

Journal of Economic Psychology 21 (2000) 605-623



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# Contingent valuation of global environmental resources: Test of perfect and regular embedding $\stackrel{\mbox{\tiny{$\stackrel{|}{$}$}}}{\to}$

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Received 9 December 1999; received in revised form 1 August 2000; accepted 9 August 2000

#### Abstract

The present study examines the internal consistency of willingness to pay (WTP) assessed for four environmental amenities in a hypothetical market scenario. Particularly, the occurrence of embedding is investigated by performing external tests of part–whole effects and insensitivity to scope. Moreover, four different measures or intensifiers of scope (i.e., absolute magnitudes, percentages, number of events, and verbal cues) are applied in order to evaluate their influence on scope sensitivity. The responsiveness of WTP is also compared with categorical rating (CR) as an alternative measure of environmental priorities. Our results indicate that neither instrument, as utilised here, is capable of making the respondents responsive to scope. The weak relation between expressed economic value and instrumental considerations are also supported by small variations in mean WTP across the four issues. A part–whole effect is finally demonstrated for global warming, where respondents are willing to pay more

 $<sup>^{\</sup>star}$  This research was supported by Kommunikationsforskningsberedningen (KFB), Sweden. I am grateful first to Dr. Olof Johansson-Stenman for his support and comments during the accomplishment of this study. I also would like to thank Prof. George Gaskell and Prof. Thomas Sterner for valuable guidance in the earlier phases of this research, Dr. Fredrik Carlsson for assistance with the econometric analysis, and Björn Olsson for data collection. Needless to say, all eventual errors are the sole responsibility of the author.

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when global warming is valued on its own than respondents who consider this amenity in conjunction with three other environmental issues. © 2000 Published by Elsevier Science B.V. All rights reserved.

#### PsycINFO classification: 3920; 4070

#### JEL classification: H41

Keywords: Environmental values; Contingent valuation; Willingness to pay; Internal consistency; Embedding

#### 1. Introduction

Over the last decade, a large number of economic analyses of environmental deterioration and improvement have been conducted in order to inform policy decisions. The most popular approach of benefit estimation is the contingent valuation method (CVM), which is a survey-based technique by which respondents are posed with willingness to pay (WTP) questions for environmental commodities in hypothetical market scenarios (e.g., Carson, Mitchell, Hanemann, Kopp, Presser & Ruud, 1992; Kramer & Mercer, 1992). Hence, the approach enables an economic valuation of otherwise non-market goods. Despite its merits, the CVM has encountered widespread criticism (e.g., Kahneman & Knetsch, 1992; Diamond & Hausman, 1994). The scepticism is maintained by the variety of biases that potentially pose a threat to the validity of the method, such as 'yea-saying' (Blamey, Bennett & Morrison, 1999), lack of correspondence with real economic commitments (Seip & Strand, 1992; Neill, Cummings, Ganderton, Harrison & McGuckin, 1994), and embedding. The latter issue has received prominent attention in the literature and is considered one of the most important objections to the use of CVM (e.g., Diamond, Hausman, Leonard & Denning, 1993; Schwarz, 1997).

The purpose of this paper is to examine the internal consistency of WTP estimates by performing various tests of embedding. The term was originally defined by Kahneman and Knetsch (1992) and is distinguished into two different kinds of effects. *Perfect embedding*, or *insensitivity to scope* occurs when the WTP is the same, or not sufficiently differentiated, between preserving environmental commodities that differ from each other in their quantities or qualities. *Regular embedding*, or *part–whole bias* refers to a situation when "the same good is assigned a lower value if WTP for it is inferred from WTP for a more inclusive good rather than if the particular good is evaluated on its

own" (Kahneman & Knetsch, 1992, p. 58). Thereby the WTP is determined by how many other (public) goods are included in the contingent valuation (CV) scenario and valued simultaneously. <sup>1</sup> Ritov and Kahneman (1997) conclude that the WTP reflects the moral satisfaction derived from making donations to a 'good' cause, rather than being an indication of economic value. Thus, WTP responses in these contexts might represent symbolic attitudes that are not necessarily based on instrumental considerations.

Apart from examining the occurrence of embedding in CV formats, we also compare the consistency of the WTP estimate of categorical rating (CR) as an alternative index of environmental priorities. Kahneman and Ritov (1994) found that opinions measured on a conventional rating scale showed more responsiveness to scope than estimates of WTP, and furthermore, that the psychometric properties of the latter notion seem to be inferior to those of traditional scales of attitudes. In order to gain a better insight into the basis of people's responses, in-depth interviews are elaborated parallel with the main study.

## 2. Internal consistency of WTP estimates

Smith and Osborne (1996) conducted a meta-analysis of five separate studies of improved (or declined) visibility at national parks. Their conclusion is that the method is responsive to the magnitude of the environmental commodity since a positive and statistically significant relationship between the WTP amounts and improvements in visible range was found. However, we are inclined to think that a meta-analysis is insufficient to judge whether CV estimates are responsive to scope. Apart from being conducted by different research teams, the five studies differ in a variety of aspects that are likely to influence the outcome, such as the type of interview, elicitation format, where the interview took place, in what way the commodity (i.e., visibility condition) was described, etc. It is therefore, doubtful whether the studies are comparable in this manner.

On the basis of a survey comprising 30 CV studies that each separately investigated the occurrence of embedding, Carson (1997) concludes that only a handful of them support the embedding hypothesis, whereas the majority

<sup>&</sup>lt;sup>1</sup> Given that income effects are large, economic theory predicts that economic values will vary depending on how many goods are valued at the same occasion. Yet, it is unlikely that such large differences that have been demonstrated can be explained solely by income effects.

clearly rejects it. However, most of these studies have performed withinsubject tests, rather than between-subject tests (e.g., Propper, 1990; Boyle, Welsh & Bishop, 1993). A major problem of the former is that the respondents ought to be influenced by previously stated values when subsequently asked about several levels of the good, and most likely try to act in an internally consistent way by providing higher bids for larger magnitudes of the good. Furthermore, one study valued the impact of the respondents' ex-ante perception on WTP (Whitehead, 1992). In this case the pre-established perception of scope is likely to determine WTP, and the study provides no clear answer to how people respond to the information provided in the CV scenario (such as scope intensifiers). Finally, at least one of the studies presents some mixed results that may as well be interpreted as supportive of embedding effects (e.g., Loomis, Lockwood & DeLacy, 1998).

Turning to studies that have performed between-subject tests of embedding, Desvousges et al. (1993) assessed the WTP for preventing 2000, 20,000 and 200,000 migratory waterfowl deaths, and found mean responses of 80, 78 and 88 dollars, respectively. Other examples of scope insensitivity are provided by Fischhoff and Furby (1988), who derived WTP estimates for preserving 110 and 10,000 hectares of wetland in New Jersey, and Kahneman and Ritov (1994) who assessed the WTP for as many as 37 different environmental and public issues. Finally, regular embedding, or part-whole bias, has been demonstrated by Strand and Taraldset (1991), and Kahneman and Knetsch (1992). However, regardless of rather strong indications of embedding, these and other studies have been much criticised for not relying on an appropriate research design, which either fails to establish a realistic scenario, or tend to mask differences in scope (e.g., Hanemann, 1994; Carson, Flores & Meade, 1996). Hutchinson, Chilton, and Davis (1995) have summarised other various common objections against demonstrations of embedding, such as insufficient piloting, lack of statistical sophistication, misleading or inappropriate context(s) for valuation, etc. Most importantly, these studies are criticised for not following the NOAA (1993) guidelines for conducting reliable CV studies.<sup>2</sup>

<sup>&</sup>lt;sup>2</sup> The National Atmospheric and Oceanic Administration (NOAA) panel was established as a result of the criticism that were raised against the CV methodology. The attempt was to "provide an atmoshpere in which an unbiased academic analysis of CVM could be conducted" (NOAA, 1993, p. 4602). The panel consisted of economic and survey experts that were appointed to evaluate the possibility of deriving non-use values for natural resources. On the basis of comments received from a number of CV researchers, along with their own analysis, the panel set out various guidelines and recommendations in order for a CV study to qualify as a reliable information source of natural damage assessment.

In this study, we attempt to apply a more extensive design than previous studies demonstrating scope insensitivity. For example, the nature of each environmental issue and the likely consequences of deterioration are clearly described. The objective is, further, to present a credible approach of solving these problems, which takes account of how the good or service is to be provided, who is responsible for this, and in what way it should or could reasonably be administered. Additionally, respondents are informed about the rationale of assigning monetary values to environmental amenities, thereby enabling them to put the enquiry in a relevant context. Yet, we do not aim to strictly follow the guidelines established by the NOAA (1993). First, although the general interpretation among CV proponents seems to be that each study ought to do exactly this, the panel states that a CV study "does not have to meet each of these guidelines" (NOAA, 1993, p. 4608). Second, not all these recommendations are indisputable, something which will be discussed when appropriate. The main point, however, is that we perform between-subject tests of embedding by applying an interview procedure and survey design similar to a typical CV study.

## 3. Design of field experiment

Data were collected in November 1997. The main study was conducted using two different administration modes. In order to yield a sufficient sample for subsequent quantitative analyses, altogether 1076 mail surveys were distributed to 6 student halls throughout London and randomly selected households in Sweden. The sample thus includes people from various backgrounds and categories, although students are somewhat over-represented. In addition to these mail-surveys, 152 students were randomly confronted at the LSE dining hall and asked to participate in an interview about environmental priorities. Respondents in this group completed the survey directly under supervision of the interviewer. Hence, the interviewer was in this case accessible to answer various questions that arose and make clear the purpose of the study as well as the intention of specific questions. <sup>3</sup> The survey format and interview design, along with the choice and description of

<sup>&</sup>lt;sup>3</sup> By conducting both mail surveys and face-to-face interviews, the latter which are generally considered more reliable, we are able to investigate whether the format has any influence on the results, in particular on the occurrence of embedding. No differences were recorded between the two administration modes.

environmental issues, are primarily based on a pre-test conducted in two sessions prior to the main study, comprising 42 interviews.

# 3.1. Interview procedures and questionnaire designs

After a general introduction to the interview that explained the rationale of the study and principles of cost-benefit analysis (CBA), respondents were asked to read through the whole list of issues and think carefully about their household income and future expenses before answering any question. Subsequent to this, information about the nature of the environmental amenity and the effects caused by a deterioration of the resource were carefully presented for each issue. In order to enhance the impression of a realistic scenario, a feasible intervention to solve the problem was finally provided. Except from one sub-sample, for which the payment vehicle was established as a yearly tax, WTP was framed as an annual voluntary contribution. The WTP was further elicited using an open-ended (OE) format. The validity of this procedure is considered inferior to a dichotomous choice (DC) format by the NOAA (1993), mainly due to the incentive compatible setting of the DC format that is likely to reduce strategic overstatement. However, on the basis of various empirical results, a number of researchers are questioning the restriction to DC formats (e.g., Loomis, 1990; Schulze, McClelland, Waldman & Lazo, 1996). <sup>4</sup> The CR scores reflecting attitude strength were finally assessed using a 7-graded scale, ranging from 0 ("does not concern me at all") to 7 ("one of the issues that concerns me most").

In order to test for perfect and regular embedding, the respondents were in the main study randomly divided into eight major sample groups. In three of these, WTP estimates were derived for four environmental amenities in the following order; *rain forests in South America, endangered wild animals, airpollution in central London,* and *global warming.* One of these three samples was used as benchmark or reference, whereas in the other two the scope was varied simultaneously for two issues at the time. Thereby, a tool is provided

<sup>&</sup>lt;sup>4</sup> A study by Lunander (1998) shows that overbidding occurs to a greater extent when using a DC format, at least when the simple majority rule is modified into a provision and payment rule. This result is problematic for the NOAA (1993) recommendation of a conservative design that "the option that tends to underestimate willingness to pay is preferred" (p. 4608). Furthermore, estimates derived from DC questions are statistically inefficient and require at least a threefold increase in sample size in order to attain the same statistical precision as OE formats (Schulze et al., 1996). Finally, the possible gain in incentive compatibility must be weighted against the anchoring effects evoked by pre-established values of WTP.

that enables us to test for scope insensitivity. The following scales of measurement or intensifiers of scope were used for the four amenities (alterations of scope for each issue are presented in brackets):

- 1. preservation of 50,000 (2 million) hectares of rain forests in Bolivia (South America);
- 2. saving of the African elephant (five endangered animals, including the Sumatran rhino, the pygmy chimpanzee, the African elephant, the koala, and the Siberian tiger);
- 3. an *improvement* (a *major improvement*) of the air-quality in your living area;
- 4. a 20% (60%) reduction of the gases that give rise to global warming.

The same procedure as above, also using three sample groups, was applied in order to see whether measures of categorical ratings are more or less responsive to scope than WTP. In the remaining two sample groups, respondents were only presented with one environmental issue, specified either as a 20% or a 60% reduction of the gases that give rise to global warming. The WTP estimates derived from these two sample groups were compared with the WTP of global warming evaluated as part of four different environmental issues, thereby providing a test for part–whole bias. Table 1 gives a description of our sample groups.

By using four different scales of measurement or intensifiers of scope (i.e., absolute magnitudes, percentages, verbal cues and number of events) to specify the extent or severity of each problem, a tool is provided to test whether the unit-type influences people's perception of how extensive or important the environmental problem is. <sup>5</sup> Although the nature of the amenities differ from each other in two important aspects (i.e., they could be said to be more or less familiar to the respondents, and they differ in the degree of personal relevance to people), we do not anticipate that these dimensions have any significant impact on the occurrence of scope insensitivity since all of them may be considered as rather unfamilar and not personally relevant issues. Therefore, we hypothesise that any difference in terms of

<sup>&</sup>lt;sup>5</sup> Kahneman and Ritov (1994) used adjectives (such as 'large', 'major', 'severe', etc.) instead of quantitative measures in order to illustrate the magnitudes or importance of various problems. However, this study is subject of the same critique as other studies demonstrating scope insensitivity. For instance, respondents were only shown brief statements (or headlines) in single sentences referring to various sorts of environmental problems, some of which were even presented as fictitious. Furthermore, rather than being given time to think carefully before answering, people were requested to respond 'as quickly as they could'. Finally, the interview comprised as many as 37 environmental issues, still it was completed in less than 15 minutes.

Sample	Environmental issue(s)	Dependent variable
group		
#1	Rain forests, endangered animals, air pollution, global warming	WTP
# 2	Rain forests, endangered animals, air pollution, global warming	WTP
# 3	Rain forests, endangered animals, air pollution, global warming	WTP
# 4	Rain forests, endangered animals, air pollution, global warming	CR
# 5	Rain forests, endangered animals, air pollution, global warming	CR
# 6	Rain forests, endangered animals, air pollution, global warming	CR
# 7	Global warming; 20% reduction	WTP
# 8	Global warming; 60% reduction	WTP

<sup>a</sup> Bold text indicates that issues are presented as major in scope, whereas normal text indicates minor scope.

responsiveness to scope will mainly be due to how magnitudes and importance are specified.

After the main task of assessing WTP or alternatively CR scores, respondents were asked some follow-up questions that captured their main motivations of WTP and CR responses, how difficult they found the task, and how confident they were with their answers. Since there may be many differences in socio-economic characteristics between the student sample and the Swedish sample (e.g., age, income, culture, etc.), a dummy variable was introduced in order to assess these differences.

### 3.2. In-depth interviews

In addition to the main study described above, 12 in-depth face-to-face interviews were conducted. These were elaborated using a procedure similar to a retrospective protocol, through which respondents are asked how they come up with their answers immediately after the decision has been made (Ericsson & Simon, 1984). Respondents were presented with the same CV scenario as in the main survey and subsequently asked for their WTP. The remaining part of the interview was set aside to ask follow-up questions in order to gain insight into how people respond to the CV question, such as, what they were thinking before making their decision, motivations of WTP, how difficult they found the task, how confident they were with their answers, etc. Some of these questions were identical to the ones presented to respondents in our main sample, however, for the latter group they were framed as closed-ended rather than open-ended questions. The findings of

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Table 1

these in-depth interviews are presented in a separate section below, and are thus not included in the statistical analysis that follows.

## 4. Results

Among the 1228 subjects targeted in our main study, 438 replied to the mail survey or chose to participate in a face-to-face interview. Eleven of these respondents were sorted out in the evaluation process due to incomplete responses; our results are in all based on 427 observations. These observations consist of 278 mail surveys (response frequency = 27%) and 149 face-to-face interviews (n = 149). Out of the 427 completed responses, 337 respondents answered WTP questions associated with either one or simultaneously four environmental issues, whereas 90 respondents reported their attitudes toward the same four environmental issues on the basis of the CR format.

## 4.1. Descriptive statistics

Altogether 313 respondents, or 92.9%, replied with a WTP > 0, for at least one of the issues, and for each environmental issue taken separately, non-zero responses varied between 77.9% and 90.6%. On average, people were willing to pay roughly 3.51% of their yearly income for the four issues in total. Inspection of Fig. 1 below reveals the nature of the distribution of total WTP for all four issues. Roughly it follows a normal distribution, although responses above £400 are extremely unevenly distributed, ranging from £400 to £12,000, indicating that these respondents possibly have misunderstood the purpose of the survey. The sample is, therefore, truncated at this point, leaving us with 317 observations of WTP altogether. <sup>6</sup> Among these, 148 respondents provided WTP estimates of four issues, whereas the remaining 169 valued *global warming* only. <sup>7</sup> The mean WTP for each issue, with

 $<sup>^{6}</sup>$  An alternative approach would be to censor the sample by setting outliers bid equal to £400. This procedure was accordingly tested, but yielded no alterations to the main results. Moreover, since respondents providing extreme WTP estimates i.e., above £400) may have partly or completely misunderstood the purpose of the survey, or alternatively are acting very strategically, we have no foundations of standardising these responses. We, therefore, consider truncation as the most appropriate approach in this case.

<sup>&</sup>lt;sup>7</sup> Since the sample groups are overlapping each other (e.g., a number of respondents assign WTP for all four issues), the observations reported in Table 4 do not necessarily add up to the total number of observations.



Total WTP (four issues)

Fig. 1. Frequency distribution of total WTP. *Note*: Frequencies are divided into classes of £20 (i.e., first pile reflects the frequency of £0, second pile the interval of  $\pm 0.1-20$ , third pile  $\pm 20.1-40$  etc.).

Table 2 Mean and median WTP

	Rain forests	Animals	Air pollution	Global warming <sup>a</sup>	Global warming <sup>b</sup>
Grand	£52.24 (20)	£30.59 (10)	£54.70 (10)	£161.43 (30)	£60.60 (22.5)
Truncated	£37.82 (20)	£24.04 (10)	£30.90 (10)	£53.00 (30)	£45.41 (20)

<sup>a</sup> Represents the overall mean and median values of *global warming* valued alone.

<sup>b</sup> Represents mean and median values for *global warming* when evaluated as part of four issues.

median in brackets, are presented in Table 2. All subsequent analyses are based on truncated data unless otherwise stated.

# 4.2. Parametric and non-parametric analysis

Table 3 presents mean WTP estimates along with ANOVA and Kruskall– Wallis test statistics. Although a statistically significant difference between the

Environmental issue	Global warming <sup>a</sup>	Rain forests	Animals	Air pollution
Mean WTP	45.41	37.82	24.04	30.90
Overall mean WTP		36.	11	
One-way ANOVA		F = 5	.28***	
Kruskall–Wallis test		$\aleph^2 = 2$	9.56***	
Mean CR score	4.46	3.94	3.39	4.48
Overall mean CR		4.0	07	
One-way ANOVA		F = 13	3.41***	
Kruskall-Wallis test		$\aleph^2 = 3$	6.62***	

Table 3		
Significance	between	issues

\*\*\* Denotes significance at the 0.01 level.

<sup>a</sup> Sub-samples which are only presented the global warming issue are excluded.

issues is found in terms of mean values, these are rather close to each other. <sup>8</sup> Following this, we might intuitively argue that the monetary figures provided are not necessarily related to the specific attributes and characteristics of the amenity. In our case the WTP estimates fall within the range of  $\pounds$ 24– $\pounds$ 45, and since the environmental issues in many aspects differ from each other in their nature, we might suspect that these values are not solely based on instrumental considerations. When comparing WTP with categorical rating, the latter estimate equally fails to distinguish clearly the issues from each other in terms of their relative importance. However, except from the *global warming* issue, both measures seem to rank the environmental issues in the same order. Thus, the relative importance of the four issues may be supported by the convergence of these alternative measures of environmental priorities.

The validity of the CV study is further assessed through 4 OLS regression equations presented in Table 4. On the basis of a Box–Cox regression, a semilog functional form was chosen in which the dependent variable is kept linear. <sup>9</sup> According to additional econometric tests, no major problems of heteroscedasticity or underspecification are found. Each regression is explained by roughly the same individual characteristics; predominantly income and gender, with women bidding higher, but also age and non-human interest as the main motive of WTP serve as mainstays in the analysis,

<sup>&</sup>lt;sup>8</sup> A critique of the CVM put forward is that the technique most commonly produce estimates within a very restricted range, regardless of what is being valued (Kahneman and Ritov, 1994).

<sup>&</sup>lt;sup>9</sup> Alternative econometric models were run but yielded no significant differences to the results presented here.

Table 4	
Determinants	of WTP

Variable	Global warming	Rain forests	Animals	Air pollution
Intercept	5.31	-63.40	-89.63	-146.6*
-	$(0.09)^{a}$	(-0.77)	(-1.36)	(-1.70)
ln Age	-20.99*	-13.56	-4.50	-3.81
-	(-1.63)	(-0.58)	(-0.24)	(-0.16)
In Income	12.06**	17.14**	13.50**	23.56***
	(2.00)	(2.16)	(2.09)	(2.86)
Gender [1] <sup>b</sup>	-21.45***	-22.33**	4.06	-26.45***
	(-3.17)	(-2.44)	(0.55)	(-2.75)
Easy task [1] <sup>b</sup>	-7.09	-13.31	3.82	-8.78
	(-0.94)	(-1.34)	(0.47)	(-0.84)
Confident [1] <sup>b</sup>	-0.10	8.17	-0.50	-6.11
	(-0.02)	(0.82)	(-0.06)	(-0.59)
Non-human interest [1] <sup>b</sup>	5.45	16.71*	14.50*	-6.89
	(0.74)	(1.74)	(1.86)	(-0.68)
Tax payment [1] <sup>b</sup>	16.71			
	(1.30)			
WTP reduced [1] <sup>b</sup>	9.05			
	(1.00)			
One issue [1] <sup>b</sup>	46.81***			
	(5.29)			
Swedish sample [1] <sup>b</sup>	17.16			
	(1.32)			
Scope [1] <sup>b</sup>	-5.32	-8.04	-2.44	5.78
	(-0.71)	(-0.83)	(-0.31)	(0.57)
R-square	0.14	0.10	0.07	0.11
F-ratio	4.64***	2.22**	1.49	2.29**
Durbin-Watson	1.84	2.18	2.02	2.02
Box-Cox statistics:				
$\lambda$ (corresponding to $X_i$ )	0.70	0.21	0.08	-0.14
	(1.08)	(0.14)	(0.08)	(-0.17)
$\theta$ (corresponding to Y)	0.96***	(0.95***	0.93***	0.94***
	(15.15)	(11.72)	(18.90)	(10.79)
$n * R^2 \sim \aleph_{df}^2 c$	4.40	4.34	4.18	6.69
n	317	145	148	144

\*Denotes significance at the p = 0.1, level. \*\*Denotes significance at the p = 0.05, level. \*\*\* Denotes significance at the p = 0.01, level.

<sup>a</sup> t ratios in parentheses.

<sup>b</sup> Classification of dummy variables:

Gender. 1 if male;

Easy task. 1 if WTP estimation considered as an easy task;

Confident. 1 if confident with stated WTP;

Non-human interest. 1 if non-human interest is an important motive for WTP;

Tax payment. 1 if payment vehicle is a yearly tax rather than a voluntary contribution;

WTP reduced. 1 if willing to reduce WTP in the follow-up question;

One issue. 1 if WTP is asked only for one issue (global warming);

Swedish sample. 1 if the respondents is drawn from the Swedish sample population;

Scope. 1 if the scenario comprise a larger scope of the environmental good.

<sup>c</sup> White's general heteroscedasticity test on the basis of the auxiliary regression:

 $e_i^2 = \alpha_1 + \alpha_2 lnage_i + \alpha_3 lnincome_i + \alpha_4 (lnage)_i^2 + \alpha_5 (lnincome) 2_i + \alpha_6 (lnage_i * lnincome_i) + v_i$ 

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holding the expected sign. Thus, people who not only consider their own selfinterest but intrinsic values as well, are likely to provide higher bids. Most importantly, it is indicated that people who are confronted with only one environmental issue (i.e., global warming), are willing to pay significantly more for this issue than are respondents who simultaneously provide WTP for three other environmental goods. The overall results do not depend on whether a tax or a voluntary contribution is used as the payment vehicle, and finally, no significant difference is found between the LSE and the Swedish sample.

Responsiveness to scope and part-whole effects are presented in Tables 5 and 6. A part-whole effect for global warming is clearly demonstrated; whereas the mean WTP amounts to £45.41 when the issue is evaluated as part of three other issues, this figure increase to £79.30 when the issue is valued on its own. The difference in the means is further statistically significant at the 0.01 level according to the Mann-Whitney *U*-test. Hence, we might assert that part of WTP is based on other motives and considerations than those postulated by conventional economic theory. However, WTP do not seem to solely reflect the moral satisfaction or symbolic value derived from contributing to the environment. In such case, we would expect that the total WTP would be roughly the same irrespective of how many issues are included in the scenario, but as illustrated in the table, total WTP of four issues is significantly higher (£115.21) than the value placed on the global warming issue when evaluated on its own (£79.30).

In Table 6, the responsiveness to scope for both WTP and categorical ratings are analysed. The most important result is that perfect embedding is demonstrated for all four environmental issues. Furthermore, the effect is independent of the way in which the magnitudes are specified; no difference is found with respect to type of intensifier or scale of measurement. The effects occur no matter if absolute magnitudes, percentages, number of

Valuation scenario	Mean WTP global warming	Mean total WTP
One issue evaluated:	79.30	79.30
As part of four issues	45.41	115.21 <sup>b</sup>
Between groups significance	$Z = -4.34^{\circ}$	$Z = 2.14^{\circ}$
	(0.00)	(0.03)

Table 5 Examination of part–whole effects<sup>a</sup>

<sup>a</sup> *p*-values in brackets.

<sup>b</sup>Mean total WTP for four issues.

<sup>c</sup> Mann-Whitney U-test.

## Table 6

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Environmental issue	Mean WTP		Mean CR score	
	Minor scope	Major scope	Minor scope	Major scope
Global warming <sup>d</sup>	46.39	43.23	4.62	4.10
Between groups significance	$F = 0.16^{b}$		$F = 2.64^{b}$	
	(0.69)		(0.11)	
Rain forests <sup>e</sup>	40.34	33.03	3.89	4.03
Between groups significance	F = 0	0.57 <sup>b</sup>	$F = 0.23^{b}$	
	(0.45)		(0.63)	
Endangered animals <sup>f</sup>	25.24	21.62	3.28	3.58
Between groups significance	$Z = -2.26^{\circ}$		$F = 0.90^{b}$	
	(0.02)		(0.34)	
Air pollution <sup>g</sup>	28.54	35.35	4.61	4.21
Between groups significance	F = 0	).45 <sup>b</sup>	F=2.	04 <sup>b</sup>
	(0.50)		(0.16)	

<sup>a</sup>*p*-values in brackets.

<sup>b</sup>One-way ANOVA.

<sup>c</sup> Mann–Whitney U-test.

<sup>d</sup> A 20% vs a 60% reduction of the gases that give rise to Global warming.

<sup>e</sup> Preservation of 50,000 ha in Bolivia vs 2 million ha in South America.

<sup>f</sup>Saving of the *African elephant* vs saving *five of the most endangered mammals*, including the African elephant.

<sup>g</sup> An *improvement* vs a *major improvement* of the air quality.

events or verbal cues are applied in order to specify the scope. These results are also verified by our regression analysis presented in Table 4 previously. For some amenities, respondents valuing a larger scope of the issue actually provided lower bids, although the misdirection of WTP is trivial and insignificant except from *endangered animals*. Thus, we cannot reject the hypothesis that respondents are insensitive to scope. Finally, a concept of attitude, measured as categorical rating, does not result in greater responsiveness to scope than does a notion of economic value. However, since categorical rating is a relative measure of importance that possibly lacks the properties of interval-ratio data, it might conceal the actual influence of scope.

## 4.3. Qualitative analysis

When asked about motives and considerations for stated WTP in association with the CV scenario, it is clear that considerations other than

those adopted by economic theory play an important role in determining economic value. The most frequent responses, in the following order, were:

contemplation of whom might be responsible for (solving) the problem (what is my own responsibility, and thus, how much I ought to pay); what is needed for an adequate solution(s) (what are the costs for it/them); the importance and/or severity of the problem;

whether or not other people will pay and how much ("a fair share"); what I can afford to pay;

to what extent I am personally involved or have an interest in the problem; how much should the society reasonably spend on the environment (collective "green" accounts);

how much I give to other charities (mental accounts for charities) or normally spend X dollars on; considerations of future generations

considerations of future generations.

Most respondents said that they were thinking of the environment in general rather than the particular commodity under valuation, or that the environment is a complex issue not separable into specific events. A few respondents also claimed that any environmental project should be put in an appropriate context, whereby real benefits and costs are decided upon, rather than being valued on a continuous scale. Overall, these statements support the notion that a variety of 'unconventional' considerations play a major role in determining WTP and attitudes. It is important to capture these reasons, preferably in a qualitative format, since people who were asked the same questions in a closed-ended format to a larger extent provided more 'rational' answers, such as referring to the importance of the problem, the extent of it, the interest of future generations, etc.

As a follow-up section to this part of the questionnaire, people were also asked if they reflected upon to the scope of the problem (31% affirmative), if they paid attention to other public issues, environmental or others, that eventually require financial support (21%), if they would agree to support other issues with a similar amount (29%), and if they considered it appropriate to base public action on monetary valuation (41%). Finally, an important implication for the future application of CV studies is that 73% of the respondents asserted that more information about specific project costs and implementation might be of help in providing monetary values for these public goods.

## 5. Discussion

Our main findings are that neither an instrument of economic value nor a concept of attitude, as utilised here, are capable of making the respondents responsive to scope. No significant difference is found between minor and major scope for WTP or CR for any of the issues, nor does it seem to matter how the magnitudes are specified (i.e., whether absolute magnitudes, percentage, number of events, or verbal cues are used). The weak relation between expressed economic value and instrumental considerations on behalf of the respondents are also supported by small variations in mean WTP across the four issues. The presumption that a measure of economic value should be psychometrically inferior to a more traditional notion of attitude (Kahneman & Ritov, 1994) is however challenged considering that neither instruments show responsiveness to scope.

Furthermore, a considerable part-whole effect is found for the global warming issue. Nevertheless, this inconsistency is unlikely to be explained completely by the moral satisfaction hypothesis, as suggested by Kahneman and Knetsch (1992), since the total WTP for all four goods are significantly larger than the WTP for global warming when evaluated on its own. Thus, rather than merely reflecting a general concern for the environment, WTP is presumably determined by a combination of symbolic expressions and other considerations. Consistent with Thaler's (1990) hypothesis, the results of this study, indicate that people have 'mental accounts' for these issues that are not easily separable into specific events; rather than focusing on the particular issue under valuation, most respondents based their WTP on environmental issues in general. Another plausible explanation for the effect is some people's failure to consider their budget constraints; of a total of 214 respondents, 22% stated that they were willing to reduce their monetary bid after explicitly calculating their stated total WTP in a follow-up question. When valuing several issues, respondents are reminded of other potential issues that may require funding, which would possibly result in more conservative estimates.

Opponents of the CV method commonly assert that CV respondents do not have a clear and real value for the item being valued; instead of relying on a well defined scheme interpreted in their minds, people seem to construct their preferences and make a decision rule whenever they need it (Schkade & Payne, 1994). As a result, people's responses in a CV context are likely to be arbitrary and unlikely to reflect properly the instrumental considerations as required by cost-benefit analysis. Such misgivings seem well founded in the

context of our results. Overall, our results indicate that assessed economic value is insensitive to factors that ought to be important according to economic theory, such as the scope or importance of particular issue, but instead are influenced by factors that should not be relevant and are problematic for subsequent welfare analysis. One may argue that there are no major incentives for the respondents to think hard about the issues covered here, but since equally unfamiliar amenities and similar formats are applied by many other CV studies, these studies are likely to be vulnerable to the same problem.

It is easy to see why economic impact analysis of various environmental improvements and deterioration is attractive as no other unit other than monetary values are capable of providing a direct and relevant comparison with other competing projects, public as well as private. However, we are not inclined to think that a holistic measure such as WTP entails the ability to accommodate the diversity of values encompassed by natural resources. Efforts should be spent on developing methodologies and instruments that capture both economic value and other complex dimensions involved, not only to possibly enhance the validity of WTP responses, but also to improve our understanding of people's values and priorities in the context of natural resources.

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