7-2008

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Organizational Behavior and Human Decision Processes 106 (2008) 143–152

ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES

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Reference dependence in iterative choices

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Received 1 July 2005
Available online 29 January 2008
Accepted by Robyn Dawes

Abstract

Valuation of goods often proceeds from a series of hypothetical pairwise choices. We examine reference dependence on the outcome of such evaluations in a large-scale study in which respondents make a series of choices between areas that differ on cost of living and the quality of lakes and rivers. We uncover three substantial reference effects. First, we find that respondents' choices are altered by being told the national value of water quality. For these people, consistent with prospect theory, changes in water quality below the 65% referenced national standard are treated as losses and given more weight while identical changes above 65% are treated as gains and given less weight. Second, we find that the sequence of iterative choices matters in a surprising way. The iterations proceed by encouraging switching either by degrading the chosen alternative or improving the item chosen. We show that improving the item not chosen produces the greatest switching, a result consistent with prospect theory, but only if the item changed in the iteration becomes the reference alternative. Finally, we find a strong starting reference effect. That is, we show that the trade-off in the first choice reflected in the change in cost of living divided by the change in water quality has a substantial impact on the final valuation. We assess the relative impact of these three reference effects and suggest ways of dealing with them for valuation of non-market goods.

Keywords: Contingent valuation; Iterative choice; Reference dependence; Loss aversion; Starting point bias; Water quality valuation; Diminishing valuation

Survey methods often provide the only way to generate individual valuations for non-market commodities. The particular methodology analyzed here is an iterative choice task in which respondents make a series of structured pairwise choices trading off gains in environmental quality against increases in cost of living. A distinctive aspect of this approach is that the sequence of decisions makes it possible to estimate each respondent's trade-off rate.

The survey was developed as part of an EPA funded study to value improvements to lakes and rivers. As the valuation aspect is detailed elsewhere (Viscusi, Huber, & Bell, 2004), we will focus on three reference effects that alter the outcome of the valuation exercise. The first reference effect involves whether respondents are given national data on water quality before making their choice; the second characterizes the impact of the particular sequence of iterative choices, and the third demonstrates strong starting point effect from anchoring on the first choice task. We build a general model that characterizes valuation as a function of respondent characteristics and these three reference effects. This model permits an assessment of the relative magnitude of these reference effects and suggests ways of dealing with them.

The goal of the iterative choice task in our study was to estimate each individual's monetary value for water quality in lakes and rivers. This is a difficult task for respondents, as they are unfamiliar both with EPA's measure

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doi:10.1016/j.obhdp.2007.10.005

of water quality and with its trade-off against cost of living. Accordingly, we sought a task that would be comprehensible and meaningful while at the same time subject to relatively few distortions. To do so, we frame the decision in terms of a hypothetical market choice in which respondents are asked to imagine moving to one of two regions that are otherwise identical except for the percentage of good water bodies and the annual cost of living. To motivate and help them articulate their values, we ask respondents to think about how these attributes affect their lives (Fischhoff, 1991). We define good water for the respondents following the terminology developed by the United States Environmental Protection Agency (1994) as the percent of lakes, rivers and streams in which it is safe to swim, from which fish are safe to eat, and for which the water sustains a healthy aquatic environment.[1]

Framing the decision in terms of a hypothetical marketplace choice was designed to limit both omission and status quo biases (Baron & Ritov, 2004; Samuelson & Zeckhauser, 1988). When choosing between pairs of new regions, neither alternative represents the default or the status quo. More important, the method deliberately abstracts from the individual's current context. This abstraction has, in our view, two benefits. First, making a trade-off independent of one's current holdings limits idiosyncratic values a person might bring by virtue of, say, living next to a particular lake or having beliefs about local water quality that contradict the survey questions. This generalized context thereby limits interpretations and inferences that can destabilize valuations (Medin, Schwartz, Blok, & Birnbaum, 1999). Second, framing the choice as a trade-off in a market context has conceptual advantages compared to the referendum method recommended for contingent valuation studies in the Arrow report (Arrow et al., 1993). In particular, a referendum vote for a $200 annual tax to improve water quality imposes both benefits and costs on all people in the region. By contrast, the choice of an alternative in a free market mainly affects the individual while having minimal impact on either the water quality or the cost of living of other citizens.

The risk here is that making judgments more abstract can make them less meaningful and therefore more open to context and reference effects. Accordingly, other aspects of the survey were designed to increase interest in, and to encourage elaboration on, the choice alternatives. The web-based survey defined the monetary and water quality dimensions and provided warm-up choices with easy dominated choice options, where one area is better on both cost of living and water quality. If a respondent incorrectly selected the dominated alternative, we reviewed that choice and provided the option to reverse it.

[1] More detail on the precise meaning of water quality and the attribute training is provided in Viscusi et al. (2004).

Once familiar with the attributes in play, respondents made an initial choice similar to the one shown in Fig. 1, where Region 1 offers lower water quality but lower cost of living than Region 2. Respondents could indicate no preference, after which the iterative process ends. Alternatively, if they indicated a preference for one of the two regions, that triggered a subsequent round of choices to better identify the trade-off rate. Each subsequent iteration depended on the response to the previous question, following a decision tree similar to that shown in Fig. 2. The bottom row of Fig. 2 gives the final dollar outcome as one of 19 possible paths, each of which defines a specific trade-off value or puts bounds on the respondent's value of water quality.

Our sample consisted of approximately 4000 surveys executed using Knowledge Network's national panel. These web-based surveys took place in six different waves between 2002 and 2004. Across and within the waves, the implementations differed with respect to the starting choice, the information provided, and the locus of change in the iteration processes. These variations are critical for assessing the impact of reference effects on the final valuations.

As discussed earlier, a number of aspects of our assessment method were designed to minimize reactions to water quality as a protected value (Baron & Spranca, 1997; Ritov & Baron, 1999; Viscusi, Magat, & Huber, 1987). Ultimately, the question of whether we were successful with respect to protest votes is an empirical one, measured by the frequency of protest votes. In our study, protest votes are indicated by persons who continue through the decision tree until they accept a dominated alternative that is worse on both attributes and remain with that choice despite a reminder. Overall, 5% of respondents exhibited such protest behavior—67% of those protesting initially chose the region with high water quality, while 33% came from those who initially chose lower cost of living. Thus, people who support clean water were more likely to protest, but generally very few protested.

Choose the region you prefer.
Remember that the national average for water quality is 65% Good.

	Region 1	Region 2	
Increase in Annual Cost of Living	$100 More Expensive	$300 More Expensive	
Percent of Lake Acres and River Miles With Good Water Quality	40% Good Water Quality	60% Good Water Quality	
Which Region Would You Prefer?	Region 1 X	Region 2 X	No Preference X

Fig. 1. Example of the initial choice task.

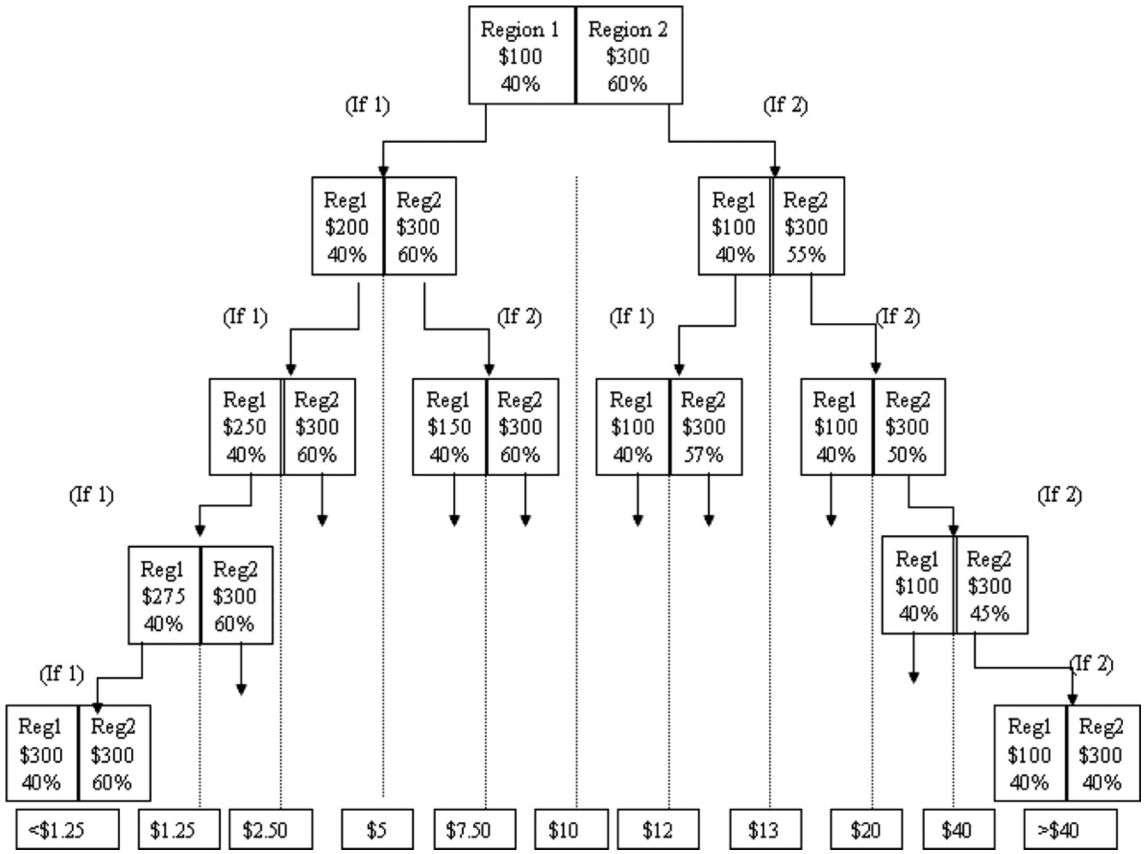

Fig. 2. Sample decision tree for generating individual value of good water quality.

The distribution of the individual valuations

The iterative choice process yields raw mean and median values of $22.99 and $15.00, where valuations at the corners of the iterative decision tree are assigned the value at that choice node. The regression approach will account for censoring and context effects, but examining the raw data reveals an important characteristic of these data.

In particular, the unlogged values, shown in the upper panel of Fig. 3, are very asymmetrical, so that a raw mean puts less emphasis on people who prefer low prices while emphasizing the large absolute differences for those who prefer high water quality. By contrast, the logged values in the lower panel display a reasonable bell-shaped distribution, leading us to use the log valuation as our key dependent variable. Additionally, there is a logical reason for the log transformation. Our key statistic is the dollar value of a 1% improvement in water quality. This focal variable could have just as reasonably been defined as its inverse, the percent improvement that is worth one dollar. Basing the analysis on the log of the raw value results makes our results invariant to whether the dependent variable is the choice of dollars per percent good or its inverse, following the mathematical equivalence of $\log(A/B)$ and $-\log(B/A)$.

A joint model of valuations and reference effects

Fig. 3 displays substantial variation across individuals in their valuation of water quality improvements. We use regression to account for how respondent and task characteristics affect these judgments. This regression model enables us to make strong tests of the magnitude of the reference effects and to estimate their impact through simulations. Table 1 gives a doubly censored regression that appropriately reflects the 9% of respondents unbounded at the low end and the 10% of respondents unbounded at the high end.

Focusing first on the respondent characteristics, we find that valuations correspond appropriately to these characteristics. Income, age, lake density in the state, and education are all positively related to willingness to pay, while having a large family or being African American are negatively related. Income, education, family size and lake density all relate to valuation in ways consistent with economic theory. Income should have a positive effect on valuations, reflecting the positive income elasticity of demand for environmental quality. Similarly, to the extent that education serves as a proxy for the present value of lifetime income, it too should have a positive effect. A positive coefficient for lake density is appropriate because a greater density

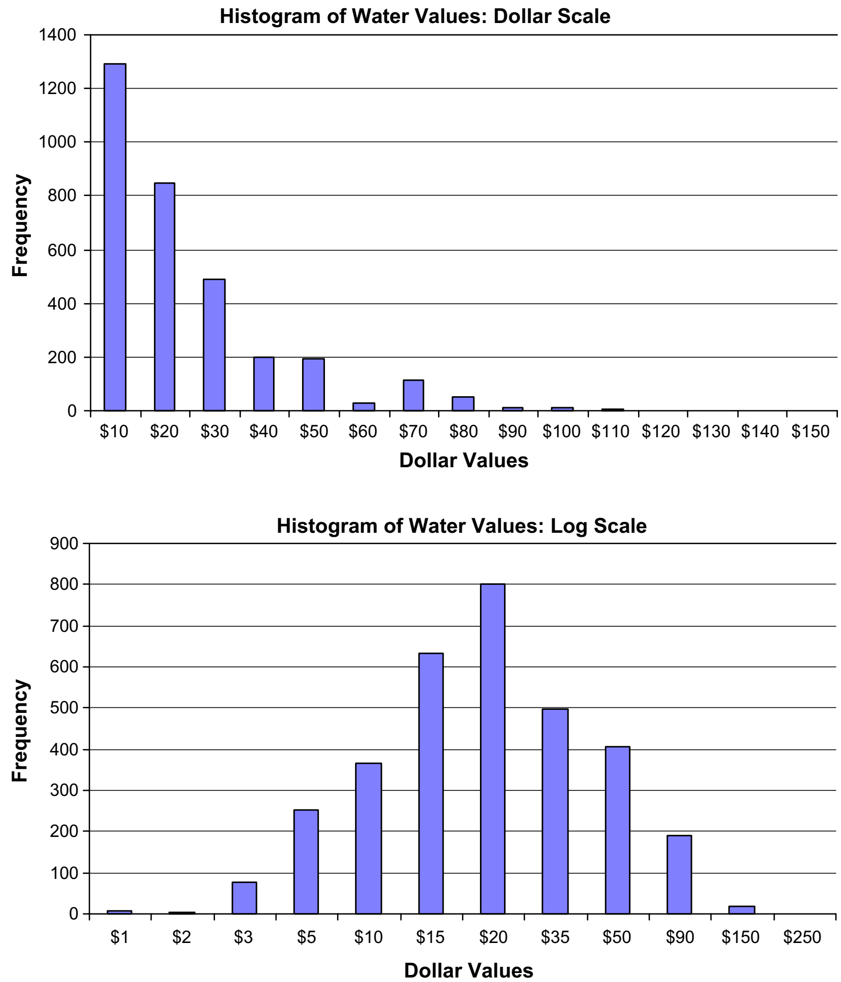

Fig. 3. Natural vs. log representation.

implies that a given percent change improves more lake acres. Finally, two dispositional variables, membership in an environmental organization and having visited a lake or river, both have significant positive coefficients, as expected. The regression also provides tests of three reference effects, which make up the core of this paper and are discussed in turn below.

The impact of the base water quality level

The question here is whether the base level of water quality alters the value of a unit improvement in water quality—for example, is the value of the gain from 30% to 31% greater than that of the gain from 70% to 71% good water? This base is 40% in Fig. 1, defined as the lower of the two offered water quality levels in the first choice question. Theoretically, respondents can be expected to display diminishing marginal valuations because the incremental value of most economic goods decreases with increases in its base level (Coombs & Avrunin, 1977). Similar logic is reasonable in the context of water quality valuation. Since a person can only use one lake acre or river mile at a time, the utility of another good lake acre diminishes as others are available. Additionally, if water bodies are substitutes one for another, the probability of finding a good quality one close to home increases at a decreasing rate as the base increases. Finally, Huber, Ariely, and Fischer (2002) show that respondents simplify choices by screening on low values, leading to choices reflecting diminishing marginal valuation. In all, while we expect diminishing valuation, there are rational patterns of response that produce increasing, decreasing, or constant marginal valuation (Keeney & Raiffa, 1993, ch. 3). Thus, the question of the change in unit value as a function of base water quality remains an empirical one.

We assess marginal valuations by measuring unit water values across base water quality levels that varied between 40% and 70% across respondents. The lower section of Table 1 includes base rate as an independent variable, displaying a coefficient of −.49 ($SE = .09$). Fig. 4 graphs this result for different base water quality levels after an adjustment is made for the inherent skew-

Table 1
Impact of respondent characteristics and reference effects on valuation

Variable	Log (dollar value for 1% better water quality)	
	Parameter estimate	*SE*
Respondent characteristics		
Income (log)	0.1222***	0.0229
Years of education	0.0398***	0.0080
Age	0.0062***	0.0012
Environmental organization membership	0.5196***	0.0883
Visited a lake or river, last 12 months	0.1903***	0.0429
Race: African American	−0.1406**	0.0593
Gender: female	−0.0476	0.0392
Household size	−0.0282*	0.0153
Region: Northeast	0.0232	0.0610
Region: South	−0.0307	0.0524
Region: West	−0.0035	0.0588
State lake acres per square mile	0.0045**	0.0021
Reference effects		
Base water quality (log)	−0.4858***	0.0939
Respondent told national water quality	−0.0373	0.0392
Told × base quality	−0.4768***	0.1567
Non-chosen alternative improves in iterated questions	0.1498***	0.0440
Water quality starting ratio (log)	0.4792***	0.0652
Intercept	0.4662	0.2516

Notes. *Significant at .10 level.
** Significant at .05 level.
*** Significant at .01 level, all two-tailed tests.
$N = 4033$ observations, including 376 left censored and 403 right censored. Pseudo R-square = 0.0236.

ness of the log normal distribution.[2] Evidence for diminishing marginal value comes from the finding that the unit value of water quality drops from \$37 to \$28 as the base level increases from 40% to 70%. In itself, this negative relationship is not reflective of a bias, but should be viewed as a characteristic of a reasonable base-dependent valuation for water quality. However, the following section provides an analysis demonstrating that diminishing valuation is strongly dependent on providing anchoring information, revealing a context effect with substantial substantive and theoretical importance.

Impact of external reference levels

The pairwise choices of the survey task were designed to limit the impact of an external reference level on valuations. To test the impact of a reference level for water quality, half of the respondents were told nothing about national levels, while the other half were given a realistic estimate of national water quality (65% good). Hsee (1996) demonstrates that difficult-to-evaluate attributes need such anchors to help gauge the importance a particular attribute level. If so, the inclusion of an internal reference level may generally increase the value of water quality. More important, we expected this reference information to alter base water quality valuation following prospect theory (Highhouse & Johnson, 1996; Kahneman & Tversky, 1979). Evaluating a location with water quality lower than the national average should put that region in the realm of losses and lead to higher unit valuations. By contrast, a location above the national average should be coded as a gain, thereby lowering the importance of a unit change in water quality.

We tested these expectations in the regression with three zero-centered terms, one for whether people were told the national water quality, a second for the base water quality, and a third for the interaction between these two factors. As Table 1 shows, contrary to our first expectation, including the national reference information did not alter the average valuation ($B = -.04$, $SE = .04$, *ns*). However, consistent with our second expectation, the interaction of base quality with whether the respondent was told the national water quality was strong and significant ($B = -.48$, $SE = 0.16$, $p < .01$). To illustrate this interaction, Fig. 5 graphs the impact of base starting levels on unit valuations and shows that this relationship depends on whether respondents are given information about the level of national water quality. Relative to no information, being told the national level decreases valuations when the base level is high but increases marginal valuations when the base is low.

[2] If a logged distribution has mean M and variance S, then the mean of the unlogged distribution is $\exp(m + S/2)$. In this application we took M and S to be the conditional means and variances given the regression (Train, 2003, p. 154).

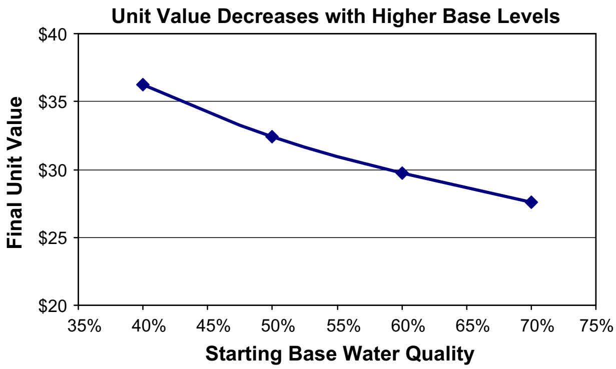

Fig. 4. Marginal value of water quality as a function of base rates.

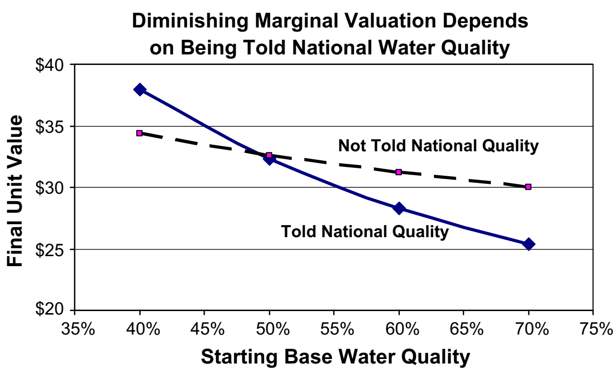

Fig. 5. Marginal value of water quality given base quality and information.

Translated to prospect theory, these results characterize unit water quality valuation that depends on whether national information is provided. With anchoring information, losses below the national level of 65% are more negatively evaluated than equivalent gains above that level. However, without that information, we cannot reject the null hypothesis of stable marginal valuation. More generally, these results suggest that diminishing incremental values may be more pronounced when internal reference levels permit the definition of gains and losses.

Iterative choice task differences

The previous analyses of base water quality and provided reference points show that values depend on the information as predicted by prospect theory. In this section we find a task-related framing effect associated with the sequence of choice options. The iterative choice task customizes subsequent pairwise choices for each respondent by altering the attributes of one region until the respondent reaches a point of indifference or finds a combination that reverses the direction of their initial choice. In this section, we demonstrate that the likelihood of this reversal is altered by the locus of change, whether the iterations degrade the chosen region or improve the rejected region.

Fig. 2 illustrates the iterative sequence where the chosen region is degraded. Examining the branch where Region 2 is chosen, those who choose the 60% water quality see it drop to 55%. In the improve-not-chosen condition (not shown), the rejected region improves from 40% to 45%. In both cases, the difference in quality between regions diminishes from 20% to 15% points, but those five points are taken from the one chosen in one condition and added to the one not chosen in the other. The question is whether this locus of change systematically alters valuation.

This type of problem is quite general. Suppose a person initially chooses a laptop with a battery life of 3 h for $2000 over one with a battery life of 5 h for $2400. Would the person be more likely to switch the 5-h option reduced its price by $100 or the 3-h option raised its price by $100? The problem also applies to investment behavior. Would the likelihood of selling a stock be greater if it lost ground, or a competitor gained?

Assuming that attention remains focused on the last item chosen regardless of the locus of change, then a straightforward application of the principle from prospect theory that losses loom larger than gains predicts greater behavioral impact from degrading the item chosen. Simply put, a loss of $100 on what one has should be more likely to motivate a switch than an equivalent gain on what one does not have. However, this account assumes that the last chosen item remains the referent. If the item changed becomes the referent then the prediction from prospect theory reverses. Suppose, in the improve-not-chosen condition, attention is drawn to the region changed, making it the referent. Past research has indicated greater choice of the item that becomes the reference object (Dhar & Simonson, 1992).

The results support the change in reference due to attention directed to the item changed. As shown in Table 2, 30% of those who choose the low cost region reverse when the region chosen becomes less attractive. However, 47% reverse when the region not chosen becomes more attractive by the same dollar amount. Proportional results derive for those who initially choose the area with high water quality. The percentage reversing increases from 16% to 22% when the region not chosen is improved.[3] Both differences are statistically significant at the .01 level. This result is compatible with prospect theory where attention due to changing an item leads to a shift in the reference alternative.

[3] It may appear that people are more likely to reverse from a cost-of-living choice than a water quality choice, however, because there was more flexibility in the range of cost of living compared with water quality, the magnitude of the shift from a water quality choice was smaller, 25%, compared with the shift in the cost of living of 50%.

Table 2
Probability of switching depending on locus of change

Valued attribute in first choice	Switching probability given rejected item improves	Switching probability given chosen alternative degrades
Lower cost of living	47.1% $n = 792$	29.5% $n = 1155$
Higher water quality	22.0% $n = 604$	16.0% $n = 1206$

This result is surprising because it suggests that the item changed may serve as a stronger reference than an initial choice. The regression results in the lower part of Table 1 show that valuations significantly increase when the non-chosen alternative improves. However, as will be demonstrated later, this result (while statistically significant) has less impact on the final valuation than the other context effects. This lowered impact occurs because switching has counterbalancing effects on valuation. For those who initially chose high water quality, valuations resulting from improving the non-chosen will *decrease*, while for those who choose cost of living, they will *increase*. As long as the likelihood to be on either side of the tree is about equal, then the magnitude of these countervailing effects should roughly counterbalance each other. Thus, this locus of change effect is less important for valuation *per se* than for what it reveals about the likelihood of reversing sequential decisions and the general importance of attention in processing such decisions.

It is important to acknowledge that the results above are limited to the second choice. Once the locus-of-change effect occurs after the second choice, we find no difference between altering the item chosen compared with the item rejected.

Impact of the starting trade-off ratio

The starting trade-off ratio is the value per 1% good water implicit in the first trade-off choice. For example, Fig. 1 pits a $200 advantage in cost of living against a 20% point advantage in water quality, resulting in an initial trade-off ratio of $200/20%, or $10 for 1% good. To determine its impact, the starting ratio varied across respondents from $5 to $30 per 1% good water.

There are a number of reasons to expect a large starting ratio effect. Either a large random component in responses or an inference and subsequent anchoring by respondents could produce such an effect. To the extent that responses have a large random component because people simply guess on their initial choice, one would expect values to increase proportionately with the starting trade-off ratio. Alternatively, suppose responses are not random, but people infer that the starting trade-off value reflects average values in the society. If so, they may use that value to anchor their response and produce a bias given when they inadequately adjust to it (Johnson & Schkade, 1989; Kahneman, Ritov, & Schkade, 1999).

There is evidence that the starting point can have a large impact on the final valuation in many judgment tasks. In the judgment literature, Cooke and Mellers (1995) show that increasing the range of one attribute alters relative preferences in ways that are compatible with a starting trade-off ratio effect. In the contingent valuation literature, Rowe, D'Arge, and Brookshire (1980) found a 60% elasticity of the initial bids offered and the final bid for an environmental valuation task. Boyle, Bishop, and Welsh (1985) found substantial effects for the starting choice when the judgment is hypothetical.

Table 1 displays the impact of the log starting ratio on final valuation. The coefficient shown ($B = .48$, $SE = .07$, $p < .01$) implies a 48% elasticity between starting ratio and final valuation. This is a major and problematic effect. Shifting the start ratio from $5 to $20 can double the final value. Lacking a constraint on the starting ratio, an analyst could generate arbitrarily different valuation levels. In the next section we suggest a rule for the starting ratio that can stabilize estimates for policy purposes.

Adjusting valuations for reference effects

We have uncovered three relevant reference effects: (1) diminishing incremental valuations of improved quality only when told the 65% national water quality level, (2) greater likelihood to reverse choice when the alternative rejected is improved compared with when the item chosen is degraded, and (3) a strong starting ratio effect. The regression in Table 1 permits us to estimate what the valuation would have been with and without contextual conditions. Since the regression is non-linear in valuation, estimating the impact on average valuation requires sample enumeration. Thus, each individual's log predicted value comes from the regression equation using that person's characteristics and whatever context parameters we wish to simulate. These values are then converted to a non-logged estimate for each sample respondent and aggregated to produce the appropriate population means and medians.

Below we estimate values for a reasonable but fundamentally arbitrary core scenario, followed by sensitivity analyses to assess the impact of changes in context. For the core scenario, we set base water quality to be 50%, a value that makes the average observed values close to the national average of 65%. Since respondents did not generally know this national water quality level, this informational condition is not part of the core scenario.

Setting the starting ratio is problematic, since it is logically unbounded and is set by the analyst. If there were known market conditions comprising reasonable trade-offs, they could be used as our base. However, if such market conditions existed then hypothetical choices could be replaced by real market analysis. In response to this indeterminacy, we propose that the initial starting ratio be set such that there is a 50–50% split across the general population for the initial choice. We term this an "equitable" initial trade-off, in that each of the starting paths down the iterative tree has equal probability. In our research, we had originally proposed that the starting ratio follow this property, and we developed a series of alternative start ratios producing responses that bracket the 50–50% split. However, we found that the variability around the first choice made it difficult to achieve that equity target exactly. So, we account for this variability with a choice model that can be used to determine the starting ratio that is most likely to result in a 50–50% split. The valuation from an equitable start can thus be estimated parametrically.

To estimate the starting value that would generate a 50–50% split, we ran a logistic regression predicting the likelihood of choosing the item that is better on cost of living as a function of the log of the starting ratio (change in cost of living/change in % good water). The equation is:

$$\text{Logit(choose cost of living)} = -2.3 + .86\ (\text{log start ratio})$$

Solving this equation for the location of a predicted 50–50% split produces an equitable start ratio of $\exp(2.3/.86) = \$14.50$. With this estimated equitable trade-off ratio, adjusting for the context effect is achieved by inserting that starting ratio into the sample enumeration of the regression shown in Table 1, in the same way as we adjust for the other context effects. Table 3 provides the valuations for the base case given the following assumptions:

Equitable start ratio = \$14.50
Base water quality = 50%
Not told national water quality level
Iteration policy: 50% chosen degraded, 50% non-chosen improved

As shown in Table 3, the projected value of a 1% gain in water quality for the base case has a median of \$14.12 and a mean of \$32.85. The next row indicates a substantial increase in a mean to nearly \$40 if the start ratio increases from \$14.50 to \$25.00. The next row shows that increasing the base water quality rate from 50% to 65% drops the mean valuation by only \$2.00; however, that same increase when the 65% national quality is revealed results in a drop in the mean valuation of nearly \$6.00. With a base rate equal to a known national average, all quality improvements are in the realm of gains, resulting in a substantial dampening effect on the unit value of water quality. Finally, a shift in iteration policy to 100% improving the non-chosen region has a modest \$2.50 impact on valuation.

These projections permit more than estimates of the impact of context effects. Through the sensitivity analyses we can clarify the magnitude of these context effects on valuation. The starting ratio is the largest bias, and thus the one most in need of stabilization through a rule such as the equitable start.

Discussion

As hypothetical choices become an increasingly popular task for those seeking to measure people's valuations for non-market goods, it becomes important to understand and control the behavioral factors that influence the preference elicitation process. We give evidence of strong reference effects in iterative choice. The biases we find may influence people's choices generally, not just in experimental valuation tasks. Below, we review three central findings and relate them to both theory and practice.

Finding 1: Reference information can magnify diminishing marginal valuations

We had expected that the percentage of good lakes and rivers would exhibit diminishing valuations simply because it was framed on a 0–100% scale, and that incremental valuation of a 1% change would be greater from a low, compared with a high quality base. What we found was that diminishing valuations are significant only when respondents were given the external reference. The fact that diminishing marginal valuation was not significant in the absence of an external reference level may be due to the fact that the tested range of base water quality percent did not get close enough to 0 or 100, but the result remains noteworthy. In particular, it reveals how explicit references can strongly increase diminishing marginal valuations through the loss aversion property of prospect theory. Compared to the case where no reference is provided, unit valuations increase in the loss domain where base quality levels are below the reference. By contrast, they decrease in the gain domain where base quality levels are above the reference. This result is strongly consonant with both the loss aversion and reference dependent properties of prospect theory.

Table 3
Sensitivity of water quality values to different contexts

Assumed survey context	Mean water valuation	Median water valuation
Base case: • Starting ratio = \$14.50 • Base quality = 50% good • Not told national quality • 50% Non-chosen improves 50% Chosen degrades	\$32.85	\$14.12
Increase starting ratio from \$14.50 to \$25.00	\$39.75	\$17.09
Increase base quality from 50% to 65%, not told national level	\$30.82	\$13.25
Increase base quality from 50% to 65%, tell national quality: 65% good	\$26.96	\$11.59
Iteration policy: 100% non-chosen improves	\$35.42	\$15.22

Including information about the national quality percentage had no main effect on the mean valuation largely because our initial base quality values averaged 50%, the point at which the base quality level curves cross in Fig. 5. Had the base starting point been lower or the national average been higher, then our data lead to the prediction that the main effect of the information would have been substantially stronger. The point here is that our null result with respect to the main effect of being told the national water quality should not suggest that this context effect can be ignored. Instead, the result of the interaction demonstrates that the magnitude of the effect depends on the location of the reference level relative to the items evaluated, and this interaction generally needs to be reflected in any estimate of average valuation.

The idea that a central reference point enhances the extent of diminishing valuation generates some interesting market predictions. For example, providing average efficiency ratings for refrigerators should drive consumers to avoid those with ratings below the average, while providing a relatively weaker impetus to purchase for refrigerators above the average. This asymmetric reaction will tend to narrow the range of items chosen, so that the refrigerators chosen will be closer to the published average. Similarly, consider the impact of information on the average airfare between a pair of cities. Buyers only finding prices above the published average will be more likely to continue searching for better deals, while those finding prices below the average will be more likely to stop searching. This differential reaction leads to the prediction that publishing the average airline price for a city pair will increase price compression around that reference level.

Finding 2: Greater switching results from improving the rejected item than from degrading the chosen item

This result, showing the importance of the locus of change, was surprising. We had expected that the item chosen would define the reference, so that degrading it would be more likely to lead to a choice reversal over improving a previously rejected item. We found, however, a consistent effect showing that switching is more likely following an improvement in the previously rejected alternative. This finding can be derived from prospect theory only under the assumption that the new information about the rejected alternative makes it the reference.

This attention-related process is potentially important in characterizing locus-of-change effects in other environments. Our results imply that when a respondent's focus is primarily on the alternative chosen, then the endowment effect and loss aversion can be expected to hold. However, the endowment effect may be limited if attention is refocused to other alternatives. Applied to candidate selection, for example, it suggests that a deep review of an alternative candidate is likely to lessen the probability of reappointing a well-known incumbent. Applied to negotiation, it implies that one has a better chance to move a person towards a previously rejected alternative by improving it compared with an equal degradation of the current option.

Still, it is important to acknowledge that the shift-of-attention explanation remains circumstantial and needs further research. Explicit measures of attention and processing are needed to validate the story that attention follows the locus of change. These measures could come from explicit process tracing techniques such as Mouselab and concurrent protocols, or from implicit techniques such as memory traces.

Finding 3: There is a strong starting ratio bias

Our data are consistent with those of other researchers who have found substantial starting-point effects, but it is important to specify where one would expect similar results. The nearly 50% elasticity relating initial starting ratio to final evaluation is reasonable for those evaluating better lakes and rivers, since there is no well-defined market value for these benefits. By contrast, one would expect reduced starting point bias for choices where known market prices exist. For example, consider valuations of square footage in a home or the value of an ocean view in Los Angeles. In these cases, the market value serves as the anchor that limits the impact of the trade-offs in the first choice.

Our treatment of starting ratio bias goes beyond that of the large literature on the possible influence of starting point effects, which are endemic to almost all stated preference surveys. Rather than simply noting the existence of such effects, we have proposed an approach for handling them in terms of equitable trade-offs in which there is a 50–50% split in the initial choice. The equitable trade-off limits the ability of a survey designer to bias choices in practical applications.

Considered broadly, our investigations have focused on water quality valuations, but the interesting future research opportunity involves determining the extent that the reference dependence occurs for choices in general. Overall, we have validated the applicability of prospect theory to choice. Our first finding is that external reference levels can strongly alter choice, suggesting these levels could either increase or decrease the incremental values of an attribute depending on their location. Our second result validates prospect theory given that that the reference point follows the locus of change in iterated choice. More generally, this latter result suggests a shift in the focus of choice research from a validation of prospect theory to assessing the location of the reference. Our third finding identifies a large starting ratio bias in which final valuations adjust as if the initial ratios of benefits were valid indicators of appropriate value. We suspect that starting point effects generally alter valuations in many applications, but too often the starting choice may not have been sufficiently manipulated to make the bias apparent. In our own work, the early starting ratio tests did not display a significant difference until we tested ratios across a broad range. Like us, many researchers may use either a narrow range or no range, and thus have no idea that their ending valuations are largely a result of where they began. In all, our experience suggests a call for more tests of context effects, combined with a push for innovative ways to account for them.

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