

Which Response Format Reveals the Truth about Donations to a Public Good?

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ABSTRACT. *Several contingent valuation studies have found that the open-ended format yields lower estimates of willingness to pay (WTP) than does the closed-ended, or dichotomous choice, format. In this study, WTP for a public environmental good was estimated under four conditions: actual payment in response to open-ended and closed-ended requests, and hypothetical payment in response to open-ended and closed-ended requests. The experimental results, showing that the response format mattered far more for hypothetical than for actual payments, support conclusions about the reasons that the dichotomous choice format yields larger estimates of hypothetical WTP, conclusions that hinge on the hypothetical nature of contingent valuation. (JEL Q26, D71)*

I. INTRODUCTION

The dichotomous choice, or closed-ended, format for soliciting estimates of willingness to pay (WTP) has gained many adherents since it was first used in contingent valuation (CV) by Bishop and Heberlein (1979). Several authors have noted the intuitively obvious advantage of the dichotomous choice format—the respondent simply reacts to a posted price, similar to shopping at the market. This places the respondent in a familiar context, and probably requires less cognitive effort than coming up with a specific estimate of maximum WTP, as required with the open-ended format. The implication is that the familiarity and relative simplicity of the dichotomous choice task enhances the ability of CV to predict actual market WTP.

Most CV studies that have compared estimates of WTP obtained using the dichotomous choice and open-ended formats have found that dichotomous choice yields higher estimates. Several explanations, discussed below, have been offered for the difference

in WTP obtained with the two response formats, some suggesting that the open-ended CV format underestimates actual (real payment) WTP and others suggesting that the dichotomous choice CV format overestimates actual WTP. There is no consensus about the reason for the difference or about which format will yield the most accurate estimate of actual WTP. Improving our understanding of the reasons why the two formats yield different CV estimates should help us learn more about what influences hypothetical WTP and decide which format will more accurately estimate actual WTP.

After reviewing what has been found in other empirical comparisons, we present the methods and results of a new comparison. This new study obtained independent sample estimates of WTP in response to dichotomous choice and open-ended questions, and did so for actual as well as hypothetical payments. The data allow us to compare the two question formats in the context of both hypothetical and real money payments, and offer some new insights into the reasons for the response format effect on WTP.

II. PAST COMPARISONS OF THE DICHOTOMOUS CHOICE AND OPEN-ENDED FORMATS

The eleven studies listed in Table 1 compared hypothetical WTP obtained in the dichotomous choice and open-ended for-

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TABLE 1
OTHER CV COMPARISONS OF DICHOTOMOUS CHOICE AND OPEN-ENDED WTP

Author	Good	Survey Administration	Independent Samples?	Mean WTP		
				Dicho. Choice	Open-ended	Ratio (dc/oe)
Bishop, Welsh, and Heiberlein (1994)	Deer hunting	Mail	Yes	\$37	\$32	1.16
Boyle et al. (1993) ^a	Moose hunting	Mail	Yes	701	484	1.45
Desvousges et al. (1992) ^a	Small oil spill effects	Mail intercept	Yes	240	129	1.86
Duffield and Allen (1988) ^a	Trout fishing	Mail	No	91	29	3.19
Gilbert, Glass, and More (1991) ^a	Wilderness protection	Mail	No	10	7	1.47
Johnson, Bregenzler, and Shelby (1990)	River recreation	Mail	Yes	53	33	1.62
Kealy and Turner (1993) ^b	Candy bar	Classroom	No	0.65	0.58	1.12
	Acid rain reduction	Classroom	No	18	8	2.20
Kriström (1990, 1993) ^c	Forest preservation	Mail	Yes	395	202	1.96
Loomis, Cooper, and Allen (1988) ^a	Elk hunting	Mail	No	40	14	2.80
Loomis, Lockwood, and DeLacy (1993) ^a	Forest preservation	Mail	No	224	100	2.24
Seller, Stoll, and Chavas (1985) ^a	Lake recreation	Mail	Yes	42	9	4.78

^a This study reported two or more comparisons, one of which is presented here. The other dc/oe ratios were also > 1.0.

^b Median, rather than mean, WTP.

^c The dichotomous choice mean is from Kriström's (1990) Table 3 based on the Bishop and Heiberlein (1979) method. The open-ended mean is from Kriström's (1993) Table 1 for sample B. SEK were converted to U.S. dollars by dividing by 6, as suggested by Kriström (1990).

rats.¹ The ratios of dichotomous choice to open-ended mean WTP are listed in the right-hand column of the table; they range from 1.12 to 4.78. Six of the eleven studies obtained the open-ended and dichotomous choice responses from separate samples of respondents, whereas the other five obtained both responses from the same respondents; this sampling decision does not appear to have affected the WTP_{dc}/WTP_{oe} ratios. The lowest ratio is for the only familiar market good—a candy bar—used among the studies. Ratios for the six recreation experiences range from 1.16 to 4.78. Ratios for the other five goods, which all have public good aspects, range from 1.47 to 2.24. There is no obvious relation between the type of good and the WTP_{dc}/WTP_{oe} ratios, except that the market good garnered the lowest ratio.

It must be noted that decisions made in the course of designing a CV study and analyzing the data may influence the comparison of dichotomous choice and open-ended estimates of WTP. Decisions of particular importance to the dichotomous

choice approach include the choice of bid levels (Cooper and Loomis 1992, 1993; Alberini 1995; Kanninen 1995), the choice of probabilistic model for characterizing the error distribution (Amemiya 1981; Maddala 1983; Alberini 1995), and the selection of

¹ Two additional studies compared dichotomous choice estimates of WTP with estimates obtained using a payment card. Haefele, Kramer, and Holmes (1992) valued forest quality with a split sample mail survey. Mean WTPs estimated with the dichotomous choice and payment card formats were \$59 and \$18, respectively. Boyle and Bishop (1988) valued riparian scenic quality with a split sample of recreationists interviewed as they completed their trip. Mean WTPs estimated with the dichotomous choice and payment card formats were \$18.88 and \$29.36, respectively. A difference in methods between the two studies, which may explain the conflicting results, is that Haefele, Kramer, and Holmes used the same bid levels in both formats, whereas Boyle and Bishop used dichotomous choice bid levels from \$10 to \$120 but payment card levels from \$0 to over \$1,500, with most of the payment card levels above \$120. The preponderance of large dollar amounts on the payment card may have biased those responses upward compared with the dichotomous choice responses.

independent variables and functional form (Hanemann 1984; Bowker and Stoll 1988; Boyle 1990). Of importance to both response formats is the decision about truncation. Regarding dichotomous choice data, Bishop and Heberlein (1979) proposed truncating the dichotomous choice WTP distribution at the maximum bid level, and this practice is sometimes followed, as is the practice of truncating at a small probability level, such as 1 percent. At the other end of the distribution, one must decide whether to truncate the distribution at zero WTP or to include the negative portion of the distribution in computing mean WTP (Hanemann 1989). Regarding open-ended data, WTP responses that seem unreasonably high are commonly excluded as outliers, but the point of truncation is a matter of judgment. It is not always clear from a published study just what the effect of truncation or other decisions was on the resulting WTP estimate, and Table 1 makes no attempt to report on such details. Certainly, any one comparison of dichotomous choice and open-ended WTP estimates must be carefully examined to see if the comparison relies on questionable design or analysis decisions. In spite of the lack of attention to such methodological details in Table 1, the WTP_{dc}/WTP_{oe} ratios in Table 1 are worth noting because of the consistency of the $WTP_{dc} > WTP_{oe}$ result across several studies that differed in their individual design and analysis. Apparently, either there is something amiss with the way dichotomous choice, or open-ended, data are typically collected and analyzed, or the two methods engender fundamentally different respondent behaviors.

We present below another comparison of the open-ended and dichotomous choice response formats in CV, a comparison that follows standard CV procedures and yields results in conformance with those of the Table 1 studies. In addition, we present a comparison of the two formats in an actual payment situation. The actual payment data allow us to discern if the $WTP_{dc} - WTP_{oe}$ difference may be related to the hypothetical nature of CV.

III. METHODS

Our empirical study crossed WTP question format (dichotomous choice or open-ended) with form of payment (hypothetical or actual), yielding a four-cell experimental design. Each respondent received only one of the four treatments, providing four independent estimates of mean WTP. With the possible exception of our choice of payment vehicle, the hypothetical treatments were designed according to generally accepted methods for CV. The actual payment treatments mirrored the hypothetical treatments except that actual cash payments were requested.

We used a voluntary contribution as the payment vehicle. We initially intended to use a referendum (voting) format for the dichotomous choice portion of the study because it purportedly provides enhanced incentives for revealing WTP for a public good (Hoehn and Randall 1987). After spending considerable time and effort developing and pretesting such a format we abandoned the effort, largely because we were unable to develop a realistic voting and payment framework for a public good in an actual payment condition (see Champ 1994 for more about our unsuccessful efforts). Further, where the good is of broad significance (as is the Grand Canyon), but the amount of money needed to provide the good is relatively modest, a referendum may not seem like a plausible funding mechanism, even in CV.

A voluntary payment towards a public good allows for free-riding, that behavior where the respondent relies on others to pay even though he or she positively values the good and would pay something given knowledge that the good would definitely not be provided without such payment. To the extent that free-riding occurs, it will depress actual payments. The possibility of free-riding does not negate the utility of the comparison of hypothetical to actual payment that this study achieves. Our approach provides a test of whether people's hypothetical contributions toward a public good reveal their actual willingness to contribute. However, the possibility of free-riding adds

an element to our study that we had hoped to avoid, or at least lessen, in the dichotomous choice portion of the study by use of a referendum format.

The good we ultimately chose was a project to remove abandoned unpaved roads along the North Rim of Grand Canyon National Park. We chose this good for three reasons. First, we wanted our results to contribute to the current debate about use of CV to measure nonuse value. The road removal good is imbued with public good characteristics because respondents² were unlikely to anticipate visiting the North Rim; their motives in payment were largely unrelated to personal use. Second, we needed a good that could actually be purchased. There was an actual Park Service program for the road removal, so the cash paid by respondents could be—and was—used for the described purpose. Third, we wanted to avoid unnecessary hypothetical bias. Thus, we wanted to avoid using a good with ill-defined benefits, such as donations to environmental organizations, or to environmental programs without clearly specified costs. And—especially after a referendum format was abandoned—we wanted a good with a clear tie between individual payment and provision. The good we chose could be purchased in small and varying amounts, so that payments of whatever amount could purchase meaningful outcomes.

Respondents were told, in part: (1) the roads were once used for cattle management and fire control, but are no longer needed for those purposes; (2) the roads reduce the wilderness character of the area and lead to soil erosion due to water running off the compacted soil surface; (3) the Park Service would like to completely remove some of the roads and convert others to hiking trails in order to improve habitat for sensitive species and make wilderness designation of the area possible; (4) the Park Service does not have the money to remove the roads but administers a program where volunteers mix organic material into the soil and plant native grasses and other plants in the old road bed; (5) ten volunteers can restore approximately 1/8 mile of road each day; and (6) food and supplies for

the volunteers cost about \$8 per person per day, resulting in a cost of about \$640 per mile of abandoned road restored. In the open-ended treatments, respondents were then asked "What is the most you would be willing to pay to provide food and supplies for volunteer crews? Each \$1 you pay would result in the removal of 8 feet of road. . . ." In the dichotomous choice treatments, respondents were asked "Are you willing to pay \$— to provide food and supplies for volunteer crews? Your \$— would lead to the removal of — feet of road. . . ." In the actual payment conditions, respondents were then told, "If you decided to pay for the road removal program, please write a check to the 'Grand Canyon National Park Service' for the amount you said you are willing to pay and send the check when you return" the questionnaire.

In the fall of 1993, respondents were first sent an advance letter on university letterhead explaining that they would be receiving a questionnaire within a week. They then received the questionnaire along with a cover letter introducing the study, mentioning the road removal program, explaining that a goal of the study was to "learn how people who live far away from the Grand Canyon feel about an environmental project there," and alerting respondents that they would be asked, among other things, "how much you would be willing to pay for the program." Respondents in the actual payment conditions were told in the cover letter they "will actually have an opportunity to pay for the project" and respondents in the hypothetical payment conditions were told they "will not be asked to actually pay for the project."

The questionnaire had two parts. Part 1 described the good and asked the WTP question. Part 2, which was the same for all four treatments, asked questions about why

² Respondents were randomly selected from the pool of Wisconsin white page telephone listings, supplemented with Wisconsin auto registration information. Few respondents indicated they anticipated going to the Grand Canyon, and even fewer anticipated visiting the relatively remote North Rim.

TABLE 2
RESPONSE RATE BY TREATMENT GROUP

	Open-ended		Dichotomous Choice	
	Hypothetical	Actual	Hypothetical	Actual
Initial sample	500	500	850	850
Undeliverable	45	52	85	82
Completed surveys	195	187	393	339
Response rate (%) ^a	43	42	51	44

^a Response rate = 100 * completed surveys / (initial sample - undeliverable).

respondents did or did not decide to pay for the program, about past and likely future trips to Grand Canyon National Park and other national parks, and about environmental attitudes and outdoor activities. Part 2 ended with standard socioeconomic questions.

Ten days after the questionnaire was mailed a post card was sent to all respondents, reminding those who had not returned the questionnaires to do so, and thanking the others for their participation. If necessary, this was followed ten days later by another cover letter and questionnaire, and finally by a third cover letter and questionnaire.

The two open-ended versions were each sent to 500 people, and the two dichotomous choice versions were each sent to 850 people (Table 2). The dichotomous choice questionnaires used one of six bid levels: \$1, \$5, \$8, \$12, \$15, and \$50. Response rates for the open-ended survey were about 43 percent in both the hypothetical and actual payment conditions. The dichotomous choice response rates were 51 percent and 44 percent for the hypothetical and actual payment conditions, respectively (Table 2). These response rates are lower than we hoped for, but probably not unreasonable given the remoteness of the good to the respondent population. The 51 percent response rate is substantially greater than the other three, but the four groups of respondents did not differ significantly—using the Scheffé multiple comparison test (Kleinbaum and Kupper 1978) at the 0.05 probability level—based on their responses to questions about demographic characteristics, experience with national parks, or envi-

ronmental attitudes. Thus, we assume that any difference in mean WTP of the four groups can be attributed to factors other than sampling or response rate effects.

Mean WTP was used as the measure of central tendency. With one exception—a hypothetical open-ended bid of \$1,000,000—all completed surveys were included in the mean WTP computations. Open-ended means were computed by simply taking the average of the WTP responses. Dichotomous choice means were estimated from the area under the logit function with bid the only independent variable. The WTP distribution was truncated at \$0 WTP at the low end.

IV. RESULTS

The open-ended bids are summarized in Table 3. Hypothetical payments ranged from \$0 to \$640, and actual payments ranged from \$0 to \$250. Sixty percent and 82 percent of the respondents bid \$0 in the hypothetical and actual conditions, respectively; thus, median WTP was \$0 in both conditions.

Because of the preponderance of \$0 responses, the Tobit model was used to explore the relation of open-ended WTP to explanatory variables. Five behavioral variables were selected for the models, characterizing respondents' household income, age, residence, past involvement with environmental groups, and past visits to the Grand Canyon (Table 4). Among the five independent variables, the following three were significant predictors of open-ended WTP at the 5 percent significance level: *CONTRIB*, *AGE*, and *URBAN* (Table 5). First, persons

TABLE 3
OPEN-ENDED BIDS

Bid Amount	Number	
	Hypothetical	Actual
\$0	111	150
1	3	
2	5	1
5	5	6
10	14	9
15	3	
20	10	2
24		1
25	11	9
30		1
40	1	
50	8	1
100	9	1
150	1	
165	1	
250		1
500	1	
640	1	
Missing	11 ^a	5 ^b
Total	195	187
Percent bidding > \$0	40	18

^a Includes one outlier, of \$1,000,000.

^b Includes three cases where respondents indicated they intended to pay some amount (\$10, \$30, and \$100) but did not send a check.

who had contributed money to or volunteered time with an environmental group tended to pay more for North Rim road removal than persons without such involvement; this relation held for both the hypothetical and actual payment groups. Second, among the hypothetical group, older people indicated lower payments. Third, in the combined model, respondents living in urban areas indicated higher payments. For the actual payment group, an additional

variable, *VISITGC*, was significant at the 7 percent level, indicating that people who had visited the Grand Canyon had higher WTP than those who had not. Income was not related to payment.³ Finally, as indicated by the *GROUP* variable in the combined model (Table 5), respondents in the hypothetical group tended to bid significantly more than those in the actual payment group. Further regression analysis of the open-ended responses, utilizing a sample selection approach (Greene 1992), found that nearly all of the explanatory power of the independent variables (Table 4) was related to the distinction between a \$0 payment and a positive payment; none of the independent variables was significantly related to the amount of payment given that the payment was positive.

The dichotomous choice responses are summarized in Table 6.⁴ As reported above, the overall response rate was greater in the

³ Simple bi-variate regressions, of open-ended bid on income, also failed to show a significant relation.

⁴ It is interesting to note the similarity between the percentage of positive bids with the open-ended format and the percentage of "yes" responses with the dichotomous choice format. In the hypothetical condition, 40 percent of the open-ended respondents bid a positive amount and 44 percent of the dichotomous choice respondents answered "yes" to the posited amount. In the actual payment condition, 17 percent of the open-ended respondents bid a positive amount and 17 percent of the dichotomous choice respondents answered "yes" to the posited amount. On face value, this result suggests the following hypothesis: that respondents approach both WTP response formats by first deciding whether they would pay anything for the good—if so, they are then likely to say "yes" to a dichotomous choice question or to estimate a positive WTP amount to an open-ended question.

TABLE 4
MODEL VARIABLES

Variable	Description	Mean ^a
<i>OFFER</i>	Offer (bid level) for dichotomous choice surveys	
<i>INCOME</i>	Household annual income before taxes (\$1,000s)	40.9
<i>AGE</i>	In years	50.3
<i>URBAN</i>	Residence (1 = urban; 0 = suburban or rural)	.37
<i>CONTRIB</i>	1 = have contributed money or volunteered with an environmental organization in the last year; 0 = have not	.28
<i>VISITGC</i>	1 = have ever visited the Grand Canyon (South or North Rim); 0 = have not	.28
<i>GROUP</i>	1 = hypothetical payment; 0 = actual payment	

^a Means for the full set of data (all four treatment groups).

TABLE 5
TOBIT EQUATIONS OF OPEN-ENDED RESPONSES

	Hypothetical	Actual	Combined Model
Constant	3.733 (40.58)	-99.848 *** (35.27)	-100.490 *** (34.14)
INCOME	0.0343 (.4757)	0.050 (.2460)	0.100 (.2889)
AGE	-2.152 *** (.7851)	-0.170 (.7757)	-1.295 *** (.5498)
URBAN	35.578 (23.18)	21.422 (17.39)	32.781 *** (16.03)
CONTRIB	63.948 *** (24.49)	50.715 *** (17.76)	71.210 *** (16.73)
VISITGC	10.359 (24.36)	32.030 * (17.87)	24.933 (17.05)
GROUP	na	na	75.785 *** (17.17)
Log likelihood	-449	-179	-635
Number of Observations	159	150	309

Note: Standard error in parentheses.

* = significant at 0.10

** = significant at 0.05

*** = significant at 0.01

TABLE 6
DICHOTOMOUS CHOICE BIDS

Bid Amount	Hypothetical			Actual ^a			Chi-square Significance of Difference in % "Yes"
	Response		Percent "Yes"	Response ^b		Percent "Yes"	
	Number	Rate (%)		Number	Rate (%)		
\$1	55	49	53	57	49	24	.0022
5	82	51	51	65	41	15	.0000
8	75	49	39	66	42	26	.1028
12	65	51	48	58	50	17	.0004
15	59	47	39	37	34	14	.0075
50	57	50	33	50	45	4	.0001
Total sample	393	51	44	333	43	17	.0000

^a Several respondents, especially at the lowest bid amounts, sent checks for more than the bid amount. These responses were coded as "yes" at the bid amount.

^b After removing six respondents who indicated they intended to pay some amount but did not send a check.

hypothetical condition than in the actual payment condition. At individual bid levels, the response rate difference between the hypothetical and actual payment conditions varied from no difference to a difference of 13 percentage points, with no consistent pattern from low to high bid levels; for example, response rates were nearly identical for the \$1 and \$12 bid levels, and most

different for the \$5 and \$15 bid levels. We have no explanation for the difference in response rate across bid levels.

The percent of "yes" responses was consistently greater, across all bid levels, for the hypothetical than for the actual payment condition; this difference was significant at the 0.01 probability level except for the \$8 bid level (Table 6). In both conditions, the

TABLE 7
LOGIT EQUATIONS OF DICHOTOMOUS CHOICE RESPONSES

	Hypothetical	Actual	Combined Model
Constant	-0.232 (.4706)	-2.322 ** (.7256)	-1.922 *** (.4144)
OFFER	-0.022 *** (.0081)	-.035 ** (.0162)	-.026 *** (.0070)
INCOME	0.017 *** (.0005)	0.021 *** (.0061)	0.019 *** (.0037)
AGE	-0.015 * (.0081)	-0.004 (.0118)	-0.011 (.0067)
URBAN	0.548 ** (.2431)	1.240 *** (.3392)	0.798 *** (.1957)
CONTRIB	0.949 *** (.2648)	0.182 (.3689)	0.646 *** (.2087)
VISITGC	-0.007 (.2727)	-0.092 (.3704)	-0.031 (.2174)
GROUP	na	na	1.471 *** (.2053)
Log likelihood	-210	-131	-328
Number of Observations	345	266	611

Note: Standard error in parentheses.

* = significant at 0.10

** = significant at 0.05

*** = significant at 0.01

percent "yes" tended to drop as bid level increased, but did not drop consistently. The \$8 bid level garnered the most peculiar affirmative response in both conditions, being lower than surrounding percentages in the hypothetical condition and higher than surrounding percentages in the actual payment condition; however, the differences in percent "yes" between the \$8 bid level and its closest neighbors were not significant. In the hypothetical condition, 33 percent of the respondents to highest bid level (\$50) chose "yes," providing a less-than-ideal bid distribution for the purpose of estimating WTP.⁵

Logit models, using the variables listed in Table 4, are presented in Table 7. As expected, the probability of a "yes" decreases with offer amount. Further, and in contrast to the open-ended results, income is significantly (positively) related to payment. In addition, the probability of a "yes" increased if the respondent lived in an urban area, increased if the respondent had past involvement with environmental groups, and decreased with age of the respondent. Past visits to the Grand Canyon were unrelated

to the probability of a "yes." Finally, respondents in the hypothetical group were more likely to respond "yes" than those in the actual payment group.

The regression equations of Tables 5 and 7 are, in large part, sensible; that is, the signs and levels of significance are not counterintuitive. Further, as reported earlier, no significant differences among the four groups of respondents were found for demographic (income, age, education level, residence type), behavior (past involvement with environmental groups, past visits to the Grand Canyon), or a number of attitude variables. Thus, we have some justification

⁵ In order to provide a more accurate estimate of hypothetical WTP, in the fall of 1994 we sent the hypothetical dichotomous choice survey to a comparable sample at higher bid levels (up to \$200). However there was no large drop in percent "yes" at these higher bid levels. Including the additional data tended to increase mean WTP compared with the estimate based only on the 1993 data. Because the additional data do not affect the conclusions, we do not include the additional data here.

TABLE 8
MEAN WILLINGNESS TO PAY

	Hypothetical	Actual	Ratio (hyp/act)	Difference (hyp - act)
Dichotomous choice ^a	\$46.55 (26.4-271.1) ^b	\$7.22 (4.7-21.2)	6.45	\$39.33
Open-ended	\$18.98 (9.9-28.3) ^c	\$4.62 (1.5-7.7)	4.11	\$14.36
Ratio (dc/oe)	2.45	1.56		
Difference (dc - oe)	\$27.57	\$2.60		

^a Dichotomous choice means were estimated using the approach described by Hanemann (1989). The hypothetical payment mean was estimated from: $L = -0.039 - 0.014 \text{ OFFER}$, where L is the log of the odds of a "yes" response; this model has a log likelihood of -267 and is based on 393 observations. The actual payment mean was estimated from: $L = -1.119 - 0.040 \text{ OFFER}$; this model has a log likelihood of -149 and is based on 333 observations. Reported means are the medians of 5,000 computations of mean WTP computed using the Krinsky and Robb (1986) procedure, with the upper end of the distribution left untruncated. Truncating the upper end of the distribution at the bid levels associated with a 0.01, 0.05, and 0.1 probability of a "yes" response yields hypothetical means of \$45.03, \$42.94, and \$38.44, and actual payment means of \$6.96, \$5.91, and \$4.59, respectively. An alternative model ($L = \alpha + \beta \ln(\text{OFFER})$) yielded similar means, and 95 percent confidence intervals that slightly overlap.

^b Dichotomous choice 95 percent confidence intervals, in parentheses, were computed using the procedure of Krinsky and Robb (1986) based on 5,000 repetitions.

^c Open-ended 95 percent confidence intervals, in parentheses, were based on the standard procedure for a normal distribution. Because of the skewed distributions, we also used a nonparametric approach—the bias-corrected and accelerated bootstrap percentile method of Efron and Tibshirani (1993), with 1,000 repetitions. This approach produced the following 95 percent confidence intervals, which are quite similar to those obtained using the standard procedure: \$12.6-\$33.0 for hypothetical payment and \$2.8-\$10.1 for actual payment.

for moving on to the primary focus of the study—the comparison of dichotomous choice and open-ended mean WTP under hypothetical and actual payment conditions.

In the hypothetical condition, mean WTP estimated using the dichotomous choice format was \$47, 2.5 times the open-ended mean of \$19. The difference, of \$28, was significant, as indicated by the fact that the 95 percent confidence intervals barely overlap (Table 8). Thus, our results are consistent with those of other CV studies that valued a public or environmental good (Table 1), indicating that the dichotomous choice format yields a larger estimate of hypothetical WTP than does the open-ended format. In the actual payment condition, the dichotomous choice mean was \$7.22, 1.6 times the open-ended mean of \$4.62. These means differ by only \$2.60. The 95 percent confidence intervals about these two means overlap substantially (Table 8).⁶ These results—that the WTP_{dc} / WTP_{oe} ratio and the $WTP_{dc} - WTP_{oe}$ difference are greater for hypothetical than for actual WTP—raise the possibil-

ity that the hypothetical nature of CV amplifies the response format difference, at least for donations to a public good.

The open-ended hypothetical format produced a more accurate estimate of actual payment than did the dichotomous choice hypothetical format. However, the improve-

⁶ Because of the dangers of computing means and confidence intervals from non-normal open-ended distributions, and comparing those confidence intervals with those from the logistic models, we also compared the dichotomous choice and open-ended distributions using a nonparametric procedure similar to that suggested by Kriström (1993). From the open-ended WTP responses we computed the percent of respondents with a positive willingness to pay at each dichotomous choice bid level. We compared these percentages with the observed percent "yes's" from the dichotomous choice responses using a chi-square test, with the dichotomous choice data considered the expected result. The computed test statistics were 40.6 for the hypothetical data and 15.1 for the actual payment data, to be compared with a critical value of 11.1 at the 0.05 probability level, indicating that the hypothesis of equal distributions is rejected for both the hypothetical and actual payments.

ment with the open-ended format is scant cause for celebration in light of the fact that the hypothetical open-ended payment was still over four times the actual payment (Table 8).⁷

V. DISCUSSION

We found, as have others (Table 1), that hypothetical payments elicited using a dichotomous choice format exceeded such payments elicited using an open-ended format. Barring the possibility that standard CV data analysis procedures are misguided, it is reasonable to explore potential behavioral explanations for the difference in WTP with the two response formats. We list four possible explanations here and consider the likelihood that they could have influenced our results.

The first explanation, proposed by Hoehn and Randall (1987) and supported by Cameron (1988) and others is that, as Cameron (p. 355) put it, a dichotomous choice format "circumvents much of the potential for strategic response bias." Hoehn and Randall make the case that a referendum format using a dichotomous choice question avoids incentives for the respondent to either overstate or understate their true WTP, whereas an open-ended WTP format avoids incentives for overstatement but not for understatement, thus allowing an open-ended mean WTP to fall below the more correct dichotomous choice mean. It is not entirely clear whether this argument was meant to apply only when the dichotomous choice format is used with a true referendum CV, where the respondent answers "yes" or "no" to a voting question that incorporates a price and where provision depends on the outcome of the group vote, or whether it was meant to apply as well as to a dichotomous choice response to a direct WTP question. In any case, the argument is unlikely to apply where there is no perceived tie between a respondent's answer and the ultimate outcome (i.e., where respondents do not think their answers will affect provision of and payment for the good). This argument is therefore unlikely to apply to our CV question because it used

a donation payment vehicle. With donations, the hypothetical WTP response has no direct implications for actual payment by the respondent if the good were to be provided.

A second explanation is that a more difficult WTP question may encourage a lower WTP response. As Mitchell and Carson (1989) have suggested, for most respondents it is probably more difficult to come up with a specific estimate of maximum WTP than it is to determine whether their WTP is above or below the posited bid level. A "yes" or "no" (take it or leave it) response avoids the more difficult task of estimating a precise WTP amount. But does cognitive difficulty lower bids? One study suggests that it might. McCollum and Miller (1994) found, in questioning that followed an open-ended WTP question, that many respondents reported they bid \$0 because they "could not put a number on" their WTP. Although respondents indicated that they had a positive attitude towards the good, their lack of ability to provide a precise WTP estimate apparently led them to just enter \$0.⁸ If the dichotomous choice format helps avoid such frustration by presenting an easier cognitive task, then difficulty of response may contribute to $WTP_{dc} > WTP_{oe}$. This argument might help explain our open-ended hypo-

⁷ The 95 percent confidence intervals about the two open-ended means do not overlap. A *t*-test and several nonparametric tests (two-tailed) all show that the open-ended means are significantly different from each other at the 0.01 probability level. See also note 3 to Table 8.

⁸ In a mail questionnaire, respondents were asked how much more, above costs, they would have been willing to pay for a recreation experience. Those reporting \$0 were given three choices: (1) the trip was worth exactly what I paid and no more; (2) I answered \$0 because I could not put a number on how much more I would have paid; and (3) other (please specify). In one sample reported in McCollum and Miller (1994), about 44 percent of the \$0 WTP respondents chose the second option. However, because respondents answering the WTP question could look down the page and see that they had the option of entering \$0 and then indicating they "could not put a number on" their WTP, the number of \$0 bids may have been inflated. If not offered that escape route, respondents might have made a greater effort to estimate their WTP.

thetical responses. However, one would expect the argument to apply as well to actual payments. The much closer mean WTP estimates of the actual payment data suggest that the cognitive difficulty explanation probably did not play a large role in affecting our CV results. Unfortunately, our data do not allow a test of this explanation.

A third explanation relies on the notion of preference uncertainty. Many respondents seem to lack a precise estimate of their maximum WTP, especially for complex and unfamiliar goods (Gregory et al. 1995; Ready, Whitehead, and Blomquist 1994).⁹ This uncertainty may be reflected differently in responses to alternative WTP response formats. We list two ways in which preference uncertainty may affect open-ended and dichotomous choice responses differently. First, dichotomous choice respondents who are willing to pay something but do not have a precise estimate of their WTP may respond "yes" to any reasonable suggestion, such as the offer amount posited in the survey. This propensity has been called "number grabbing" or "yea-saying" (Mitchell and Carson 1989, 240). Essentially, the posited bid is accepted as a cue of what is a reasonable WTP amount.¹⁰ In contrast, when asked an open-ended question, the respondent is given no cue, and is forced to either estimate WTP or refuse to answer (or, as mentioned above, to bid \$0 in frustration).¹¹

The second way in which preference uncertainty may play a role in causing $WTP_{dc} > WTP_{oe}$ relies on the assumption that respondents have an initial *range* of plausible WTP—that they know when they are below or above their range of maximum WTP, but are not sure within those bounds what they would pay. Gregory et al. (1995) concluded, based on results to a paper and pencil exercise focusing on WTP for public goods, that people appear to have a surprisingly large range of maximum WTP. Given this finding, they proposed that some range of WTP will be initially plausible to the respondent, that posited bids above this range will receive a "no," and that all other posited bids will potentially receive a "yes." That is, if asked a dichotomous choice question, people are likely to respond "yes" to

any bid level within that range simply because it is an initially plausible payment. However, if asked an open-ended question, the respondent is not pushed to the upper end of the range of maximum WTP, and is likely to bid an amount with which he or she is more comfortable, perhaps an amount closer to the midpoint of the range than to its end point.

The fourth potential explanation submits that respondents may have two objectives in responding to a WTP question. First, they may want to truthfully answer the question asked about their actual willingness to pay. Second, they may want to indicate how favorably they view the good at issue, or at least whether they view the good favorably. The motive behind this second objective may simply be self-expression,¹² or a desire to influence provision of the good (based on the assumption that a positive response will increase the prospect that the good will be provided). An open-ended format allows respondents to meet both objectives with the

⁹ Data analyzed by Ready, Whitehead, and Blomquist (1994) led them to suggest that "there may exist a core of persistent ambivalence that the respondent is unable to resolve" in attempting to decide whether he or she would be willing to pay some posited amount.

¹⁰ The yea-saying explanation is especially relevant to factual questions about which respondents lack any idea of a correct response. For example, if asked to estimate obscure amounts (such as the distance in miles from Earth to Mars, or the number of people who died of the plague in the fourteenth century), many people may respond "yes" to any reasonable suggested amount. This explanation may be less relevant for questions of personal opinion, such as WTP questions. Most respondents may have a better idea of their WTP than they do of obscure factual amounts.

¹¹ Holmes and Kramer (1995) compared dichotomous choice responses to payment card responses and concluded that yea-saying contributed to the higher estimate of mean WTP with the dichotomous choice format.

¹² People may derive utility from expressing their opinions, and surveys offer an opportunity for such expressions. Furthermore, the particular good at issue in a CV may act as a symbol for strongly felt moral concerns or core values, the expression of which is all the more desirable (see Chaiken and Stangor 1987; Blamey and Common, no date). Thus, CV respondents may focus more on expressing their opinions about, for example, environmental stewardship than on their actual WTP for the particular good at issue.

same response; that is, a positive WTP response allows for a truthful WTP estimate and also allows for indicating a positive attitude about the good. However, with the dichotomous choice format, only a "yes" response indicates a positive attitude about the good. If the posited bid level is more than the respondent thinks he or she would be willing to pay, the respondent must choose between the two objectives; if it is more important to indicate a favorable impression of the good than to indicate a truthful WTP, the respondent will say "yes." A variation of this explanation proposes that the *likelihood* of a "yes" response decreases as the positive difference of the dichotomous choice bid level minus the amount that respondents think they would actually be willing to pay increases.

The first and second explanations are unlikely to have played a large role in causing $WTP_{dc} > WTP_{oc}$. The third explanation (preference uncertainty) and the fourth explanation (conflicting objectives) are more plausible explanations of our results in light of the much smaller $WTP_{dc} - WTP_{oc}$ difference with actual than with hypothetical payment. This is because yea-saying and related behaviors are less costly in hypothetical than in actual payment situations. The cost of yea-saying or of failing to narrow a large range of initial WTP is, in an actual payment context, in terms of decreased purchases of other goods, whereas in a hypothetical payment context the cost, if noticed at all, is merely in terms of second thoughts about whether the survey response was accurate. Likewise, the cost of indicating a favorable impression of the good with a "yes" even if the posited amount is larger than respondents think they would actually pay is much more salient with actual than with hypothetical payment. If more costly behaviors are less likely to occur, the latter two of the four explanations are more likely to occur in a hypothetical than in an actual payment context. Thus, we have some indication that the latter two explanations played a role in affecting our results.

There remains the possibility that different CV procedures could have lowered the hypothetical WTP responses, causing them to converge with the actual payment re-

sponses, thereby largely eliminating the hypothetical $WTP_{dc} - WTP_{oc}$ difference. For example, to be strictly comparable with the actual payment conditions, we should have informed the CV respondents that their hypothetical payment would, if it were to be a real payment, have to be *sent in with* their survey response. And we might have included language pleading for consideration of budget constraints and for careful reflection about what they *really* would be willing to pay. Such additions might have lowered the hypothetical WTP means somewhat, but it seems unlikely that the additions would eliminate the difference between actual and hypothetical payment.¹³ And the additions could affect WTP responses to both CV formats, perhaps having little effect on the hypothetical $WTP_{dc} - WTP_{oc}$ difference. But we, of course, will have to wait for future studies to know for sure.

Comparison of the regression equations obtained for the open-ended (Table 5) and dichotomous choice (Table 7) response formats shows considerably more explanatory power, for the independent variables we chose to include, with the dichotomous choice models. The lack of a statistically significant relation between the open-ended WTP response and income is puzzling, especially in light of the significant relation found for the dichotomous choice models. The quite different models for the two formats suggests that the formats may engender different decision processes. Also puzzling is the finding that most of the explanatory power of the independent variables in explaining open-ended WTP could be attributed solely to the binary distinction between a \$0 payment and a positive payment. It is possible that the more difficult task required of open-ended respondents causes additional factors (that we failed to measure) or random factors to play a role in determining the WTP response, factors that do not influence dichotomous choice WTP responses. This possibility deserves additional research.

¹³ Loomis, Gonzalez-Caban, and Gregory (1994) tested the effect of adding to CV a reminder to carefully consider one's budget constraint in estimating WTP, and found that the addition had no effect.

Our results indicate that the $WTP_{dc} - WTP_{oe}$ difference is enhanced in a hypothetical context, at least for donations toward a public environmental good. We suspect that the $WTP_{dc} - WTP_{oe}$ difference would decrease, all else equal, for a different type of good and related change in payment vehicle. Specifically, the difference could be expected to decrease with a private market good, for two reasons that refer back to the latter two potential explanations for the response format difference listed above. First, respondents would use information about market price to either avoid the tendency of yea-saying about whatever offer were included in a dichotomous choice survey, or approach the survey with a more narrow range of plausible WTP. Second, the private nature of the good would reduce any tendency to want to answer "yes" in order to indicate a favorable attitude about the good. An independent sample experiment comparing open-ended and dichotomous choice WTP responses for a private good, in hypothetical and actual payment contexts, would help settle this question.

The results we report indicate that the more important question for CV is not "Which response format should we use?" but rather "How can we structure CV to either engender truthful responses or distinguish between the truthful and the exaggerated responses?" Our results, and those of a previous study by Duffield and Patterson (1992), suggest that a truthful donation payment vehicle is not easily instituted using CV. Such results do not, of course, imply that a different payment vehicle would perform as poorly as the donation vehicle performed here. Perhaps, as has been argued by Hoehn and Randall (1987) and others, a referendum is preferable. However, it is not obvious how a referendum can be fashioned for some goods. A referendum made little sense with the good used here, a rather inexpensive good of national interest.

We have no way to know to what extent the finding that hypothetical WTP exceeded actual WTP reflects free-riding by respondents given the opportunity to send in actual payment, as opposed to overly optimistic estimates by respondents asked the

hypothetical payment questions. It is possible, but doubtful, that free-riding can largely account for the discrepancy—doubtful because several studies (Boyce et al. 1989; Cummings, Harrison, and Rutström 1995; Neill et al. 1994) found that hypothetical WTP substantially exceeded actual WTP for private goods (where free-riding is not an issue).

VI. CONCLUSION

Several recent studies comparing hypothetical and actual payments (Duffield and Patterson 1992; Seip and Strand 1992; plus the private good studies cited above) found that CV, as applied, overestimated actual WTP. The results of the study reported here add weight to that finding. Hypothetical questions, especially about donations to generally desirable environmental goods, seem to engender overestimates of actual WTP.

What we found in addition, however, is that the tendency for CV to overestimate WTP seems to be exacerbated by use of the dichotomous choice response format, at least when a donation payment vehicle is used to value a public environmental good. Our study was not designed to ferret out the specific behavioral tendencies behind a finding of $WTP_{dc} > WTP_{oe}$ in CV. However, our reasoning suggests that the lack of a costly consequence to overestimating WTP, in the presence of preference uncertainty or conflicting respondent objectives, allows the dichotomous choice format to yield greater estimates of hypothetical WTP than does the open-ended format.

In response to the question posed in the title of the paper, we found that neither the open-ended nor the dichotomous choice format revealed the truth about donations to a public good. However, this is certainly not the end of the story for CV. At least these two questions remain: first, will clever modifications to CV, perhaps utilizing a new or altered WTP response format, avoid or allow adjustment for the hypothetical bias that currently troubles donation applications of CV; second, will use of dichotomous

choice in a referendum CV also overestimate actual WTP?

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