_1 + k_2). \quad (3)$$

Equation (3) shows that the slope or main effect of either Cue 1 or Cue 2 in a two-cue design compared to the three-cue design will depend only on the sign of the assumed relationship between the given cue and the missing cue, b_{ij}. For example, the slope of Cue 1 will be a function of its weight: $w_1 + w_3b_{13}$. Because w_1 and w_3 are positive, the effect of Cue 1 in the two-cue design will be larger than in the three-cue design if b_{13} is positive and will be smaller if b_{13} is negative. An important prediction can be derived: according to this model, if Cue 1 has a flatter slope when Cue 3 is missing than in the three-cue design, then Cue 3 ought also to have a flatter slope when Cue 1 is missing than in the three-cue design. This is because when Cue 1 is missing and Cue 2 and Cue 3 are given, the weight of Cue 3 will be $(w_3 + w_1b_{13})$. *Therefore, in the inferred values model the signs of each* b_{ij} are determined by comparing the two-cue and three-cue design slopes. This is outlined in Table 1.[1]

[1] Surber (1984, 1985) described a "subjective" multiple-regression model for judgment based on three cues. That model allows the assumed relationship between two available cues to influence the b_{ij} value. Although she did not elaborate the model for inferred values, it can be shown that the model also requires that a given b_{ij} have the same sign regardless of whether cue-i is inferred from cue-j or vice versa. For example, if Cue 1 and Cue 2 are given and Cue 3 is to be inferred from both given cues, the values of b_{13} and b_{23} could be represented as

$$b_{13} = (r_{13} - r_{12}r_{23})/(1 - r_{12}^2) \text{ and}$$

$$b_{23} = (r_{23} - r_{12}r_{13})/(1 - r_{12}^2),$$

where the rs are the subjective cue correlations. The b_{ij} will be positive or negative depending on the value in the numerator. However, under this model the exact value of the b_{ij}, but *not* the sign, will depend on which cue is being inferred. For example, if Cues 1 and 3 are given, then for inference of Cue 2 from Cue 3,

$$b_{23} = (r_{23} - r_{12}r_{13})/(1 - r_{13}^2),$$

Notice that the denominator is different than for b_{23} above. The sign on b_{ij} is determined by the numerator, which is identical in the two expressions. Therefore, our restriction on the signs of the b_{ij} in Eqs. (1)–(4) is consistent with a subjective multiple-regression model. The qualitative predictions of the subjective multiple-regression model and the inferred values model presented in the text are identical.

TABLE 1

Determination of b_{ij} from Slope Comparisons: Two-Cue versus Three-Cue Designs

Cue absent	Two-cue versus three-cue slope comparison	Implication
Cue 3	Slope of Cue 1 (× Cue 2) > slope of Cue 1 (three-cue design)	$b_{13} > 0$
	Slope of Cue 1 (× Cue 2) < slope of Cue 1 (three-cue design)	$b_{13} < 0$
Cue 3	Slope of Cue 2 (× Cue 1) > slope of Cue 2 (three-cue design)	$b_{23} > 0$
	Slope of Cue 2 (× Cue 1) < slope of Cue 2 (three-cue design)	$b_{23} < 0$
Cue 2	Slope of Cue 1 (× Cue 3) > slope of Cue 1 (three-cue design)	$b_{12} > 0$
	Slope of Cue 1 (× Cue 3) < slope of Cue 1 (three-cue design)	$b_{12} < 0$
Cue 2	Slope of Cue 3 (× Cue 1) > slope of Cue 3 (three-cue design)	$b_{23} > 0$
	Slope of Cue 3 (× Cue 1) < slope of Cue 3 (three-cue design)	$b_{23} < 0$
Cue 1	Slope of Cue 2 (× Cue 3) > slope of Cue 2 (three-cue design)	$b_{12} > 0$
	Slope of Cue 2 (× Cue 3) < slope of Cue 2 (three-cue design)	$b_{12} < 0$
Cue 1	Slope of Cue 3 (× Cue 2) > slope of Cue 3 (three-cue design)	$b_{13} > 0$
	Slope of Cue 3 (× Cue 2) < slope of Cue 3 (three-cue design)	$b_{13} < 0$

Case 2: One Cue Given, Two Cues Inferred

Assume that Cue 3 is given and that the judgment is based on inferred values of Cues 1 and 2 combined with the given value of Cue 3:

$$J = w_1(b_{13}s_3 + k_1) + w_2(b_{23}s_3 + k_2) + w_3s_3. \tag{4}$$

This reduces to

$$J = (w_1b_{13} + w_2b_{23} + w_3)s_3 + c.$$

According to Eq. (4), whether the effect of Cue 3 will be larger or smaller by itself than when all three cues are present depends on the values of both b_{13} and b_{23}. If the quantity $w_1b_{13} + w_2b_{23}$ is less than zero, then the effect of Cue 3 will be smaller when it is presented alone than when it is combined with other cues. Such a result implies that at least one of the *b*s must be negative. Therefore, comparison of slopes across the single-cue and three-cue designs will not determine the direction of the assumed relationship between cues or sign of the b_{ij}. However, these comparisons do impose some constraints. We derived the qualitative implications of each pattern of one-cue vs three-cue slope differences for the values of the b_{ij}. These are presented in Table 2. For example, consider a person who shows the information dilution effect for all three cues in the one-cue vs three-cue slope comparisons (denoted by "+ + +" in the first row of Table 2). In the inferred values model of Eqs. (1)–(4), that person can have all *b*s positive or any one *b* negative. For example, in Eq. (4) the value of b_{13} could be negative as long as the net value of $w_1b_{13} + w_2b_{23}$ is positive. With the "+ + +" pattern, only one of the three b_{ij} can be negative. If two of them are negative, then the model predicts a different slope difference

TABLE 2

Implications of Patterns of One-Cue versus Three-Cue Slope Differences

Cue 1	Cue 2	Cue 3	b_{ij} Patterns permitted or required	b_{ij} Patterns not permitted
+	+	+	All b_{ij} positive; Any one b_{ij} negative	Any two or more b_{ij} negative
+	+	−	b_{12} must be positive	b_{13} and b_{23} both positive; b_{12} negative
+	−	+	b_{13} must be positive	b_{12} and b_{23} both positive; b_{13} negative
+	−	−	b_{23} must be negative	b_{12} and b_{13} both negative; b_{23} positive
−	+	+	b_{23} must be positive	b_{12} and b_{13} both positive; b_{23} negative
−	+	−	b_{13} must be negative	b_{12} and b_{23} both negative; b_{13} positive
−	−	+	b_{12} must be negative	b_{13} and b_{23} both negative; b_{12} positive
−	−	−	All b_{ij} negative; Any one b_{ij} positive	Any two or more b_{ij} positive

Note. A "+" indicates that the slope of a cue in a one-cue design is steeper than in the three-cue design, and a "−" indicates that the slope in the one-cue design is flatter than in the three-cue design.

pattern. Notice that all eight possible slope-difference patterns for one-cue vs three-cue effects are possible in the model. Thus, by testing only the one-cue versus three-cue slope differences alone, Wills and Moore (1996) took only the first step toward testing for missing cue inference.

Combining the criteria from the two-cue vs three-cue and one-cue vs three-cue slopes allows a test of the hypothesis that people infer values for missing information. The two-cue vs three-cue slope comparisons define the signs of the *b*s, as shown in Eq. (3) and Table 1. Therefore, by examining the slope difference pattern across designs each participant can be categorized as showing a pattern consistent with the inferred values model, inconsistent with the inferred values model, or nondiagnostic (i.e., b_{ij} values not clearly defined because of null slope differences in the two-cue versus three-cue designs or inconsistencies in implied value for a b_{ij} across the two-cue designs that could define it). We tested this model in the two experiments reported here. Again, this assumes that the use of inferred values, if present, would be consistent across trials.

"Penalty" for Incomplete Information

Several authors have also concluded that there is a "bias" or "penalty" for cases or items with missing information (Jagacinski, 1991, 1994; Johnson, 1987; Yates, Jagacinski, & Faber, 1978). That is, an item with a cue missing will be judged more negatively than an identical item but with the omitted cue at an average value. The "penalty" for missing information may be based on assumptions about why information is missing. Because trust among stakeholders is a central concern in environmental issues (Cvetkovich & Earle, 1994), lack of information may lead to lack of trust, which may in turn lead to negative assumptions about missing information. Therefore, we expected to find that there would be a bias or penalty for missing information. In addition, by asking for reports of assumptions about missing information, we explored the relationship between reported assumptions and the “penalty” effect for missing information in individual data.

Self-Awareness in the Context of Judgments

Given that individuals display differences in their styles of judgment for environmental issues, to what extent do people display self-awareness of aspects of their processes of judgment? When judgments of environmental issues are involved, the issue of whether people can report their judgment criteria is especially important for resolving conflicts and achieving compromises. It has been argued that people do not have access to many of the internal states and processes that go into judgment and decision making (cf. Nisbett & Wilson, 1977), including clear, consistent political opinions or political decision-making strategies (Campbell, Converse, Miller, & Stokes, 1960). Other findings, however, have suggested that the apparent lack of self-awareness in the judgment literature may have more to do with experimenters’ inappropriate interpretation of participant self-reports than with poor insight on the part of the participants (cf. Goldstein & Beattie, 1991) and have shown that there is at least some relationship between reported “weight” or importance and cue use (Goldstein, 1990; Reilly & Doherty, 1989, 1992; Slovic & Lichtenstein, 1973; Surber, 1985). In the present study, we examined two aspects of self-awareness: (a) the relationship between cue use and reported importance and (b) the relationship between the “penalty” effect for missing information and reported assumptions about missing information.

Decision Making and the Environment

Environmental issues, because of their scope and societal importance as well as personal importance to most people (Dunlap & VanLiere, 1978; Herrera, 1992; Shetzer, Stackman, & Moore, 1991), are intrinsically interesting to study. In addition, environmental issues are often regarded as involving moral considerations because they concern irreplaceable resources and the welfare of others (including nonhuman species and future generations) (Irwin, 1994), and they also offer an excellent opportunity to study reactions to incomplete information in judgments. Because environmental issues often involve entrenched differences of opinion (Flynn, Slovic, & Mertz, 1993; McClelland, Schulze, & Hurd, 1990; Vining, 1992), they provide an excellent forum for studying individual differences in judgment. For example, there is often a strongly polarized argument over local effects (e.g., job creation, job loss, localized pollution or “NIMBY”) and over risk to the natural environment (loss of a sensitive species or ecosystem, increased pollution of a specific type). Even when people agree, there can be different reasons for holding similar opinions (Ebenbach, Moore, & Parsil, 1998). In the context of judgments about environmental issues, the study of individual differences could allow researchers to begin to isolate the sources of entrenched opinions and work toward conflict resolution in environmental debates (Keltner & Robinson, 1993).[2]

The Present Research

The two experiments reported here concerned judgments of degree of support or opposition for two distinct projects: reintroduction of an endangered species (Experiment 1) or siting a solid-waste processing facility (Experiment 2). These two projects were chosen because they have opposite implications to environmentalists. Reintroducing an endangered species is usually regarded as a positive event by most environmentalists, whereas industrial developments are often regarded negatively. In each case participants were presented with one to three sources of information. The types of information were chosen to represent the kinds of information about which environmental conflicts occur currently in America. For endangered species reintroduction the sources of information were risk to the ecosystem, expected local effects, and the reaction of the audience at a public meeting pertaining to the project. For siting the solid-waste processing facility, we gave information about the current use of the land (previously undeveloped wetland, farm, or urban), number of jobs to be created, and the environmental record of the company building the project. We anticipated that these topics and types of information would reveal important individual differences in judgment strategies and would allow us to test the three-cue model of missing cue inference, as well as the degree to which participants displayed self-awareness of aspects of their judgmental processes.

METHOD: STUDIES 1 AND 2[3]

Participants and Procedure

In Study 1 (Endangered Species Reintroduction), 74 University of Wisconsin–Madison undergraduates (49 women, 23 men, and 2 who did not indicate gender) participated, while Study 2 (Solid Waste Siting) had 76 participants (36 women and 40 men). One participant in Study 2 omitted part of the booklet, leaving 75 participants. In both cases, people participated in return for extra-credit points to be counted toward their grades in an introductory psychology course. The participants were given the experimental packets that constituted the materials for this study after completing one of two other separate, unrelated studies. They completed these packets in groups of 2–10, working individually. Most participants took approximately 30 min to complete the study.

Materials and Design

Study 1: endangered species reintroduction. The instructions in the experimental packets asked participants to imagine that they were responsible for

[2] This possibility assumes that judgments, or "expressed preferences," are not entirely labile and are in fact somewhat stable. We return to this point in the Discussion.

[3] For both the Method and Results sections, Studies 1 and 2 are presented in parallel to highlight the similarities and differences between the instructions and outcomes of the studies.

deciding whether to reintroduce an endangered species to a local area and that they were attending a public meeting where this issue was being explained by officials and discussed. Participants made ratings regarding hypothetical cases of proposed endangered species reintroductions, each of which differed in the information that was associated with the proposal. Before beginning, the participants read detailed information regarding the three types of information that were relevant to the decision: the risk of irreversible negative effects on the ecosystem (risk), the audience's reaction to the information given at the public meeting (audience), and the effects on the local people and economy (local effects). These types of information were selected because of their relevance to the decision, and in the instructions, detail was provided as to how a species reintroduction might possibly affect such variables as Risk, Audience, and Local Effects.

Participants were instructed to assume that all of the information was received in the public meeting. For a given case, the Risk was summarized as a "very very slight risk," a "very slight risk," or a "slight risk." The Audience reaction to the proposal was summarized as "most seem strongly opposed," "most seem neutral," or "most seem strongly in favor." Finally, the Local Effects were summarized as having a "positive balance" (more positive than negative effects), a "neutral balance" (positives and negatives approximately equal), or a "negative balance" (more negative than positive effects). The stimuli were constructed from factorial combinations of the cue values. The 3 (Risk) × 3 (Audience) × 3 (Local Effects) factorial design, yielded 27 trials. Six incomplete information subdesigns were included. These consisted of the three possible two-cue combinations of variables in the absence of the third variable (Risk × Audience, Risk × Local Effects, Audience × Local Effects) and the three one-cue designs in which each type of information was presented by itself (Risk only, Audience only, Local Effects only). The inclusion of these designs increased the total number of hypothetical cases to 63. All 63 cases were randomized and preceded by 9 other cases that were representative of the full range of information. These 9 practice cases allowed participants to stabilize their criteria and use of the rating scale and were not included in the data analyses. To the participants, the 9 practice cases were indistinguishable from the 63 cases for which the data were analyzed.

After reading the information for a case, the participant then indicated her or his support for reintroducing the species on a scale from 1 (*strongly oppose*) to 19 (*strongly support*), with the midpoint of 10 indicating a *neutral* stance. After completing the ratings for 9 practice cases and the 63 experimental cases, the participants indicated the relative importance they placed on each piece of information, using a pairwise comparison method. Each variable was rated in comparison to each other variable, for a total of three comparisons, using an 11-point rating scale. The numbers 1 and 11 were labeled as *very much more important* and 5 was labeled *equally important*. For example, when Local Effects was compared to Audience Reaction, a 1 would have indicated that Local Effects were very much more important in affecting the participant's ratings, and a 5 would have indicated that the two sources of information were equally important. Finally, participants indicated what assumptions they made when certain pieces of information were missing, answering three open-ended questions reading, “When the risk to the ecosystem [or audience reaction or local effects] was not available, I assumed. . . .”

Study 2: solid-waste siting. The instructions in the experimental packets were very similar to the instructions in Study 1. Participants were asked to imagine that they were responsible for deciding whether to site a solid-waste processing plant in a given location. Participants made ratings regarding hypothetical cases of proposed solid-waste processing plants, each of which differed in the information that was associated with the proposal. Before beginning, the participants read detailed information regarding three types of information: number of jobs created by the plant (jobs), location of the proposed siting (location), and the company’s environmental record (environmental record).

Jobs information was said to have been provided by the company that would build and own the plant. For a given case, the information indicated that 25, 50, or 75 jobs would be created. The proposed location of the plant was summarized as “untouched wetland habitat” (outside the city, requiring that the natural habitat be eliminated), “farm land adjoining the city” (requiring the cessation of agricultural activity there), or “vacant city land” (requiring only the removal of old buildings). Finally, the company’s environmental record was summarized as either “poor” (repeated violations of environmental law and failure to comply with regulations), “fair” (occasional violations but overall compliance), or “good” (no violations and complete compliance with environmental regulations).

The design and procedures were analogous to those of Study 1. The stimuli were constructed from all possible factorial combinations, yielding 63 trials. After completing the ratings of all the cases, participants indicated the relative importance they placed on each piece of information, using a pairwise comparison method as in Study 1. Finally, participants indicated what assumptions they made when certain pieces of information were missing, answering three open-ended questions.

RESULTS

Preliminary Analyses

In Study 1, the endangered species reintroduction study, a 3 (Risk to Ecosystem) $\times$ 3 (Local Effects) $\times$ 3 (Audience Reaction) $\times$ 2 (Gender of Participant) ANOVA showed no significant main effect of gender, $F(1, 70) = 2.46$, $p > .10$, and there were no significant interactions with gender, all ps $> .05$. Therefore gender of participant was not included in the other analyses reported below. Each of the three information cues had significant main effects on mean judged support for an endangered species reintroduction, Fs$(2, 140) = 69.07$, 168.35, 113.55, all ps $< .001$ for risk, local effects, and audience, respectively. In all of the other subdesigns of the study, all information cues had significant main effects, ps $< .01$.

In Study 2, the solid-waste siting study, a 3(Jobs) $\times$ 3 (Location) $\times$ 3 (Environmental Record) $\times$ 2 (Gender of Participant) ANOVA showed no significant main effect of gender, $F(1, 73) = 2.36$, $p > .10$, and there were no significant interactions with gender, all ps $>.10$. Therefore gender of participant was not included in the other analyses reported below. Each of the three information cues had significant main effects on mean judged support for waste facility siting, Fs(2, 146) = 54.80, 131.22, 339.75, all ps $< .001$ for jobs, location, and environmental record, respectively. In all of the other subdesigns of the study, all information cues had significant main effects, ps $< .01$.

In both Study 1 and Study 2, there were several cue $\times$ cue interactions, but none of them were disordinal, and none of them qualify the other findings discussed below. Because the focus of this research is on individuals and their judgments rather than the effects of the specific cues themselves across subjects, these cue $\times$ cue interactions are not discussed further.

Reported Importance of Information

The cue importance ratings were used to group participants according to the cue reported to be most important. The results are shown in Fig. 1, with the endangered species study on the left and the waste facility siting study on the right. For the endangered species study, Risk to the ecosystem and Local Effects were most frequently reported to be the most important cues, and Location and Environmental Record were the most frequently reported as most important in the waste siting study. In the endangered species study, nine participants

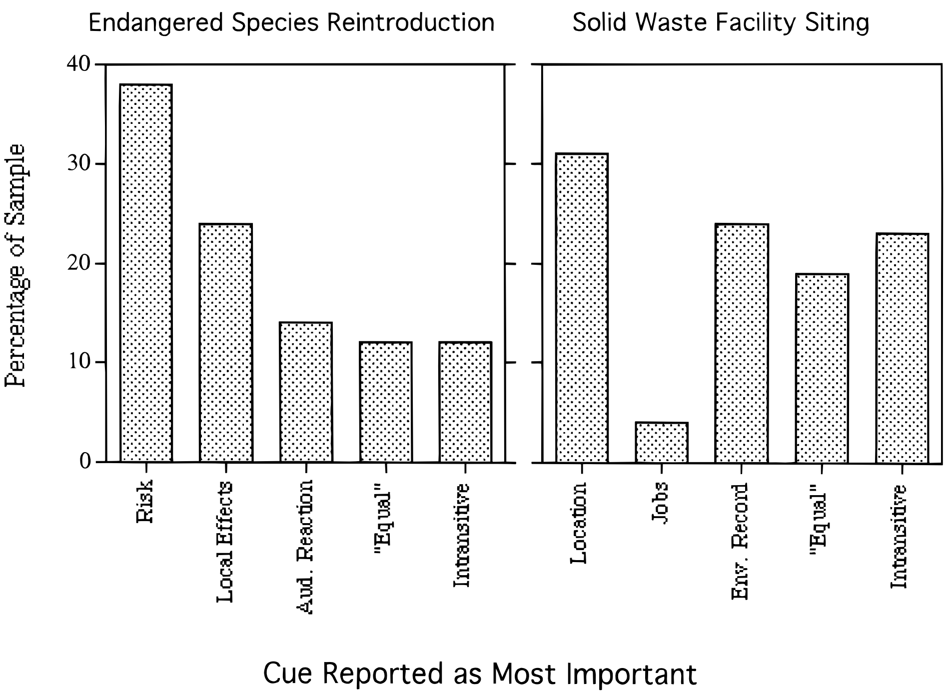

FIG. 1. Grouping of participants by rated cue importance (Studies 1 and 2).

(12%) gave intransitive cue importance ratings (for example, Risk rated more important than Audience, Audience more important than Local Effects, but Local Effects more important than Risk), and nine (12%) rated two cues to be equally the most important in their judgments (these are grouped as "Equal" in Fig. 1). There were more intransitive cue importance ratings in Study 2 than in Study 1 and also more participants who rated two cues to be equally the most important in their judgments.[4]

The distributions of importance ratings were also examined. None of the three ratings showed a mode at the midpoint of the scale in the endangered species study. In the waste siting study, the only one of the three ratings showing a mode near the midpoint of the scale was the importance rating comparing Environmental Record to Location (Mode = 5). For the other importance ratings, distributions were either dramatically skewed, with one variable seen as more important by most people, or bimodal, with some people preferring one variable and others preferring the other.

In order to test whether reported cue importance relates to cue importance in judgments, we did two kinds of analyses: (a) correlations of importance ratings with cue use and (b) tests for mean differences in cue use for groups differing in reported cue importance. Both analyses showed significant results. The slope of the judgments for a cue reflects the net effect of that cue. Because the reported cue importances were comparative ratings (e.g., risk vs audience), we correlated the importance ratings with the differences between the slopes of the judgments from the three-cue design for the two relevant cues.[5] These correlations were all significant in both studies, in each case showing larger slopes associated with greater relative cue importance (endangered species study: Local vs Risk, $r(74) = .54$, $p < .001$; Local vs Audience, $r(74) = .52$, $p < .001$; Risk vs Audience, $r(74) = .32$, $p < .05$; Waste siting study: location vs jobs, $r(75) = .39$, $p < .01$; jobs versus environmental record, $r(75) = .42$, $p < .01$; environmental record vs jobs, $r(75) = .42$, $< .01$).

We also used the groups shown in Fig. 1 to analyze the judgments of the three-cue design for each experiment. Figure 2 shows the results of these analyses for the major subgroups based on the importance ratings (risk, local effects, and audience in Study 1 and location and environmental record in Study 2; the jobs-importance group is omitted from the figure for Study 2 because there were only three individuals in it). In Fig. 2 the steepest slope for each cue was for the group that rated the cue to be the most important. For example, on the left, those who considered location to be the most

[4] The nearly equal importance of the location and environmental record cues may be partly responsible for the larger number of intransitive cue importance ratings in Study 2.

[5] We calculated the slope for each cue in the three-cue design as the difference between the judgments of cases involving the two extreme stimulus values for each cue. For the three-cue design this is the difference between the participant's main effect means for the two extreme stimulus values (e.g., *very very slight risk* to the ecosystem minus *slight risk* to the ecosystem). We used the three-cue design so that the relationship between reported importance and cue use could be examined independent of any effects of missing information.

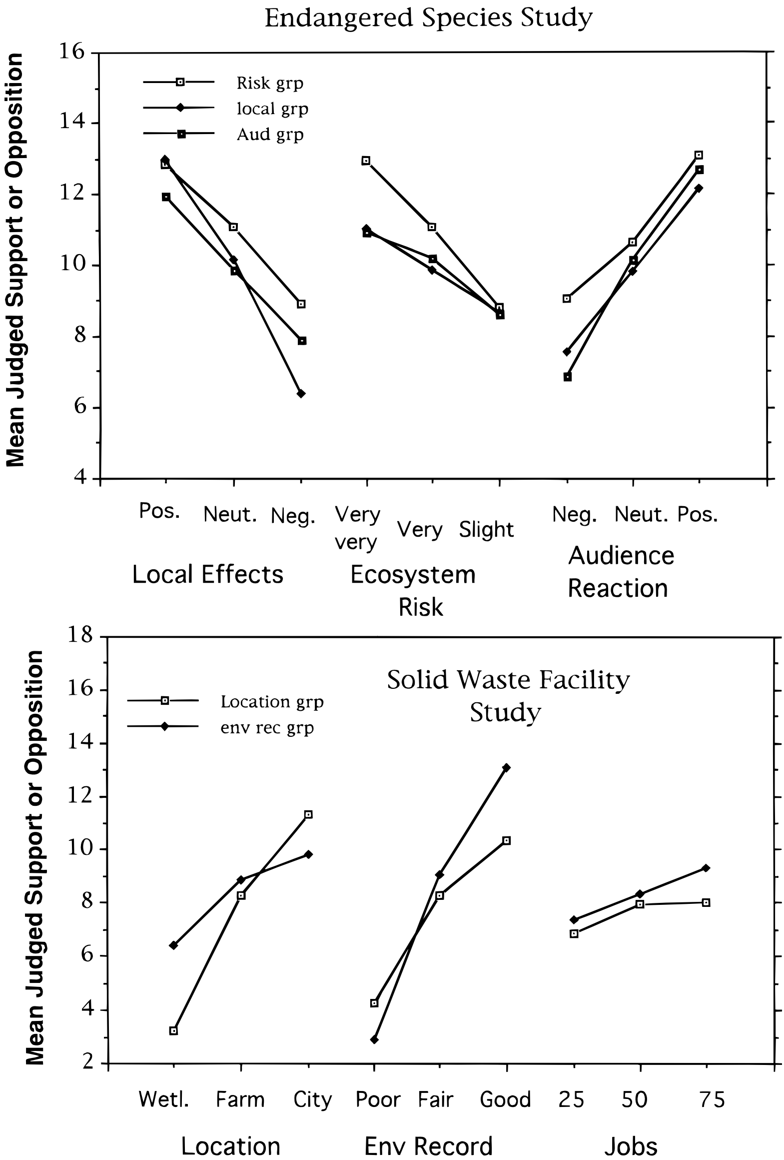

FIG. 2. Judgments by participants' importance groups (Studies 1 and 2).

important cue showed a much steeper slope for location than did those who considered environmental record to be the most important cue. The ANOVAs with importance group as a factor showed significant interactions of group × local effects, $F(8, 138) = 3.55$, $p < .005$, in the endangered species study, group × location, $F(6, 136) = 4.74$, $p < .001$, and group × environmental record, $F(6, 136) = 5.87$, $p < .001$, in the solid-waste siting study, and a trend toward a significant group × risk interaction, $F(8, 138) = 2.00$, $p < .08$, in the endangered species study. Overall, the results show evidence of at least partial self-awareness of cue importance in judgment for this environmental issue.

Effects of Missing Information: Test of the Inference Model

We used the judgment trials with three cues, two cues, and one cue in order to test the three-cue model of inference of missing information. The slope of each cue in each design was calculated in the same way as described earlier. The ordering of the slopes was then examined across the subdesigns with one, two, or three cues. No individual in either study had slopes across all designs and cues that were ordinally consistent with information dilution. The mean slopes of the three cues in the three designs are presented in Table 3. There is no evidence of information dilution or averaging effects in the means. In fact, the mean differences are the opposite of information dilution (one-cue slopes are slightly flatter than three-cue slopes). This is also inconsistent with the possibility that participants inferred values based on a perceived positive relationship between cues, while leaving open the possibility of inferences based on a perceived negative relationship between cues.

To test the three-cue inference model we first compared the ordering of slopes for each participant in the two-cue and three-cue designs. As shown in Table 1, the sign of the assumed cue interrelationship (or b_{ij}) is determined separately by two different comparisons. For each possible b_{ij} we constructed a contingency table to test for consistency in the assumed cue relationships. We categorized as “inconclusive” those with a zero difference in slopes for either test. The results are summarized in Table 4. As can be seen in the left two columns, between 47 and 64% of participants showed slope differences interpretable as evidence of a consistent inferred cue interrelationship, either positive or negative. These results show the upper limit of the number of participants whose judgments might agree with the three-cue inference model on a consistent basis. In addition, because negative b_{ij} values contradict the averaging model, the results show that a maximum of 15 and 8% of individuals could have given a pattern consistent with averaging. The results can also be interpreted as evidence of two kinds of intraindividual differences. First, if a person assumes

TABLE 3

Mean Slopes of Three Cues in Each Design (Studies 1 and 2)

	Design		
Slope	3-cue	2-cue	1-cue
Study 1: Endangered Species Reintroduction			
Risk	3.02	2.85	2.25
Audience Reaction	4.58	4.24	0.75
Local Effects	5.04	4.59	0.97
Study 2: Solid-Waste Siting			
Jobs	1.56	1.40	1.44
Location	5.97	4.99	4.83
Environmental Record	7.43	6.00	5.35

TABLE 4

Implications of Two-Cue versus Three-Cue Slope Differences for b_{ij}

	Sign of b_{ij}			
	Positive	Negative	Inconsistent	Inconclusive
	Study 1			
$b_{\text{Audience–Loal Effects}}$	19 (26)	16 (22)	35 (47)	4 (5)
$b_{\text{Audience–Risk}}$	14 (19)	21 (28)	36 (49)	3 (4)
$b_{\text{Local Effects–Risk}}$	11 (15)	28 (38)	33 (45)	2 (3)
	Study 2			
$b_{\text{Location–Jobs}}$	16 (21)	27 (36)	29 (39)	3 (4)
$b_{\text{Location–Env. Record}}$	6 (8)	42 (56)	23 (31)	4 (5)
$b_{\text{Jobs–Env. Record}}$	13 (17)	24 (32)	32 (43)	6 (8)

Note. Cell entries are numbers of participants. Values in parentheses are percentages of participants.

a positive relationship between two cues (say, audience reaction and local effects), the same person will not necessarily assume a positive relationship between other pairs of cues (e.g., local effects and risk to the ecosystem). Second, the "inconsistent" column might be interpreted as evidence of intraindividual variation in the assumed relationship between a specific pair of cues. We used the term incoherence to describe this in the introduction. A less incoherent form of intraindividual differences is shown by those in the "inconclusive" column; those showing this pattern may be inferring one missing cue from a second, but not vice versa.

Second, for each participant we examined the slope differences across the one-cue and three-cue designs. Recall from Table 2 that each of the eight possible one-cue vs three-cue slope difference patterns constrains (but does not uniquely determine) the possible values of b_{ij}. Using both the one-cue versus three-cue and the two-cue versus three-cue slope comparisons, we categorized each participant's pattern as consistent with the inferred value model, inconsistent with the model, or "nondiagnostic." We included as "nondiagnostic" those in the "Inconclusive or inconsistent" column of Table 4. Our reasoning was that if the data do not clearly determine a sign for a b_{ij} in the two- versus three-cue comparison, then the one- versus three-cue comparison cannot be used to determine whether the pattern of b_{ij} is consistent with the inferred values model. Table 5 shows the results. Only a minority of participants showed judgment patterns that are consistently in agreement with the three-cue inference model. The modal pattern is what we call "nondiagnostic," a category that includes those with inconsistent b_{ij} signs from Table 4.

Our overall interpretation of the results is that for environmental issues there are individual differences in both the tendency to infer missing information and the direction of the assumed relationship. The model test shows these differences clearly. There also appear to be intraindividual differences in this

TABLE 5

Test of Inferred Value Model (in Percentages)

	Consistent	Inconsistent	Nondiagnostic
Study 1	13	24	64
Study 2	17	19	59

tendency, such that a given person is more likely to infer missing information for one cue than for another. In other words, the lack of agreement with the averaging and inferred values models may indicate that people do use these strategies, but only under certain circumstances. This is explored further in a later section.

Is There A "Penalty" for Missing Information?

Both Johnson (1987) and Jagacinski (1994) concluded that there is a "penalty" or negative bias for missing information, such that scenarios with a missing cue will be rated more negatively than the same scenarios with an average value provided. In the present research, we can test not only whether the "penalty" for missing information occurs, but whether it depends on reported assumptions.

First, in order to test the overall "penalty" hypothesis, we used three separate three-cue ANOVAs in each study to compare directly those scenarios in which a cue was missing to those in which the same cue was at the middle value. In these analyses, one factor was the Design (two-cue with a cue absent vs three-cue with the same cue at the middle value) and the other factors were the two remaining cues. A separate analysis was done for each missing cue. If there is a "penalty" for a missing cue compared to the middle value of the cue in the experiment, then there should be a significant main effect of design. Significant main effects for Design were obtained in five of six such tests across the two studies. In Study 1, Design was significant when Local Effects was the missing cue (Audience Reaction × Risk × Design ANOVA), $F(1, 74) = 48.35$, $p < .01$, and when Risk was the missing cue (Audience Reaction × Local Effects × Design ANOVA), $F(1, 67) = 49.44$, $p < .01$. In both cases, the ratings in the two-cue designs were lower overall than in the three-cue designs. When Audience Reaction was the missing cue (Risk × Local Effects × Design ANOVA), however, the Design main effect was nonsignificant, $F(1, 74) = 1.86$, $p > .05$. In Study 2, significant main effects for Design were obtained when Location was missing (Environmental Record × Jobs × Design ANOVA), $F(1, 74) = 56.99$, $p < .01$, when Environmental Record was missing (Location × Jobs × Design ANOVA), $F(1, 74) = 99.89$, $p < .01$, and when Jobs was missing (Location × Environmental Record × Design ANOVA), $F(1, 74) = 96.04$, $p < .01$, such that the ratings in the two-cue designs were lower overall than in the three-cue designs. Thus, the results show a significant penalty for missing risk and local effects information in Study 1 and for all three cues in Study 2. Next we address the issue of whether the penalty effect for missing information depends on the assumptions people report making for the missing information.

Assumptions about Missing Information

Responses to the questions about assumptions for missing information were coded into four major categories: (a) information genuinely unknown, not important, or its absence ignored; (b) information assumed to have an average value or item said to be rated average; (c) information assumed to have a low (unfavorable) value or item said to be rated low; and (d) other. The "other" category included inference of the missing information from specific given information, rating high or assuming a high (favorable) value, rating the item at the neutral point of the scales, and uncodable responses.

Participants often reported interesting rationales to back up their reported assumptions. In Study 1, five people (7%) reported that information may have been deliberately hidden when Risk to the ecosystem was not available and five others said that the risks had not been adequately studied. Others said ecosystem effects were inherently unknown or unpredictable. When Audience reaction was not available, one person said that no hearing was held because there was no controversy; others said that no one showed up or not enough voted. As rationales for lacking information about Local Effects, some said there would be no local effects, others said the researchers were unsure of the local effects or that local effects would only be known later. Ten people (13%) reported that information may have been deliberately hidden when environmental record was not available, and three reported "hiding something" when location information was missing. Occasionally participants indicated that the company was undecided or didn't know about either Jobs information (11%) or Location information (13%). The richness and diversity of the rationales behind the reported assumptions shows that participants took the hypothetical scenarios seriously and elaborated the situations portrayed.

We used the responses regarding assumptions about missing information to answer three questions. First, how frequently do people report inferring values for missing information from the available information? Second, are reported assumptions about missing information consistent within individuals, or do they vary with the cue type? Third, and most important, are reported assumptions about missing information predictably related to judgments when information is missing?

Figure 3 presents the frequencies of responses in the different categories by type of information. Explicitly stating that a cue was inferred from other information is included in the "other" category because it was infrequent in both studies for all cues (4% of responses in both studies). Thus, in this setting explicit inference of missing information from given information is not reported very frequently by the participants. This result agrees with the inference model results presented above. Our conclusion is that only a minority of participants (maximum of 17%) showed consistent inference of missing cues from available information.

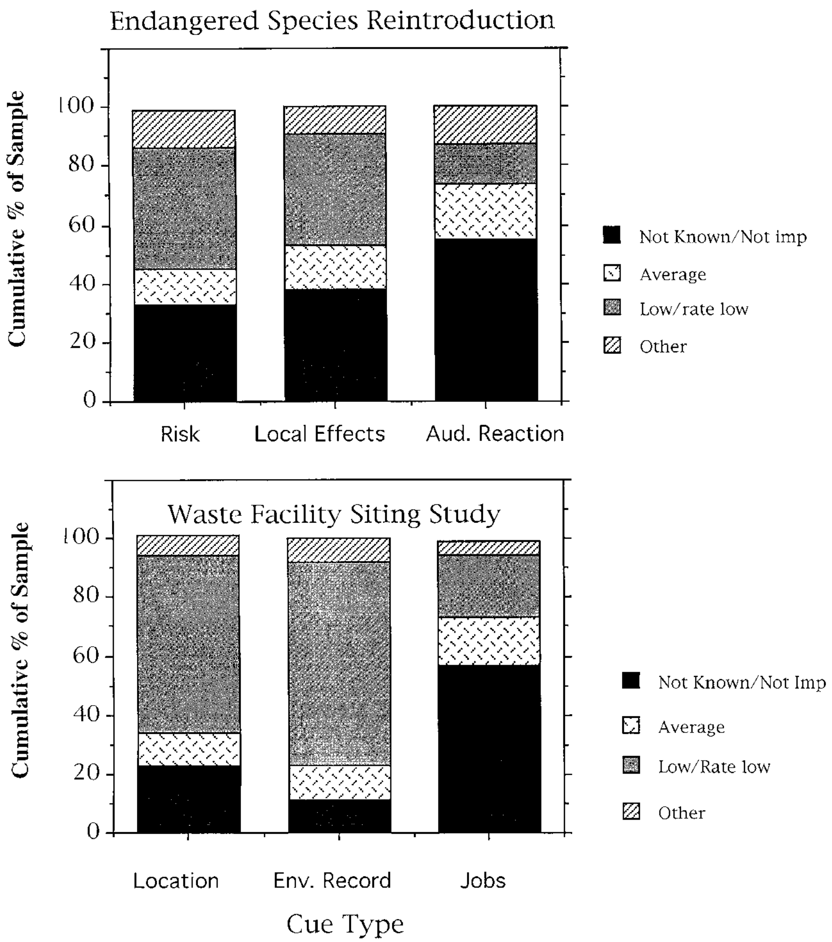

FIG. 3. Frequencies of reported assumptions about missing information (Studies 1 and 2).

In order to compare the assumptions made across cues, we constructed a 3×3 contingency table for each pair of cues (the "other" category was omitted to avoid excessive small expected values). These analyses, displayed in Table 6, answered our second question: reported assumptions were both significantly associated across different cues, but also differed significantly across cues. Tests of independence showed significant association for each pair of cue types, $\chi^2(4) = 9.44$, 13.12, 51.16, $ps < .05$, for Audience vs Risk, Audience vs Local Effects, and Risk vs Local Effects, respectively, in Study 1, and in Study 2, $\chi^2(4) = 14.73$, 13.75, and 16.68, $ps < .05$ for Environmental Record vs Location, Jobs vs Location, and Environmental Record vs Jobs, respectively.

We also tested symmetry using McNemar's change test to see whether participants shifted significantly in one direction across cues (e.g., from "assume low" to "not known/not important" versus the other direction). These analyses test for intraindividual differences in assumptions. The McNemar tests were significant except when they compared the two most important cues [risk and local effects in Study 1, $\chi^2(3) = 1.81$, $p > .15$; location and environmental record in Study 2, $\chi^2(3) = 4.6$, $p > .15$]. The other symmetry tests showed a tendency

TABLE 6

Consistency of Reported Assumptions across Cues

		Risk 1	Risk 2	Risk 3
Local Effects	1	20	0	4
	2	1	6	4
	3	2	3	23

		Location 1	Location 2	Location 3
Environmental Record	1	2	0	6
	2	1	6	6
	3	14	4	33

		Local Effects 1	Local Effects 2	Local Effects 3
Audience	1	19	4	15
	2	3	6	5
	3	1	1	7

		Location 1	Location 2	Location 3
Jobs	1	14	2	25
	2	1	5	7
	3	2	2	13

		Risk 1	Risk 2	Risk 3
Audience	1	17	3	18
	2	3	4	6
	3	0	2	6

		Environmental Record 1	Environmental Record 2	Environmental Record 3
Jobs	1	5	5	32
	2	1	7	5
	3	2	0	14

Note. Category 1, Not known or not important; 2, Average; 3, Rate low or assume low. Cell entries are numbers of participants.

for the "assume low/rate low" category for one cue to be associated with the "not known/not important" category for the other cue, $\chi^2(3) = 15.06, 20.00, 22.70, 34.14$, $ps < .01$, for local effects vs audience, risk vs audience, location vs jobs, and environmental record vs jobs, respectively. Thus, there are significant shifts in assumptions across cues, indicating important intraindividual differences in these judgment processes. This does not explain why individuals' judgments failed to consistently agree with the inferred values and averaging models within a given cue, but the fact that assumptions shifted across cues may help explain why the data of individuals failed to agree with these models consistently across cues.

Next we tested the hypothesis that reported assumptions about missing information are related to the judgments when the information in question is absent. For example, those who claim to assign low values to missing information should produce low judgments in its absence (i.e., in the two-cue design that does not include that cue). We conducted three ANOVAs of the two-cue designs with reported assumption group as a factor (e.g., the Audience × Risk design was analyzed with Local Effects assumption group added as a between-subjects factor). In these analyses we omitted participants in the "other" assumption category. The grand means of the assumption groups are presented in Fig. 4. Note that the means for the assume low/rate low groups at the right hand side are lower than the other groups. The ANOVAs showed that Local Effects assumption grouping had a significant main effect when the local effects cue was missing (Risk × Audience design), $F(2, 62) = 3.57$, $p < .05$, Risk assumption grouping had a significant main effect when the risk cue was

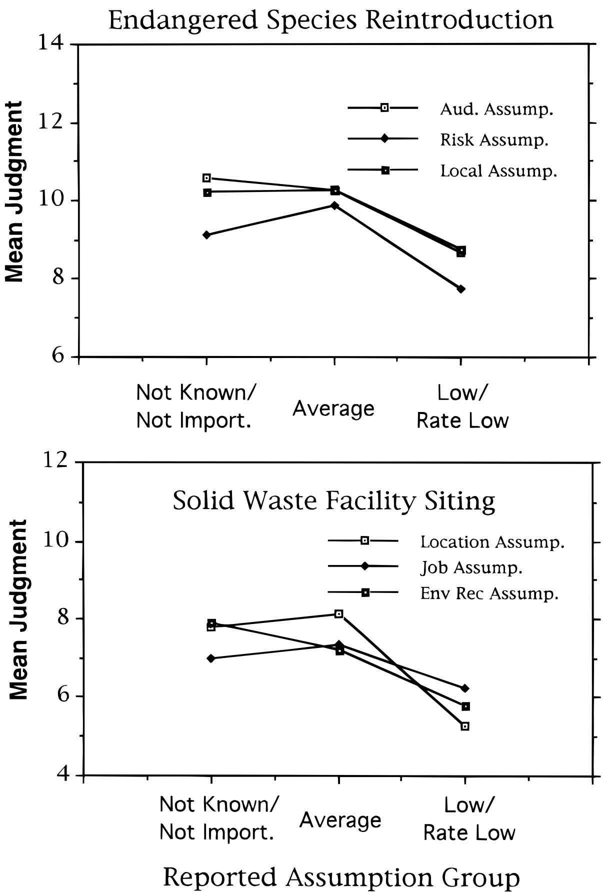

FIG. 4. Judgments by participants' assumption groups (Studies 1 and 2).

missing (Audience × Local Effects design), $F(2, 65) = 3.49$, $p < .05$, and Audience assumption grouping had a significant main effect when the audience cue was missing (Local Effects × Risk design), $F(2, 61) = 4.30$, $p < .02$. In Study 2, Location assumption group had a significant main effect when the location cue was missing (Environmental Record × Jobs design), $F(2, 67) = p < .01$, the effect of Environmental Record assumption group approached significance when the environmental record cue was missing (Location × Jobs design), $F(2, 66) = 3.02$, $p < .06$, but the effect of Jobs assumption was not significant when the jobs cue was missing (Location × Environmental Record design), $F(2, 68) = 1.13$. The effect of Jobs assumption would be expected to be very weak because the Jobs variable was not reported to be very important by most participants.

In all group comparisons, the Assume Low/Rate Low assumption group made lower mean judgments than the Not Known/Not Important and Average Value groups. These analyses show that self-reports of assuming low values are associated with more negative ratings. It is possible that the effects of assumption group on judgments in the absence of one cue are due to a general. disposition toward negative judgments in the Assume Low assumption groups. In other words, these participants may not be making assumptions specific to the absence of that cue, but may instead be revealing generally negative decision-making styles regardless of the absence or presence of cues. Arguing against this possibility, however, is the significant tendency to shift from the Assume Low category for one cue to the not known/not important category for another cue (see Table 6).

Further, if these reported assumptions do reflect general negativistic dispositions, then main effects of assumption group should occur in subdesigns in which that cue is also *present*. This did not occur. Separate ANOVAs for each assumption grouping showed no significant main effects of assumption grouping in the two-cue designs with the cue present or the three-cue design in either study, all ps $>$ .10 (these analyses involve nine ANOVAs per study). Thus, reported assumptions about a cue's absence were *specific* to situations in which the cue was absent. This implies that each assumption is specific to its cue and does not reflect a general disposition toward low ratings.

DISCUSSION

The present investigation indicated that when deciding on the reintroduction of an endangered species or the siting of a solid-waste processing plant, participants showed distinct approaches to the problem of rendering judgment. Although the participants showed some consensus across studies that environmentally relevant cues were important, there were still large individual differences in the importance placed on specific cues. Both individual differences and intraindividual differences occurred in the reactions of participants to incomplete information. Our studies show clearly that individual reactions to incomplete information were related to the self-reports of assumptions people made about missing information and that their self-reports of cue importance were predictive of their actual differential use of the cues.

In addition to these interindividual differences, participants exhibited strong intraindividual differences. As noted above, rather than treat each cue in the same manner, participants made different assumptions about each cue when it was missing. For example, participants were somewhat likely to suspect deception when a company's environmental record was hidden, but less so when jobs information was missing. Furthermore, if inferences were made based on the given information, the assumed relationships between a pair of cues were often inconsistent depending on which cue was missing. These intraindividual differences are discussed further below.

As noted in the introduction, many authors have proposed that missing information is inferred from the information that is provided. One contribution of the present research is that the model we have articulated brings out the complexities in this seemingly simple hypothesis. Understanding the effects of inference of missing information is especially important in the context of judgment topics where social conflict may result when people's judgments do not agree. The model explicated in this article makes it clear that even though two individuals may assume the same *directional* relationship between one pair of cues, depending on its strength, the other cue interrelationships assumed, and the way the cues are weighted, their judgments may differ quite dramatically. For example, take two people who both assume that jobs created and the environmental records of companies are inversely related. When given information about a proposed industrial siting that omits environmental record, it is possible for one person to show an enhanced effect of the jobs information and the other to show a smaller effect of jobs (see lines 4 and 6 of Table 2).

In spite of the ability of the model to accommodate a variety of effects of missing information, only 15% of the participants over the two experiments showed judgment patterns that were ordinally consistent with inference of missing information, and less than 5% explicitly reported inference of missing cues from given information. Our conclusion is that in the present context consistent inference of missing information plays only a minor role. The model we have presented could be useful in other settings in testing the inference hypothesis.

The intraindividual differences in the assumptions made about missing cues provides other evidence for considerable complexity in how people deal with missing information. The fact that different assumptions are made for different cues by a single individual is a new finding of the present study. This finding suggests active processing and interpretation of information as a part of the judgment process. Text-processing-based approaches to human judgment (Sanfrey & Hastie, 1998) may have relevance to explaining these intraindividual differences. This finding also helps to explain the lack of support for the averaging and inferred values models. When an individual failed to consistently infer values across missing cues, this could have as easily been due to the use of different strategies across cues as to the untenability of the inferred values model for explaining judgments. However, in neither study was strong evidence found for consistent use of inferred values or averaging within cues, and this is less easily explained by intraindividual differences. In sum, insofar as inferred values and averaging are used in these judgments, they are only used by some people and only some of the time.

One striking and consistent finding is that the "penalty" or "bias" against cases with missing cues was strongly related to self-reported assumptions. The practical implications of the penalty effect are that information that citizens expect to see or request ought not to be withheld. The penalty or bias effect for missing information may also explain why lay people, on average, judge hazards with unknown long-term effects to be riskier than experts do. Lay people may have a tendency to assume that long-term effects that are not known will be negative. That people in our studies showed self-awareness of the penalty or bias effect is encouraging for negotiations between citizens and their governmental agencies over environmental issues. Self-awareness implies that differences of opinion can be discussed.

An important issue is the source of the individual and intraindividual differences observed. The origins of individual differences in judgments about environmental controversies has theoretical importance but would also be of use to policymakers and others. It is possible, on the one hand, that some of these differences are the result of “labile values” that are constructed for the specific situation (cf. Fischoff, 1991). The “labile values” viewpoint is derived from research on factors such as framing effects and response modes that are capable of creating irrational preference reversals in judgments and decisions (Dawes, 1988; Lichtenstein & Slovic, 1971; Mellers, Chang, Birnbaum, & Ordonez, 1992; Tversky & Kahneman, 1981). Although such situational effects have been widely replicated, no one has claimed that they completely overwhelm individual differences in preferences. On the other hand, it seems likely that variables such as positive or negative framing would combine with one’s own individual attitudes and values to influence the importance given to different cues, assumptions about missing information, and so on. There has been little exploration of the extent to which judgments are based in part on what some call terminal values (cf. Rokeach, 1973; Stern & Dietz, 1994) or on other attitude and individual difference variables. There is evidence that the values that support environmental beliefs (e.g., unity with nature, protecting the environment for future generations, etc.) coexist in an organized network (Schwartz, 1992) and that such values do seem to influence environmental attitudes (Grube, Mayton, & Ball-Rokeach, 1994). Environmental attitudes, in turn, can be influenced by other attitudes (e.g., authoritarianism; cf. Schultz & Stone, 1994); worldviews (Dake, 1991); and demographic factors such as education (Rasinski, Smith, & Zuckerbraun, 1994), gender (Arcury, Scollay, & Johnson, 1987), and ethnic background (Hershey & Hill, 1977–1978). Future research should examine how durable values and other individual difference (both inter- and intra-) variables interact with situational variables such as missing information or framing to yield expressed preferences. The present investigation sets the stage for such a program of research.

Implications and Conclusions

The findings from Study 1 and Study 2 show individual differences in cue importance and intraindividual differences in assumptions about missing information and in the tendency to infer missing information from available information. Because judgments about the environment have the potential to affect many people, individual differences such as found here highlight potential social conflicts. Efforts at conflict resolution will have to take into consideration the fact that even people exposed to *exactly* the same information may disagree and that disagreements may not reflect misunderstanding of information, as is often implied by policymakers (cf. Meyer, 1998). Therefore, solutions to conflicts over environmental issues may lie more in perspective taking than in the presentation of information, as has been found in the context of other issues (e.g., abortion and capital punishment; see Keltner & Robinson, 1993).

The tendency toward the “penalty effect” or unfavorable judgments when important information is missing was clear in our two studies, and there were individual differences in this tendency and intraindividual differences across cues. Assuming that people will simply ignore missing information seems imprudent, given our results. Therefore, policymakers, members of industry, and environmental organizations that are genuinely interested in the judgments of the populace (especially favorable ones) would do well to make all pertinent information available, especially if anyone asks for it. Of course, there are practical and psychological limitations to presenting all pertinent information. In principle, it is impossible to provide all relevant information, and recipients will likely be daunted if excesses of information are given to them. In any given situation, interested parties should determine what information is deemed most important to the specific people making judgments and make sure that it is available to those people.

Lastly, our findings with respect to self-awareness of judgment strategies might well provide reason for optimism among survey researchers, pollsters, and conflict mediators. To the extent that people can report their emphases on such socially important issues, perhaps survey results can be confidently used as interim tests of new policies before they are put into place. Further, conflict mediators, who often use “what if” scenarios in discussions between parties, can use people’s reports of cue importance in projecting reactions to proposed solutions. Finally, because human judgments are at the center of human activities, human activities are at the center of environmental issues, and environmental issues are central to the future of the human race, every step we take in understanding those judgments is an important one.

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