ISSN 0316-5078

INSTITUTE FOR ECONOMIC RESEARCH

DISCUSSION PAPERS
#848

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March 1992

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THE EFFECTS OF INFORMATION IN CONTINGENT MARKETS FOR ENVIRONMENTAL GOODS: A SURVEY AND SOME NEW EVIDENCE.[1]

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[1] We thank the Nature Conservancy Council for research funding; and David Jamieson and Sangita Dubey for research assistance. Helpful comments were received on an earlier version from seminar participants at the University of Alberta, Department of Rural Economy. Full responsibility for all errors and omissions rests with the authors.

ABSTRACT

This paper considers the ways in which information can impact contingent valuation estimates of environmental values. The Hoehn/Randall distinction between value formulation and value statement is employed. We distinguish several ways information should be expected to effect true Willingness to Pay, and survey past contingent valuation work in the area. A model of information impacts is used to set up a series of testable hypotheses. These are then tested using data from a contingent valuation survey of the benefits of heathland preservation.

1. Introduction

The Contingent Valuation Method (CVM) is now widely used as a technique for valuing non-market environmental costs and benefits (Mitchell and Carson, 1989). By creating a hypothetical market for the environmental good in question, individuals are persuaded to reveal their willingness to pay (WTP) or willingness to accept compensation (WTA) for increases or decreases in supply of the good. These responses correspond to exact welfare measures of compensating or equivalent surplus under quantity constraints, contingent on the nature of the hypothetical market. Several features of this market have been argued to be of particular importance , such as its realism, and the payment mechanism proposed. These features, along with information provided to respondents on the good in question and the rule for provision or non-provision on the good, constitute the 'framing' of the good to be valued (Cummings, Brookshire and Schulze, 1986). Changes in this framing can be expected to change revealed values. In this paper, we concentrate on the possible effects of information on revealed values. Given both the recent upsurge in the use made of CVM, and in work on information impacts, this seems an important task.

The paper is structured as follows. Section Two outlines a number of ways in which information provided in a CVM survey can influence stated bids. Section Three looks at previous empirical findings, whilst in Section Four we develop a model of information impacts. This model is used to derive predictions for impacts on mean bids for two sorts of information; and on the

degree of protest bidding. Effects on bid variance are also investigated. Predictions from the model are thentested using data from a recent UK application in Section Five. Finally, some conclusions are offered in Section Six.

2. Information impacts in contingent valuation.

In this section, it will be helpful to consider the two-stage decision making process modeled by Hoehn and Randall (1987) and Bergstrom, Stoll and Randall (1989,1990). Individuals who are part of the sample for a CVM survey can be thought of as solving two problems. The first is how to decide on the true value they place on a change in the supply of an environmental good. This is referred to as the "value formulation" stage, and results in a true WTP figure for that individual at the time when the CVM questions are asked. True WTP (which we refer to from now on as WTP^t) is the solution to the cost-minimization problem the individual solves, where expenditure is minimized subject to a particular level of utility being held constant[2], given alternative levels of supply of the environmental good. For welfare-improving moves, WTP^t is a Hicksian compensating measure of the money value of the welfare change, whilst for a welfare decreasing move, WTP^t is equal to equivalent surplus. Briefly stated, for an improvement in environmental quality from Q_o to Q_1, compensating surplus is $[M_o-M_1]$, where the subscripts relate to pre- and post-income levels respectively, and where M_1 is the

[2] In what follows, we refer only to willingness to pay, and not willingness to accept compensation measures of value.

solution to:

$$M_1 = \min_X \{PX: U_o = U(X, Q_1)\}$$

where P is a price vector of private goods X, and U_o is the initial utility level (Bergstrom, Stoll and Randall, p.687).

Once individuals have solved the value formulation problem, then must then decide what WTP figure to reveal to researchers. This is the "value statement" stage. If incentives exist for strategic behaviour, then WTP^t may be less than or greater than revealed WTP, WTP^r. As Bergstrom, Stoll and Randall (1989) note, this two-stage process represents a considerable simplification over the six stage valuation process suggested by some psychologists (Beach and Mitchell, 1978).

Information provided by the researcher impacts on both stages of this valuation process. With regard to the value formulation stage, WTP^t may change with alterations in the following classes of information:

1. Information on the environmental good itself.

Bergstrom, Stoll and Randall (1990) distinguish between information on the services supplied by the environmental good, in terms of its "..possible uses"..(p.614), referred to as "service information"; and information on physical descriptors of the good, which they refer to as "characteristic information". So for a mature forest, service information would include descriptions of the importance of the forest for micro-climate regulation and soil retention; whilst characteristic information would include detail on the size and species composition of the

forest. Bergstrom *et al* maintain that individuals can hold significant amounts of characteristic information without being aware of services provided by the relevant resource: this will clearly only describe a subset of individuals. The distinction is not required in our analysis of the issue.

Clearly, if individuals are given new information about either the characteristics or services provided by an environmental resource, they may change their WTP^t. For example, being told that the area of wetlands in a country is declining, or that wetlands provide flood protection benefits may cause me to revise upwards my WTP^t. This is the prediction of Bergstrom *et al*'s model for increases in 'good' service information.

2. Information on substitute and complementary environmental goods.

If individuals are questioned in a CVM survey about the value of a particular forest, their WTP^t may well be affected by additional information on substitute and complementary environmental goods. This additional information will be combined with information the individual holds at the outset of the survey. For example, being told of the existence of an very similar forest not far from the forest being valued may decrease WTP^t, if this represents new information (Whitehead and Blomquist, 1991). Alternatively, being told that a second habitat exists for an endangered species may increase WTP^t for a first site, if this means individuals no longer perceive safeguarding the species as a 'lost cause'. Information about substitutes and complements may also address itself to their

prices, as well as their physical characteristics (Boyle, Reiling and Phillips, 1990). The provision of substitute/complement information may be more important in cases where non-users of a resource are being questioned, since they are less likely to be informed on these issues than are users.

3. Information on relative expenditure.

In CVM surveys, respondents are asked to state an amount indicating their WTP for a particular resource change. However, individuals may be imperfectly informed about how this amount compares to their spending on other public goods, such as defence, how it compares to their income, and how it compares to any environmental budget that individuals have formulated (Seip and Strand, 1990). Providing information on any of these items may change WTP^t. For example, if I am asked as to my maximum WTP to save a local nature reserve, I may bid $10. If told that this compares with $150 per year that I spend on entertainment expenses for local councilors I may well adjust upwards my true WTP for the reserve. If told that my bid represents a very low percentage of my disposable income, then again I may revise up my WTP^t.

4. Information of future availability of the good

This kind of information might well be subsumed under (1) above, but has been treated differently in the literature, as one determinant of option value (Bishop, 1982; Johanssen, 1987). WTP^t has been shown to be an increasing function of supply

uncertainty, with individuals being willing to pay a premium to secure supply of a good, given demand certainty. Information relating to supply uncertainty may thus change WTP^t.

5. Information about the behaviuor of others and the provision and cost-sharing rule(s).

Information of types (1) through (4) above can all be considered to have possible effects on true WTP[3]. But information on the behaviuor of others, on the cost-sharing rule, and on the provision rule will all potentially impact on revealed WTP, causing the ratio of WTP^r to WTP^t to change.[4] Such potential impacts have been noted by many authors, from Samuelson (1954) through to Mitchell and Carson (1989). For a project which improves environmental quality, if respondents believe that stated bids will be collected, then they have an incentive to understate WTP^t since benefits of the project are non-excludable. This is the classic free rider problem. If respondents believe that bids will not be collected, but that the outcome of the survey will guide policy, then supporters of the project will

[3] We have not considered one other way in which information effects true value here. this is the value of information in irreversible developments: the Arrow-Fisher-Henry notion of quasi option value. This is because this seems a separate case, since here information is potentially received after the project proceeds. We however are discussing cases where more or less information is given now: although telling respondents about the concept of quasi option value might increase true WTP (supposing the concept to be understandable by the sample.

[4] Here we ignore possible impacts of the behaviuor of others on true value, as suggested by Arthur et al, 1991.

have an incentive to overstate their WTP^t. Incentives change when policy is not thought to depend on the outcome of the survey: here a supporter may understate WTP^t. Information on the behaviuor of others can affect the incentive to behave strategically. If a free-rider who value the environmental improvement is told that the aggregate bid is insufficient to have the project go ahead, then she may revise her bid upward, and surrender some of the rent gained by understating.

However, there is an important point here. Whilst CVM researchers can say whether they expect a particular sort of information to effect WTP^t *or* WTP^r, they can only observe stated bids. This is so even in tests for strategic behaviour in CVM surveys, such as that in Bergstrom *et al* (1989) reported in the next section. We shall adopt the position in this paper that all tests for information impacts in CVM empirical work can be considered as tests for impacts on WTP^t. In other words, we shall adopt the working assumption that WTP^t is insignificantly different from WTP^r. This undoubtedly convenient assumption needs to be justified.

True WTP can be approximated by revealed WTP for the following three reasons:

(i) In experimental studies where respondents have been encouraged to engage in either strategic under or over-statement of WTP^t, several studies have found surprisingly little divergence between WTP^t and WTP^r. For example, Bohm (1972) found that WTP^r captured 71 to 85% of true value, and that WTP^r and WTP^t were not statistically different from each other in all

treatments considered. Brubacker, in a later study, found again that WTP^r was not subject to to significant levels of free riding, even where respondents were given every incentive to do so (Brubacker, 1982).[5] Brubacker concluded that respondents found it hard to formulate WTP^t exactly, but kept a range of values for this amount in their minds. Effort to narrow the range would only be undertaken in face of some external threat. In the absence of such a threat, respondents would state a figure at the *lower* end of their range for WTP^t, to avoid over-committing themselves. This, if true, would mean CVM bids would tend to understate WTP^t, as Mitchell and Carson (1989) point out. Free-riding in CVM surveys has as a necessary (but not sufficient) condition that respondents are sure that they will be provided with the good no matter what bid they make. Even then, as we have seen above, free riding may still not occur.

Milon (1989) tests for three types of strategic behaviuor in a field CVM setting. Strong free riding occures when stated WTP under any payment mechanisms is zero, even though true WTP is supposed to be positive. Weak free-riding occurs when $WTP^t>0$, but $WTP^t>QTP^r$. Over-riding occurs when $WTP^t>0$, and $WTP^t<WTP^r$: thsi may happen if the respondent believes that her response will influence supply of the public good, but that her bid will not be collected. Milon assumes that a Hoehn and Randall closed-ended

5 The incentive to free ride was that respondents, making bids in an experimental setting, were told that respondents would be required to pay the amount they revealed, but that the good would be provided for all persons making a bid greater than zero.

referendum set-up will produce truthful behaviuor, and thus use responses under this scenario as WTP^t. One interesting feature of the study is that respondents were allowed to say that they could not formulate a bid. Milon finds no evidence of strong free rider or over-riding, and no evidence of weak free riding when those who could not formulate a bid were excluded.

(ii) In experimental settings, simple preference revelation, in response to direct questions such as "what is the most you would be willing to pay for this shopping voucher" have been shown to perform almost as well (if not better) than complex compensation or tax-based Incentive Compatible Preference Revelation Mechanisms (ICPRMs), such as those described in Varian (1978) and Feldman (1980). Yet such simple mechanisms are exactly what CVM surveys consist of. Performance here consists of allowing a co-operative solution to be reached, which is Pareto-preferred to strategic, un-cooperative behaviour. Possible explanations for this absence of strategic behaviour which have been offered are the costs of formulating strategic strategies, the computational complexity of such strategies for each respondent, and non-zero costs of dishonest behaviour (Smith, 1980; Grether and Plott, 1979).

(iii) Game theorists have recently suggested that honesty may be the best strategy in repeated games, due to similar reasons to those outlined above in (ii). Examples include Evans and Harris (1982) and Ackerloff (1983).

(iv) Individuals are under cultural and moral imperatives to tell the truth unless good reasons exist for not doing so (ie

truth telling is the default strategy).

Whilst the bid revelation mechanism in the CVM studies reported in section 5 of this paper do not correspond to Hoehn and Randall's system (where it is argued that WTP^r is an understatement of WTP^t [Hoehn and Randall, 1987]), we nevertheless will take any information impacts on WTP^r to be indicating impacts on WTP^t, rather than on the level of strategic behaviuor, for the reasons given above.[6] As Milon (1989) says:

"..field CVM respondents try, to the best of their ability, to provide truthful information about their preferences"

3. Previous empirical work in CVM

In this section, we summarize previous empirical CVM work on information impacts, classifying the studies according to the "possible impacts" 1-5 listed in the previous section. This leads in to the formulation of a model of information impacts in section 4.

Early empirical studies were concerned with changes in information describing the good or goods to be valued. In the study by Bergstrom, Dillman and Stoll (1985), respondents were classified according to whether or not they were given information on the benefits of prime land preservation in the USA. These benefits included scenic and nostalgic values. This experiment thus tests for differences in WTP due to changing the set of service information that respondents hold. Bergstrom *et al*

[6] Although as Mitchell and Carson (1989) point out, Hoehn and Randall's model is actually an incorrect application of Zeckhauser (1973), since their 'game' is a repeated one, and Zeckhauser's model holds only for once-and -only choices.

found that the hypothesis that additional service information increased mean WTP could not be rejected at the 99% level of significance, with the mean increase for WTP for prime land preservation increasing with the extra information by $5.29.

Samples, Dixon and Gowen (1986) sought CV estimates of WTP to preserve three species (rabbit, monkey and rat) under four differing information sets. These were (1) no information on any species; (2) physical appearance; (3) endangered status; and (4) physical appearance plus endangered status. In a related experiment, they compared bids to preserve the humpback whale in two situations, distinguished by whether or not respondents were shown a film about humpback whales, which gave information on both their characteristics and threats to their survival. Samples et al concluded that there was a significant relationship between information given and stated WTP: they remark that, "...it is unambiguous that information disclosure can influence ...an individual's budget allocation" (p.311). This finding was taken up by critics of environmental valuation as proof that CV was an unacceptable methodology: Sagoff (1988), for example, makes the accusation that this impact of information results in values becoming endogenous to the valuation process, and thus unreliable in a methodology as supposedly objective as CBA.

Boyle (1989), however, challenged Sample et al's results in the following way: only when all information was presented to the 'three-species' group of respondents could their information set be described as "true and accurate", in the terms of Cummings, Brookshire and Schulze (1986). Boyle states, (p.58):

"...I argue that the only relevant description, for valuing endangered species, was provided by Samples as the final level of information".

Boyle then reports the results of an experiment determining WTP to preserve a brown trout fishery in Wisconsin (using fishing licenses as the bid vehicle) under different levels of information provision. He splits his sample into 3 groups, A, B and C. Group A received only basic information about the commodity to be valued (i.e. brown trout in Southern Wisconsin streams). Group B were also told about current stocking activities, whilst Group C were, in addition, informed as to the cost of these activities. These three groups thus differ according to the amount of characteristics information provided to them by Boyle. Boyle found no significant difference in the means of stated WTP across the three levels of information, although he did find that the estimated variances of bids fell significantly as the level of information given increased (more information thus producing more precise estimates), whilst the percentages of zero bids also fell significantly in moving from sub-sample 'A' to 'C'.

Boyle concludes his paper by stating that "...the argument that changes in accurate or true commodity description in the framing of (CV) questions will change value estimates is unwarranted as a blanket statement".

Bergstrom, Stoll and Randall (1990: henceforth BRS) also tested empirically for effects of alternative descriptions of the good being valued. They specify a model of the impact of service

information on WTP for a welfare-improving change, from which they derive a prediction that WTP may rise or fall with additional service information, depending on which of two effects is bigger: an effect on the marginal cost of utility, and an effect on the marginal utility of the (rationed) environmental good. The first effect occurs since respondents with the additional information have to consume a lower amount of the good to achieve a given utility level; whilst the latter effect occurs since their perception of the good changes (increasing its marginal utility). BRS find that for additional information on the services provided by wetlands, WTP is significantly increased.

Bergstrom and co-authors have also tested for information effects where information is provided on stated WTP as a percentage of income and on its magnitude relative to expenditures on other goods (Bergstrom, Stoll and Randall, 1989:). These types of information effect clearly fall under category (3) above, and are termed by BRS Perspective Information and Relative Expenditure Information respectively. Additional Perspective and Relative Expenditure information are both predicted to increase WTP^t, since they allow consumers to better solve the constrained minimization problem they face (see section 2). In a study of WTP for water quality management, additional inputs of neither type had a significant effect on mean bids (although the sample size was very small (n=51)). Respondents were then told that the average bid reported across the sample was insufficient to secure the environmental good (access to recreational facilities on the

river). This move was intended to reduce any free-riding. Again, no significant change in bids was recorded, although this might be because respondents were not behaving strategically anyway (see above). Bergstrom *et al* conclude that information changes have impacted on stated WTP sums in a predicted way, but not to significant levels.[7]

Finally, CVM researchers have tested for the impact of information about substitute and complementary goods on WTP^t. Whitehead and Blomquist (1991) estimate mean bids for the preservation of a particular wetland, Clear Creek, in Western Kentucky. Their sample is categorized according to what information respondents are given on other wetland sites. Whitehead and Blomquist (WB hereafter) argue that WTP^t will be underestimated if individuals lack information on complementary goods, and will be overestimated if respondents are not told about substitute goods. Clearly there is a problem here in deciding. empirically, what goods to reveal as possible substitutes/complements, how many of such goods to reveal, and in what detail. WB use dummies in a bid curve to represent the inclusion or exclusion of information on other wetland sites. Their data came from a postal survey of a random sample of Kentucky households. A response rate of 31% was achieved, giving a sample of n=215. No evidence of non-response bias was found. It

[7] When all three effects are combined, WTP does show a significant increase, but as Bergstrom et al point out, this may well be because respondents felt pressured after three questions of the form "Now do you want to increase your bid" to eventually reply "Yes".

was found that information about a substitute good (a lake on land reclaimed from mining) significantly reduced the probability of a yes response to the suggested cost of preserving Clear Creek[8], whilst information on a complementary wetland increased this probability (but not significantly).WB conclude that (i) providing information on substitutes and complements produces predictable and testable impacts on WTP; and that (ii) "..(our) results support the notion that information introduced in contingent markets produces a desirable information effect. "(p.2530). This is a very different conclusion to those of Samples *et al* and Sagoff (op cit).

Boyle, Reiling and Phillips (1990) consider the impacts of revealing different information concerning the prices of substitute recreational goods, in a CVM survey of Maine hunters. Here, substitution was across different species that were available to be hunted (eg deer, upland birds, and sea ducks). The alternative prices (specified in terms of hunting costs) were that (i) substitute prices were unchanged; and (ii) that they had doubled.[9] Mean bids were higher under treatment (ii) than for treatment (i) for two out of the three species on which sufficient data was available, but the difference was not statistically significant. Boyle *et al* attribute this finding to a number of factors, among which were (a) that their hypothetical

[8] WB use a close-ended CVM approach.

[9] The 'substitute price unchanged' scenario was in fact further divided in explicit and implicit statements of this fact. No significant difference in mean bids was found between these two treatments. See Boyle et al (op cit).

market may have not been credible; and (b) that a doubling of hunting costs may be insignificant for day hunters.

4. A Model of Information Impacts.

Summarizing the above material, WTP^t for environmental goods depends on the framing of these goods. This framing includes service and characteristic information; level of supply uncertainty; and structure of the hypothetical market (including payment rules and information on others' bids). We now look at the impact of changes on elements in this frame-service and characteristic information, and threats to future supply-using the expected utility model. These changes may occur both to the mean and spread of WTP^t. We also consider a further impact of information, namely that on the level of protest bidding. In this section, we illustrate with reference to one of the subjects of empirical work reported later ; namely the preservation of lowland heathland, an increasingly-rare semi-natural habitat found in the UK, and highly valued by conservationists.

Suppose there are m potential heathland sites that a consumer can visit. Site k ($(=1,\ldots,m)$) has a variety of attributes that make it desirable. In the case of heathland these may include, for example, the area of the site and the variety and abundance of flora and fauna. Even for regular visitors to the site, the scale and availability of the characteristics of the site and other, substitute sites will be uncertain (so that uncertainty attaches to both the services and characteristics of the site, in BSR terms). So suppose there are n characteristics, z_i

$(i=1,\ldots,n)$ and let the set of possible attributes for all m sites[10] be Z – a compact subset of R^n. For site k, the probability density function of potential characteristics is $g^k(z)$ (where $z = (z_1,\ldots,z_n)$), with $G^k(z)$ as the cumulative density function. Suppose there is also a maximal element z_{max} such that $G^k(z_{max}) = 1$ for all k and similarly z_{min} such that $G^k(z_{min}) = 0$ for all k. Preferences are of the form, $u(z) - c^k$, where c^k is the generalized travel cost of visiting a site, U is twice differentiable and it is assumed, at least initially, that U is increasing in all the arguments of z.[11] Letting v^k be the expected utility for a site then a consumer chooses to visit the kth site in preference to all others (i.e. site choice is mutually exclusive)[12], as long as,

$$v^k-c^k - \max\left(\max(v^j-c^j:\quad j=1,\ldots,m), v_f\right) \qquad (1)$$

where v_f is the fallback utility available from other activities. So, let v^*-c^* be the expected utility of the chosen site and $\underline{v}-\underline{c}$, the next best alternative then the individual's maximum WTP^t to

10. Some sites will not possess certain attributes. Here this is represented by the probability density function rather than by altering the set of potential features for each site.

11. For simplicity assume that c^k is known. The results that follow can be affected by making c stochastic as long as the information provided does not affect its distribution.

12. Many considers in our Heathland survey visited a number of sites each year. The arguments given here are easily extended to the case where a subset of the m sites is chosen by each agent.

visit the site (option price) is:

$$WTP = (v^* - c^*) - (\underline{v} - \underline{c}) \qquad (2)$$

The effects of information are hard to formalize and there is no consensus on the functional form of an increase in information on G. For that reason we use a very general notion of the consequences of increasing the information available to individuals. Information is positive for an individual if it raises the subjective probabilities that a particular site has more of the good attributes. More formally, if after receiving information the cumulative density function is $G^{k'}$ such that $G^{k'}(z) \leq G^{k}(z)$ for all z and all individuals and the inequality is strict for at least one point in Z for at least one individual, then the information is positive for all individuals.[13] Now, the expected benefit of visiting the kth site is,

$$v^k = \int \ldots \int U(z) g^k(z)\, dz_1 \ldots dz_n \qquad \ldots\ldots\ldots (3)$$

For simplicity, write this as $\int U g^k dz$. Integrating by parts, this is equal to,

13. Thus our approach should be distinguished from that of Hoehn and Randall (1987) who consider the consequences of reducing uncertainty rather than the effects of giving specific information. It should be made clear that giving information can make a consumer more uncertain rather than less if prior probabilities are biased (e.g. telling someone that an amenity may be destroyed when they were sure it was absolutely safe).

$$U(z_{max})G(z_{max}) - U(z_{min})G(z_{min}) - \int U_z G^k(z)\, dz. \qquad \ldots (4)$$

But $G(z_{max}) = 1$, while $G(z_{min}) = 0$, so

$$v^k = U(z_{max}) - \int U_z G^k(z) dz \qquad \ldots . (5)$$

So, if positive information is received then the change in expected utility is:

$$v^{k'} - v^k = \int U_z [G^k(z) - G^{k'}(z)]\, dz \qquad \ldots\ldots\ldots (6)$$

But given the previous assumptions, the arguments of this equation are positive, so expected utility rises. Similarly if information is negative (defined in the obvious way), then expected utility is diminished by fresh information. The effects of information on WTP follow naturally: if positive information is received in the site chosen (e.g. on what rare species can be found there) , then v^* rises while v^j for all $j \neq k$, stays constant, hence WTP must rise[14]. The prediction for a given site S is that WTP in the presence of additional good information will be higher than in the absence of such information: ie we can test:

H_0^1: $WTP(S)_0^t = WTP(S)_1^t$ versus H_1^1: $WTP(S)_0^t < WTP(S)_1^t$

where the subscript 1 refers to the situation after the extra

[14] Our definition of 'good' information rules out the possibility of the additional information on the existence, for example, of a rare poisonous spider decreasing WTP, since this we classify as 'bad' information.

information, and the subscript 0 refers to before the extra information. In what follows, we will omit the superscript t, taking all WTP anounts to refer to true WTP.

If, though, information is positive, but is interpreted as applying to all possible sites, then the valuation of any given site may rise, but of course overall WTP may fall. To say anything more requires making conjectures about how the different G^k functions are affected by information. Empirically, we can test for this effect. Defining WTP(G) as WTP to preserve the option to visit sites in general, we test:

$$H_0^2\text{: } WTP(G)_0 = WTP(G)_1 \qquad \text{versus} \qquad H_1^2\text{: } WTP(G)_0 < WTP(G)_1$$

If the vector of characteristics, z is defined to include the future benefits from a site, then information on threatened future losses in the area of a given heath will raise the probability that the flow of benefits on other sites will be curtailed. So $\underline{v}' \leq \underline{v}$. If a CV question also states that the site on which the questioning is being carried out can be saved from destruction, then, to the extent that there is a pre-existing perceived threat to the site, asking the question also raises the probability that the flow of benefits will continue and so $v^{*\prime} \geq v^*$. Therefore WTP(S) should rise. If the CV study also raises the possibility of saving all sites, then increased supply uncertainty will again increase bids, so that WTP(G) will rise. Terming this a 'relative scarcity' effect, we have two more testable hypotheses:

$H_0^3: WTP(S)_0 = WTP(S)_1$ versus $H_0^3: WTP(S)_0 < WTP(S)_1$

and

$H_0^4: WTP(G)_0 = WTP(G)_1$ versus $H_1^4: WTP(G)_0 < WTP(G)_1$

where again the sub-scripts 1 and 0 represent with and without additional information respectively.

A second issue is the question of the credibility of the CV framework. Individuals are asked to imagine a threat to the site. They put a probability, p, on the conjectured threat being true, in which case their expected utility is the sum of the expected benefits from continuing to use the site plus the expected benefits of using the second-choice site if their first choice is destroyed. So,

$$WTP = (v^*-c^*)-[(1-p)(v^*-c^*)+ p(\underline{v}-\underline{c})] = p[(v^*-c^*)-(\underline{v}-\underline{c})] \quad ....(7)$$

If information raises the credibility of a conditional statement 'suppose this site will be destroyed...' then the probability p rises. This increases WTP, even in the absence of the previously discussed consequences for v^* and $\underline{v}$. Furthermore, the effect should be reflected not just in the mean WTP scores, but also in the number of protest bids, since one of the prime reasons usually given for these bids is the interviewee's lack of belief in the credibility of the questions posed. We thus hypothesize:

$$H_0^5: \pi_0 = \pi_1$$

where π_1 is the percentage of all bids classified as protests *with* additional relative scarcity information (for both site-specific bids and bids for heathland in general. Hypothesis

H_0^5 is tested against:

$$H_1^5: \pi_0 > \pi_1$$

In addition for its consequences for average measures of WTP, some authors (e.g. Boyle (1989) (see section 2) have suggested that measures of dispersion should be affected by the provision of information. In particular, it can be argued that as more information is received, those who are already informed will adjust their WTP only marginally, while those who were relatively ignorant will raise their valuations substantially. This should narrow the gap between the ignorant and the informed and hence reduce measures of the dispersion of WTP. But as we have already argued, this requires adopting a specific functional form for the relationship between G and information and it is our view that this is impossible within the normal confines of contingent valuation. To see that in general nothing can be predicted about the variance or the standard error, consider the effect of providing positive information on the site chosen. Let s be the valuations ((v-c)) prior to the information being acquired, s' be the post information valuations and let $\underline{s}$ be the valuations of the next best alternatives (which we suppose remains unchanged). Then if there are H individuals (and the superscripts h = 1,...,H are omitted for simplicity), the change in the variance is given by,

$$\left(\frac{1}{H}\right)\sum_{h=1}^{h=H}(s'-s)\left[(s'+s-2\underline{s}) - \left(\frac{1}{H}\right)\sum_{h=1}^{h=H}(s'+s-2\underline{s})\right] \qquad (8)$$

Now $(s'-s)$ is the change in the valuation of the best outcome, while $s + s' - 2\underline{s} = (s'-\underline{s}) + ((s-\underline{s}))$, which is the sum of the WTPs before and after information is received. Hence if the sum of the WTPs and the change in valuations are positively correlated, the variance of WTPs may rise in the wake of information. How likely is this result? Essentially, if those with the highest initial valuation are the most ignorant then the variance will rise. This does not seem likely in all cases, especially where use values are elicited from a sample of users: after all the set of those visiting the heathland is not random, but will tend to consist of those with the highest valuation and those most informed about the site attributes. However, even in a completely random survey, in order to state that the variance of WTPs will fall after information is given, we require the eminently reasonable, but unfortunately unverifiable assumption, that the WTP of those most ignorant in the sample is more sensitive to information than the informed. Thus no predictions are made about changes in measures of dispersion.

So, in summary the provision of information should affect an individual's WTP. Positive information for all individuals should raise the mean WTP figures while negative information about other sites should also increase the bids. Meanwhile, if the credibility of the whole process is enhanced by the provision of information, then the number of protest) bids should fall. However there is no clear cut prediction of the effects of information on measures of dispersion.

4. Empirical Tests of Information impacts

Tests on the impact of information in accordance with the maintained hypotheses set out above were implemented in a case study of preservation values for an increasingly scarce habitat type in Southern and Eastern England, namely lowland heathland. Lowland heathlands are located on poor soils, and are the result of past agricultural activity, being produced by a system of very low intensity livestock grazing on acidic, sandy soils. Heaths support an important, though limited, range of flora and fauna, being especially important for reptiles (such as the Smooth Snake), flora such as the Cross-Leaved Heath (*erica tetralix*), and birds such as the Dartford Warbler (*sylvia undata*). Britain's existing 57,222 hectares amount for up to 40% of the total European area of lowland heaths (Farrell, 1989), but represents a much reduced resource in size: since 1888, 72% of U.K. lowland heath has disappeared due to agricultural improvements, afforestation, and (most recently) housing developments (Hanley, Munro and Jamieson, 1991). The Southern English countries of Dorset, Surrey and Hampshire contain a large proportion of lowland heathland in the U.K.: our case study area is located in Dorset.

A CV survey was carried out at Avon Forest Park in order to ascertain peoples' perceptions of the value of lowland heathland. Avon Forest Park is owned by Dorset County Council and managed for its nature conservation, informal recreation and educational value. The park's ecological value is recognized by the fact that it forms about half of the 553.3 hectare Hurn Common Site of

Special Scientific Interest (SSSI), an SSSI which itself is made up of seven, mainly heathland fragments. It is situated between the New Forest heathlands and the remainder of the Dorset heaths, this location making it, in ecological terms, a strategically important site. A large proportion of the park is dry heath and, consequently, species dependent upon dry heath are well represented, notable examples being Dwarf gorse (*Ulex Minor*) and Heath Spotted Orchid (*Dactylorhiza maculata*). As its name suggests, there is also a high proportion of woodland separating the heathland elements, the major species being Scots Pine (*Pinus sylvestris*), Maritime Pine (*Pinus pinaster*) and Birch (*Betula pubescens*).

All six native reptiles can be found in Avon Forest Park. There are very strong populations of the rare Sand Lizard (*Lacerta agilis*) and the Smooth Snake (*Coronella austriaca*) is well represented. Several notable heathland birds nest on the site. These include the Dartford Warbler (*Sylvia undata*), Hobby (*Falco subbuteo*) and the decreasing Nightjar (*Caprimulgus europaeus*).

All respondents were presented on-site with three CV questions. The first two (WTP_a and WTP_b respectively) seek to estimate an option price for visitors to Avon Forest Park, using two different bid vehicles: an entry fee, and an annual permit. Respondents were also asked (WTP_c) about their WTP into a specially-created trust fund to preserve heathland in general (i.e. not just Avon Forest). The questionnaire is given in Appendix A.

A sample of 237 replies was obtained by interviewing visitors to Avon Forest during September 1990. A single interviewer was used, and both week-day and week-end visitors were sampled. Questionning was spread evenly over the four major access points to the site, and respondents wree interviewed when they returned from walks, or suring picnics. Respondents had therefore 'used' the heath before being questionned . Seventy-one percent of those visiting were there as the "main purpose" of their day out, while "looking at scenery" was the most reason for the trip, followed by "walking" and "watching wildlife".

The survey used four different information sets, L, M, P and Q. These are defined as follows:

L = basic information only regarding hypothetical market (means and reasons for payments);

M = L plus information on the rate and extent of depletion of Dorset heathlands in general (relative scarcity) including charts showing its decline over the last two centuries;

P = L plus information on what rare flora and fauna could be found at Avon Forest Park (characteristics information). Colour flashcards showing Dartford Warbler, Silver Studded Blue butterfly, Dwarf Gorse Heather and Dorset Heath and Sand Lizard were used;

Q = L plus M plus P sets of information.

WTP bids were then available over the 3 payment scenarios and 4 information sets. Taking the sample as a whole, we obtained the data in Table 1. All mean, median, and spread figures are

calculated excluding protest bids, which were identified as zero bids tendered for reasons other than a zero value being placed on the site. No outliers were either identified or excluded in any of the three payment scenarios.

table 1

Willingness to Pay for Heathland Conservation

Payment scenario	*N*	*p*	*Mean* (£)	*Median* (£)	*Stnd.Dev.* (£)	*Range* (£)
WTP_a	177	58	0.74	0.50	0.56	0-3.50
WTP_b	203	32	9.73	7.50	10.47	0-60.00
WTP_c	211	24	25.57	10.00	32.43	0-200.0

Notes: p = number of protest bids

N = number of non-protest bids

Payment scenarios: WTPa=entrance fee; WTPb=annual permit;
WTPc=bid for general heathland preservation.

table 2

Impact of information on mean WTP bids (£) by scenario

Payment Scenario	*Information Set*			
	L (basic)	*M* (relative scarcity)	*P* (characteristics)	*Q* (both)
WTP_a	0.59	0.81	0.76	0.79
WTP_b	6.77	11.49	10.39	10.32
WTP_c	21.54	20.64	21.52	38.49

Whilst for the site-specific questions Avon Forest (WTP_a and WTP_b), additional information on flora and fauna raises bids, the

biggest impact is additional information on the scarcity of heaths per se. Moving from data set L to dataset Q increases bids by 34% in the WTP_a scenario, by 52% in the WTP_b scenario and by 79% in the WTP_c scenario. The standard deviation of WTP_a responses rises as additional information is supplied; thus is also true for WTP_b. Since the theoretical arguments of section 4 suggested increases in WTP for those receiving information in both the site specific and general cases, we tested for statistically significant differences between pairs of mean values using one-sided t-tests. The null hypothesis of no significant difference was tested across nine pairs of mean values. The results of the tests are given in table 3: null hypotheses mentioned in the preceding section are indicated in the final column.

table 3

Significance Tests for mean WTP responses

Payment Scenario	*Difference tested*	*|t-value|*	*hypothesis*
WTP_a	Set L vs set M	1.83 *	H_0^3
"	Set L vs set P	1.43	H_0^1
"	Set L vs set Q	1.74 *	n/a
WTP_b	Set L vs set M	2.82 *	H_0^3
"	Set L vs set P	1.87 *	H_0^1
"	Set L vs set Q	1.88 *	n/a
WTP_c	Set L vs set M	0.18	H_0^4
"	Set L vs set P	0.01	H_0^2
"	Set L vs set Q	2.24 *	n/a

Notes: *=significant at 95% level (critical value=1.64)

Mixed conclusions may be drawn from the statistical significance tests reported above:

(1) For WTP to preserve the option to visit the site (WTP(S) in the notation of section 4), increasing the level of both characteristic and relative scarcity information significantly increases mean bids, in 3 out of 4 cases. The null hypotheses H^1 and H^3 are rejected at the 95% level. Combining these additional pices of information (that is, moving from set L to set Q) significantly increases WTP for both the entry fee (WTP_a) and annual permit (WTP_b).

(2) Information effects on bids to preserve heathland in general (WTP_c) are less strong: only when the effects of the relative scarcity and characteristics information are combined does WTP rise significantly. The null hypotheses H^2 and H^4 cannot be rejected at the 95% level.

We also tested for the difference in means between information set M and set Q; and between information set P and set Q. For WTP_a and WTP_b, moving from set M or P to set Q has no significant effect on mean bid (t statistics were -0.2 and 0.275 respectively). In other words, adding to the information set once respondents had received relative scarcity *or* characteristics information had no significant effect on WTP: this could be interpreted as evidence of what Bergstrom, Stoll and Randall refer to as "weak information overload": that information effects are positive, but diminish at the margin.[15]

Although for both WTPa and WTPb, the marginal impact is

With regard to the impact of information on the percentage of protest bids (in the heathland case only), we recall Boyle's finding that the level of information significantly influenced the number of protest bids and our arguments that no such effect need occur. Our own results are given in full in tables in Appendix B, with the main conclusions as follows. In all cases, the percentage of protest bids rises in moving from set L to set M and rises in two out of three cases when moving from L to P. However, it falls in the majority of cases in moving from L to Q (full information). We were unable to reject the hypothesis H_0^5 of no significant difference in the proportions of protest bids at the 95% level, and quite clearly there is never a statistically significant change as a result of providing extra relative scarcity information in this case. This conclusion is unsurprising when one considers the reported reasons for tendering protest bids. Out of 58 protests for WTP_a, most common motives were "unable to afford any payment" and that the area was regarded as common ground which should be free for all to access (ie lack of credibility of the hypothetical market). For WTP_b, 32 protests were tendered in total. Most common motives were that the area was regarded as common land(ie as above), that respondents would prefer to pay a per-visit fee, and that existing taxes should be used to pay for protection. Again, credibility of the hypothetical market was not an issue. Finally, for WTP_c, the three main reasonsfor protest bidding (from a total of 24 protests) were that (i) heathlands should be protected by

(insignificantly) negative in this case.

law, (ii) a different payment mechanism was preferred, and (iii) that the hypothetical market would not be operational. Given these responses, it would be surprising if we could not reject the null hypothesis in this case study.

Interestingly, however, a two-way anova analysis of protest proportions against information set and payment scenario (ie WTP_a, WTP_b, or WTP_c) could not reject the null hypothesis of no significant effect across payment scenario: the percentage of protests rose significantly when a daily permit (WTP_a) was used rather than an annual permit.

5. Conclusions

As a whole, our results from the heathland experiment support the theoretical arguments of section 4 that giving information can affect the value of bids received. A relevant question is by *how much* individuals' information sets can be increased before significant changes in WTP. Very small changes in information about characteristics or relative scarcity may have very little effects on WTP. This might be due to the kind of threshold effects noted in studies of advertising (e.g. Lambkin (1976)). Below a certain number of adverts consumer behaviour is unresponsive to the information received, but once a critical mass is reached individuals respond.

The threshold effect hypothesis is supported by results of two other CV studies carried out at Stirling. In the first (reported in Hanley and Spash, 1992), bids for the protection of an ancient semi-natural woodland were collected. Respondents were

split into two groups: one was given the additional information that the wood was "..an ancient woodland of national importance", the other was not. There was no significant effect on mean WTP. In the second, visitors to public forests were asked to state their maximum WTP to secure continued access to the wood where they were questioned, by means of a charge per visit. One half were told that such a charge was necessary due to increased management costs. The other half were not provided with this reason for payment (very few UK public forests impose entrance charges), but were told that the Forestry Commission might decide such a charge was appropriate. Again, no significant effect was discovered. Whilst these two studies are quite clearly different, they both support the suggestion that small changes in wording in CV studies have insignificant effects.

Yet clearly this does not mean that *any* information can be given to CV respondents. Information must be "true and accurate" (we would argue that all four sets L-Q correspond to this description); whilst the policy implications in this case of how much information was provided are clearly not insignificant. Using the highest value obtained almost doubles the conservation value of heathland.

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Appendix A. Part of Questionnaire for Avon Park.

(Note: scenario=WTPa)

(i) Avon forest Park is currently owned and managed by Dorset County Council.

Managing the site costs money: money to pay for wardening services, information displays, and monitoring the heathland. Suppose that the Council, due to financial pressures, was faced with the decision of either introducing an entrance charge to the area, or else selling the site to developers. In such a hypothetical situation, visitors such as yourself could only retain the opportunity to visit the site by agreeing to pay such a charge. Clearly, the higher the charge that could be collected, the more likely it would be that the heathland would enjoy permanent protection.

What is the most you would be willing to pay as an entrance fee to save this heathland from development?

£0	50p	£1	£1.50	£2	£2.50	£3
£3.50	£4	£4.50	£5	£5.50	£6	

(please circle one value)

If the most you would be willing to pay is not shown here, please write the amount here _____

If you would not be willing to pay anything as an entrance fee, please write your reason here

_____

Appendix B

Protest bids under different information sets

Payment Scenario	*Information Set*	*No. of protests*	*% of sample*	*Reject H_o^5?*
WTP_a	L	15	26.3	N/A
"	M	17	28.3	no
"	P	18	18	no
"	Q	8	13.5	no
WTP_b	L	7	12.3	N/A
"	M	13	21.6	no
"	P	8	13.5	no
"	Q	4	6.7	no
WTP_c	L	5	8.7	N/A
"	M	10	16.6	no
"	P	3	5.1	no
"	Q	6	10.2	no