# Validating Contingent Valuation With Surveys of Experts

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Contingent-valuation estimates for white-water boating passengers are compared with Likert ratings by river guides. The approach involves asking whether passengers and their guides ordinally rank alternative flows the same. The National Oceanic and Atmospheric Administration's Contingent Valuation Panel (1993) suggested "one might want to compare its (contingent-valuation's) outcome with that provided by a panel of experts." River guides constitute a counterfactual panel of "experts." For commercial trips, optimum flows are 34,000 cfs and 31,000 cfs for passengers and guides, and the comparable figures for private trips are 28,000 cfs and 29,000 cfs. In the NOAA Panel framework, passengers can evaluate the consequences of various river flows and translate this into contingent-valuation responses.

Since Robert Davis (1964) conducted the first contingent-valuation study, a number of researchers have critiqued this methodology (Scott, 1965; Phillips and Zeckhauser, 1989; Kahneman and Knetsch, 1992; Diamond *et al.*, 1993). Despite the evolution of a substantial literature investigating the validity of contingent-valuation estimates, the critiques persist because Hicksian surplus for nonmarketed goods is unknown and often is not measurable through revealed behavior (Cropper and Oates, 1992). Inferences about the validity of contingent valuation are commonly based on tests of criterion or convergent validity (Carmines and Zeller, 1979). Criterion-validity tests are experiments where cash transactions, taken as truth, are used in one treatment and contingent valuation is carried out in a parallel treatment (Bishop and Heberlein, 1990; Dickie, Fisher and Gerking, 1987; Kealy, Dovidio and Rockel, 1988). The more common approach is the conduct of convergent-validity tests comparing contingent-valuation estimates with value estimates derived using other nonmarket valuation methodologies. Tests focus on comparisons with travel-cost estimates (Sellar, Stoll and Chavas, 1985; Smith, Desvousges and Fisher, 1986), estimates derived from hedonic-price models (Brookshire *et al.*, 1982), and comparisons with various formats of asking contingent-valuation questions themselves (Boyle and Bishop, 1988; Smith, Desvousges and Fisher, 1986). If estimation methodologies provide statistically similar estimates of Hicksian surplus, convergent validity is established.

In contrast to the controversy surrounding the use of contingent valuation, professional opinions of experts are commonly employed in legal proceedings, public decision making and business decisions. The National Oceanic and Atmospheric Administration's Contingent Valuation Panel (1993) (NOAA Panel hereafter) suggested "that these agents are more 'expert' or at least draw upon more knowledge than the citizens themselves" (p. 4607). The NOAA Panel goes on to propose that "one might want to compare its (contingent-valuation's) outcome with that provided by a panel of experts." Implementing such a validity test is easier said than done, and the NOAA Panel provides no guidance regarding the composition of an expert panel nor how contingent-valuation (CV) responses might be compared with expert opinions. In addition, a lack of comparability between CV estimates and expert opinions does not refute the validity of CV. Experts are a self-selected group and there may be very good reasons why their opinions might differ from those of a sample of individuals responding to a CV survey.

There are also reasons why an expert panel might provide a useful test of convergent validity.

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Respondents to CV surveys often do not have experience with the alternative condition described in the valuation scenario, perhaps they do not even have experience with the baseline condition. CV estimates, therefore, depend crucially on the information presented in the survey instrument. Experts, on the other hand, are expected to be familiar with the condition of a resource and effects of changes in the condition of the resource. Thus, a test of convergent validity using expert opinions can provide useful information to support the credibility of CV estimates. A divergence between CV estimates and expert opinions motivates investigations to explain the differences, and this may lead to an enhanced understanding of respondents' answers to CV questions. It is only through the use of this auxiliary information that the credibility of CV estimates can be called into question.

While the NOAA Panel was referring to CV estimates of nonuse values, such a comparison is also relevant in the context of use values. In this paper we report results of such a comparison where CV estimates for white-water boating on the Colorado River at various river flows are compared with Likert ratings of various flows by river guides.

The approach involves asking whether passengers on white-water trips and their guides rank alternative flows the same; an ordinal comparison. Such a test of convergent validity is not based on the strong assumption that one estimate represents the truth, but demonstrates that CV respondents are capable of making judgments consistent with those of experts who may be better informed regarding technical and qualitative implications of various white-water flows.

## Conceptual Framework

Colorado River flows through the Grand Canyon are controlled by releases from Glen Canyon Dam. Dam releases vary daily depending on hydrological conditions and demand for electric power. Although river flows affect the quality of white-water trips, a specific flow is not a choice variable when passengers decide to take a raft trip. White-water raft trips are often planned a year or more in advance and releases are difficult to predict this far in advance. Moreover, white-water rafters generally take one Grand Canyon trip and are familiar only with the flow they experienced. While rafters do not know the river flow when they start their trips, the guides who lead these trips often can infer flow levels from river conditions and are familiar with the effects of alternative flows on white-water rafting.[1] The river guides constitute the counterfactual panel of "experts."

It is generally assumed moderate flows (20,000 to 30,000 cubic feet per second (cfs)) are desirable while low flows (less than 10,000 cfs) or high flows (greater than 40,000 cfs) are less desirable (Boyle, Welsh and Bishop, 1993; Shelby, Brown and Baumgartner, 1992). Low flows are undesirable because trips take longer and rafters must walk around some rapids due to exposed rocks. A slow trip limits passengers' ability to visit attractions along the river and it is harder to keep trips on schedule. Walking around rapids is undesirable because riding through rapids is an important trip attribute for passengers. High flows result in flooded beaches, limiting camping opportunities, and rafters must walk around some rapids because the wave hydraulics are too severe to raft. Limited camping beaches are undesirable to passengers because of crowding with other parties.

The underlying assumption of the proposed test of convergent validity is that no matter what one's preferences are, all who understand white-water rafting will rank flows in the same order. We propose the ranking of river flows will follow a quadratic relationship. Guides (experts) technical understanding of the objective phenomena of flows is used as the counterfactual standard against which passengers' (lay persons') knowledge can be judged. The NOAA Panel suggests this comparison "will help to check whether respondents . . . are reasonably well-informed" (p. 4607). This test does not require CV respondents and experts to have identical preferences or equal values, they simply process technical data in a similar manner.

Passengers were asked to answer a CV question for the following value definition:

$$(1) \qquad V(p, y - \Theta_j; f_j) = V(p^\circ, y; f_j)$$

where $V(\cdot)$ is an indirect utility function, $p$ is the price of a white-water trip, $y$ is income, $\Theta_j$ is Hicksian compensating surplus (willingness to pay) for a white-water trip at flow $f_j$, $f_j$ is the flow a rafter experienced, and $p^\circ$ is a price at or above the choke price at which a trip would not be taken (Boyle *et al.*, 1993). All other arguments are suppressed for notational convenience.

The guides were asked to evaluate a variety of flows, for a boat they were piloting, on an integer scale ranging from 1 (very satisfactory) to 5 (very unsatisfactory) where:

[1] Guides may choose to lead a trip at a desirable flow or to not lead a trip at an undesirable flow.

$$(2) \qquad 1 \leqslant R(f_j) \leqslant 5$$

and $R(\cdot)$is a preference function ($R_j$) for river guides and $f_j$ are river flows (Shelby *et al.*, 1992). Guides were not asked to respond to a CV question because most are paid to lead trips. The guide rankings are recoded such that 0 is very unsatisfactory and 4 is very satisfactory:

$$(3) \qquad R_{gj} = 5 - Rj.$$

This is done so the lowest ranking is comparable to $0 in CV estimates.

The basic test is that both $\Theta_j$ and $R_{gj}$ are quadratic functions of river flow:

$$(4a) \qquad R_{gj} = g(f_j, f_j^2)$$

and

$$(4b) \qquad \Theta_j = h(f_j, f_j^2)$$

Other right-hand-side arguments are suppressed for notational convenience. If the guides' ratings are a quadratic function of flow, confirming the presumed desirability of moderate flows, and CV estimates are also a quadratic function of flow, this suggests CV respondents process implications of various flows in a manner similar to guides (experts). If both variables are quadratic functions of flow, the estimated functions can be solved to determine the optimal flow for each group. Identical optimal flows imply identical ordinal rankings of lower and higher flows according to estimated CV values and guides rankings.

CV values were elicited using a dichotomous-choice question and responses to the question were analyzed using a logit model. Recoded guide ratings are used to estimate an ordered probit model. Passenger and guide equations were estimated using flow and flow squared as explanatory variables. The hypothesis regarding a quadratic relationship between ratings and flows is:

$$(5) \qquad \text{Ho: } \hat{b}_f = \hat{b}_{f2} = 0$$

where $\hat{b}_f$ and $\hat{b}_{f2}$ are the estimated coefficients for the flow and flow squared variables.

## Application

The test was conducted for two types of white-water trips, commercial and private. Commercial passengers are individuals who take trips organized by companies which, for a fee, supply guides, boats, food and most of the equipment passengers need. Commercial guides are individuals who work for rafting companies. Private trips are organized by groups of individuals who provide their own equipment and supplies, and maneuver their own boats downstream. Private guides are individuals identified as leaders on private trip rosters, are the most experienced rafters in their parties, and sometimes are commercial guides operating on a freelance basis.[2]

The CV survey was administered by mail in 1986 to 598 randomly selected white-water passengers who took a raft trip during 1985.[3] A total of 506 responses were obtained (337 commercial passengers and 169 private passengers), representing 91 percent of the deliverable surveys.[4] Respondents to the CV survey experienced flows ranging from an average daily low of 1,974 cubic feet per second (cfs) to an average daily high of 43,214 cfs trips.[5] This flow data was obtained from the U.S. Bureau of reclamation which controls Colorado River flows through the Grand Canyon via releases from Glen Canyon Dam. Flow data were merged with the CV data based on the dates of respondent's trips.

Respondents answered a dichotomous-choice valuation question evaluating their white-water trips: "would you still have gone on the Grand Canyon white water trip if *your* costs had been $_____ more than the total you just calculated in Question A26?"[6] Responses were "yes" or "no." The wording of this question was identical for commercial and private passengers. Analyses of responses have been reported by Boyle, Welsh and Bishop (1993). Estimated logit equations include average flows respondents experienced specified as a quadratic relationship.[7] These estimates are replicated in Table 1.

The survey of guides was administered by mail to 385 randomly selected river guides in December

[2] The samples of private passengers and private guides are independent. Trip leaders were not eligible for selection in the boater sample and other party members were not eligible for selection in the guides sample.

[3] The National Park Service maintains records of the rosters of rafters on all private raft trips. Our sample was drawn from these records and records of passengers provided by commercial rafting companies.

[4] The commercial passenger sample is twice as large as the private passenger sample because the commercial passenger sample is comprised of individuals who took either a commercial-oar or a commercial-motor trip. Responses of individuals in the commercial-oar and commercial-motor samples were statistically indistinguishable so they are pooled to simplify exposition (Bishop *et al.*, 1987).

[5] The highest average flow experienced was 40,413 cfs among commercial passengers and 43,214 cfs among private passengers, the respective low flows were 1,974 and 10,709 cfs, and the respective average flows were 21,666 and 25,895 cfs.

[6] The dollar amounts for this valuation question were randomly assigned according to the procedure outlines in Boyle, Welsh and Bishop (1988). The initial distribution of bids was developed from a mail pretest of the survey instrument.

[7] A linear specification of the indirect utility function was assumed for all variables except flow. Therefore, income does not enter the empirical model (Hanemann, 1984).

**Table 1. Estimated Flow Functions**

| | Commercial | | Private | |
|---|---|---|---|---|
| Variables | Passengers[a] (Logit) | Guides (Probit) | Passengers[a] (Logit) | Guides (Probit) |
| Constant | −3.050**[b] | — | 0.176 | — |
| | (1.684)[c] | | (2.293) | |
| Constant (1) | —[d] | 0.350* | — | 0.803* |
| | | (0.081) | | (0.140) |
| Constant (2) | — | 0.559* | — | 1.539* |
| | | (0.103) | | (0.178) |
| Constant (3) | — | 0.950* | — | 2.010* |
| | | (0.139) | | (0.196) |
| FLOW | 0.290* | 0.072** | 0.376** | 0.277* |
| | (0.111) | (0.031) | (0.167) | (0.029) |
| FLOW SQUARED | −0.004** | −0.001** | −0.007** | −0.005* |
| | (0.002) | (0.001) | (0.003) | (0.000) |
| Bid (Dollar amount from contingent-valuation question) | −0.004* | — | −0.005* | — |
| | (0.001) | | (0.001) | |
| Expense[e] (Reported trip cost) | 0.001* | — | 0.001** | — |
| | (0.000) | | (0.001) | |
| Water-Level Preference (−1 lower, 0 same, and 1 higher) | −0.554*** | — | — | — |
| | (0.311) | | | |
| Crowding (1 not crowded to 9 extremely crowded, integer scale) | — | — | −0.549* | — |
| | | | (0.164) | |
| Shared a Camping Beach (1 shared and 0 otherwise) | — | — | −1.081** | — |
| | | | (0.519) | |
| Fee (1 if felt answers would affect trip costs and 0 otherwise) | −1.451* | — | −2.014* | — |
| | (0.295) | | (0.535) | |
| $\chi^2$ | 91.3 | 44 | 51.0 | 119 |
| N | 297 | 132 | 143 | 149 |
| Optimal Flow ($10^3$ cfs) | 34 | 31 | 28 | 29 |

[a]Estimates replicated from column (1), Table III (commercial passengers) and column 1, Table IV (private passengers) in Boyle, Welsh and Bishop (1993).
[b]Single asterisk denotes significance at the 0.01 level, double asterisk denotes significance at the 0.05 level, and triple asterisk denotes significance at the 0.10 level.
[c]Standard errors presented in parentheses.
[d]Dashes indicate variables not included in the equation.
[e]While the sign on the expense coefficient does not have an expected negative sign, including income in the model does not correct this problem.

1985/January 1986 (Shelby, Brown and Baumgartner, 1992).[8] A total of 286 responses were obtained (134 commercial guides and 152 private guides), representing 78 percent of the deliverable surveys.[9]

Guides were asked to evaluate 14 different river flows ranging from 2,000 cfs to 80,000 cfs.[10] Since none of the individuals in the white-water passenger samples experienced flows in excess of 50,000 cfs, only 12 flows between 2,000 cfs and 50,000 cfs were included in the analyses.[11] The question for commercial guides is: "how would you, as a commercial river guide using the boat you usually pilot, evaluate each of the following water levels for a commercial Grand Canyon river trip?"[12] The response categories were "very sat-

[8] Commercial guides were selected from the National Park Service's file of qualified guides, which includes individuals working for commercial raft companies and who operate on a freelance basis. Private guides were selected from the National Park Service 1985 launch records for private trips.

[9] The commercial guides sample was stratified according to whether the guides led commercial-oar or commercial-motor trips. As with the commercial passengers, the responses were statistically indistinguishable and all responses of commercial guides are pooled to facilitate exposition (Bishop *et al.*, 1987).

[10] Both commercial and private guides, on average, had nine years experience leading raft trips. Commercial guides had taken an average of 56.4 trips on the Colorado River through the Grand Canyon, while the comparable figure for private guides was 14.4 trips.

[11] The flows included in the analyses are: 2,000, 3,000, 4,000, 5,000, 7,500, 10,000, 15,000, 20,000, 25,000, 30,000, 40,000, 50,000 cfs. The excluded flows were 60,000 and 80,000 cfs. For analyses reported here we randomly select one eligible flow evaluation ($2{,}000 \leq f_i \leq 50{,}000$) for each guide. This was done to assure independence of observations on guide.

[12] Excerpting one question from the guide survey does not convey the theme of the entire survey. Guides were asked to report their perceptions. The last sentence of the introduction to the survey stated "please answer the question from your perspective as a commercial guide." Underlining was included for emphasis and "commercial guide" was replaced by "private trip leader" for private trips.

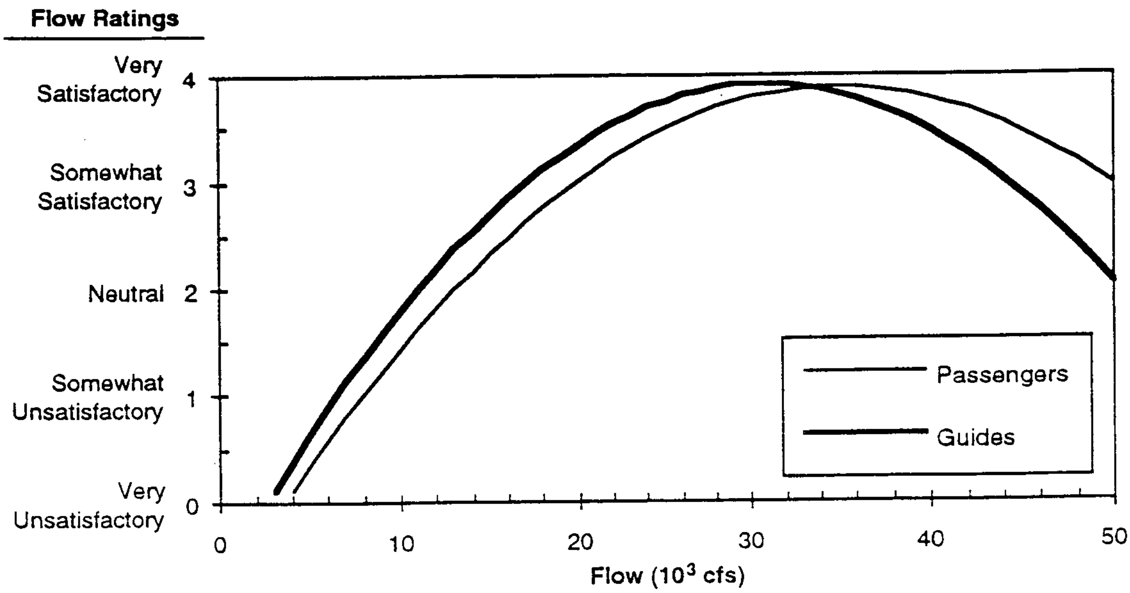


**Figure 1. Commercial Passenger and Guide Flow-Rating Functions**

isfactory'' (1), ''somewhat satisfactory'' (2), ''neutral'' (3), ''somewhat unsatisfactory'' (4), and ''very unsatisfactory'' (5). The same wording was used in the survey of private guides, with ''commercial river guide'' being replaced by ''private trip leader'' and ''commercial'' being replace by ''private.'' Analyses of these data have been reported by Shelby, Brown and Baumgartner (1992), but these researchers did not estimate a statistical relationship between the guide ratings and respective river flows. After ratings we recoded according to equation (3), ordered probit models were estimated for commercial guides and for private guides with flow and flow squared as explanatory variables.

## Results

Coefficient estimates for the logit and probit equations are presented in Table 1.[13] The coefficients on the flow and flow squared variables have the expected signs and are significant (i.e., the quadratic relationships hold). For commercial trips, the optimum flows are 34,000 cfs for passengers and 31,000 cfs for guides. The optimal flow for commercial passengers may be slightly larger than that for guides because passengers remember the great ride they had while guides may be considering factors such as passenger safety, but a difference of 3,000 cfs is not substantial. The optimum flow for private passengers is 28,000 cfs and the comparable figure for private guides is 29,000 cfs. Not only are passenger and guide ratings quadratic functions of river flow, but the optimum flows are remarkably similar for commercial and private trips (Figures 1 and 2). The CV estimates are recoded to the [0,4] interval of the guide rankings to construct the commercial passenger and private boater curves in Figures 1 and 2. This computation is:

$$R_{ij} = ((\hat{\theta}_{ij}/\hat{\theta}_{im}) * 4) \quad (6)$$

where $R_{ij}$ are the derived passenger ratings, $i$ denotes commercial passengers or private boaters, $j$ indicates a specific flow, $\hat{\theta}_{ij}$ are the conditional value estimates for each group at flow $j$, and $\hat{\theta}_{im}$ are the maximum conditional value estimates over all flows for each group. This transformation, while providing a continuous ranking scale, maps the willingness to pay estimates to the same interval as the guide rankings.

The significance of the quadratic relationships and the consistency of optimal flows implies that passengers and guides provide similar rankings of flows. Private boaters ordinal rankings are essentially identical and we argue the commercial boat-

[13] Insignificant variables were omitted by conducting $\chi^2$ tests using long and short equations, and exclusion of insignificant variables did not affect the magnitude nor the statistical significance of the remaining variables. Furthermore, when the commercial passenger and private boater equations contain the same set of attribute variables, the null hypothesis of no difference in the estimated vectors of coefficients can be rejected at the 10% level. A further discussion of the variables considered in the analyses can be found in Bishop *et al.* (1987).

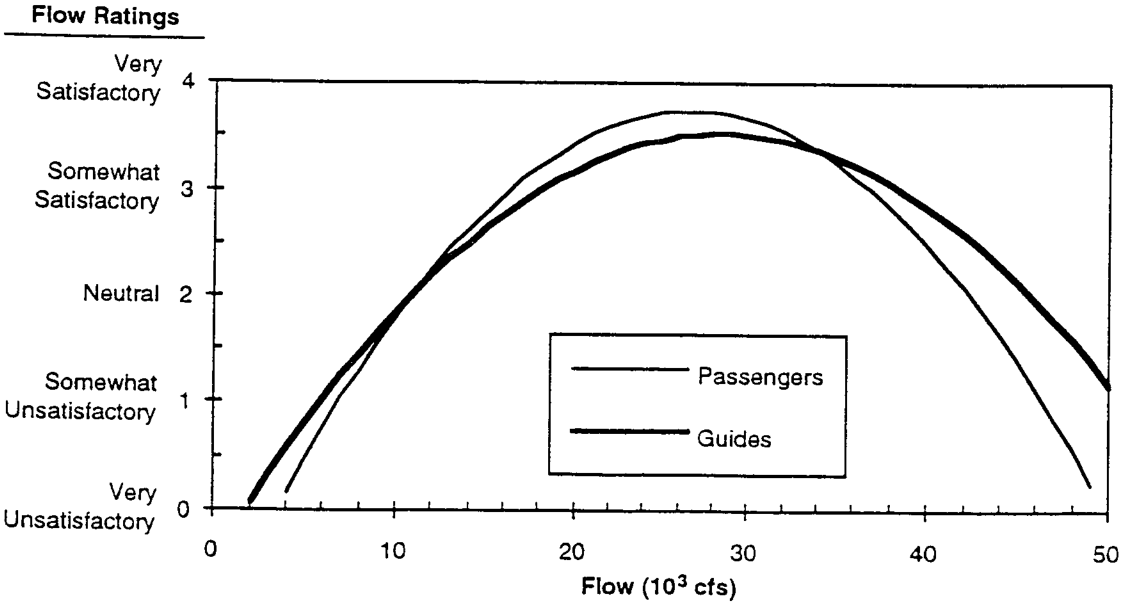


**Figure 2. Private Passenger and Guide Flow-Rating Functions**

ers ordinal rankings are not sufficiently different to cause concern. In the NOAA Panel framework these results indicate passengers can evaluate the consequences of various river flows on raft trips and translate this into their responses to the CV question. This is true despite a Grand Canyon river trip being a once-in-a-life-time experience for most commercial passengers and a full-time, seasonal profession for most commercial guides.

## Discussion

Diamond and Hausman (1994) state CV "evaluation involves the credibility, bias . . . , and precision of responses. Credibility refers to whether survey respondents are answering the question the interviewer is trying to ask" (p. 45). They go on to assert "that the evidence supports the conclusion that to date, contingent valuation surveys do not measure the preferences they attempt to measure" and "that these surveys do not have much information to contribute to informed policy-making" (p. 46). The results of the comparisons presented in this paper suggest the CV estimates of use values are not random noise as Diamond and Hausman implicitly assert. This is true for private boaters who have extensive white-water boating experience on a number of rivers and commercial passengers who have limited white-water boating experience. Both groups process information of the effects of different river flows on white-water boating in credible manner that mimics the ratings of comparable groups of experts. The comparability of the CV response functions with the guide response functions imply that the CV estimates in the current study are credible and can contribute useful information for public policy. Furthermore, the comparisons suggest the CV estimates are responsive to the scope of environmental change being considered; the credibility test proposed by the NOAA panel.

When identifying any group of individuals as experts to provide a counterfactual experimental control for investigating convergent validity of CV responses, three questions must be answered:

- Who are the experts?
- How do experts and CV respondents interpret the scenario information?
- Is the interpretation of information similar?

We suspect the above questions are difficult to answer for expert panels composed of scientists from various disciplines, regardless of whether CV estimates of use or nonuse values are being validated. The primary reason for this concern is the lack of interaction between these types of experts and publics who value resources for which they are expert. This lack of interaction may make it difficult to affirmatively answer the two latter questions.

In the white-water rafting application, we expect passengers and guides to interpret information on river flows in a similar manner for two reasons.

Guides are passengers primary (perhaps only) source of "factual" information on river flows and guides must consider the preferences of their passengers when making trip decisions. The similarity is the hypothesized quadratic relationship between trip ratings and river flows.

An approach to validating nonuse values that may have potential is to develop an expert panel composed of naturalists who interpret ecological data to the public as a profession. Naturalists are assumed to possess extensive technical knowledge and provide a counter-factual expert panel capable of satisfying the conditions we propose. Another expert panel may be comprised of decision makers familiar with making trade-off decisions required of the valuation process, while supposedly considering the preferences of the public(s) they serve. This type of panel may be closer to the NOAA Panel's proposal.

Experts may also be a sample of individuals eligible for inclusion in a CV sample whom researchers apply different experimental treatments to raise their understanding of the item(s) being evaluated. In this case, experts and CV respondents are similar in that both samples are independent draws from the same population. Such treatments may include attempts to develop "full information/context" survey instruments (McClelland *et al.*, 1992). An alternative approach follows the investigation by Whittington *et al.* (1992) where respondents are given time to think and are then contacted a second time for administration of CV question(s). A hybrid of the McClelland and Whittington approaches may provide the best opportunity. This iterative process allows researchers to convey more information than is possible in a single survey contact without burdening respondents' cognitive capabilities. Concurrently, respondents can think about the valuation issue, seek information outside the valuation process, and formulate questions to pose to the researchers at subsequent contacts. Respondents become more expert than in a traditional single-contact, CV study (see Coursey, Hovis and Schulze, 1987), and the interactive process is similar to that which individuals might employ when making any major purchase decision.

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