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# Informing and forming preferences in environmental valuation: Coral reef biodiversity

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## Abstract

The level and depth of information provision required for making informed judgements over environmental options has remained troublesome in various contexts from individual choice through to international policy. In the valuation literature concern has been expressed for ‘information bias’ leading to distorted estimates of the worth of environmental entities (e.g. wildlife, ecosystems) because peoples intentions are formed during the valuation process by the information provided. Contending psychological models on the role of information and its relationship to ethical concerns are reviewed with respect to public decision processes over environmental entities. The robustness of pre-existing environmental preferences is then linked to ethical positions but their role is unclear. Empirical evidence is reported from a contingent valuation method study of coral reef biodiversity on the strong connections between informing and forming preferences and specific ethical beliefs regarding environmental entities.

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## 1. Introduction

In trying to address the social welfare impacts of environmental change economists have confronted many problems, but a major challenge has been how to

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address information provision. In general the public may be ill-informed about a complex environmental problem and/or scientific knowledge may be incomplete. This means economic assessments must judge how to inform about and bound environmental issues for valuation. Such issues take a specific form when considering the role of information for conducting cost–benefit analysis (CBA) and this has been particularly evident when using the contingent valuation method (CVM) to assess welfare impacts of environmental change. The CVM is unusual in economics because it collects primary data and requires direct contact with the general public. Due to the sensitivity of responses to the information supplied, the pre-testing of the survey, and more recently focus groups, have become of increasing importance.

The problem of information provision on environmental problems can be viewed as impacting individuals through controlled design, with either intended or unintended consequences, or via external factors which are influences of uncontrolled information. For example, a survey on the compensation required for accepting a nuclear power plant in your neighbourhood can control the presentation of information on the risks associated with such developments but uncontrolled media events and surprise occurrences can also intervene e.g., a Greenpeace campaign or a Chernobyl incident. In environmental valuation information has largely been discussed in terms of whether providing more information on an issue is likely to increase willingness to pay (WTP). Cummings, Brookshire, and Schulze (1986, pp. 53–54) explain the impact of supplying more of what they call ‘endogenous information’ (i.e., information controlled by the researcher). They posit the following hypothesis.

$$H_0 : V(t_0, I_1) = V(t_0, I_2),$$

where  $V(t_0)$  is the expressed value at time 0 for a CVM commodity  $X$  during the typical short interview; and  $I$  is the information set where  $I_1 < I_2$ . The assumption is that objective information relevant to the valuation of an entity can be provided by the interviewer in different quantities.

The National Oceanic and Atmospheric Administration (NOAA) panel on resource damage assessment recommended CVM aim for a level of information provision “...at least as high as that which the average voter brings to a real referendum on the provision of a specific public good...”, and make use of ‘follow-up questions’ on understanding (Arrow, Solow, Portney, Leamer, & Schuman, 1993, p. 4607). Their guidelines recommend that: “Adequate information must be provided to respondents about the environmental program that is offered. It must be defined in a way that is relevant to damage assessment” (Arrow et al., 1993, p. 4608). However, the meaning of being adequately informed with relevant information is vague and the methods by which individuals assimilate and process information unexplained. Those economists trying to understand human valuation of environmental entities need to know how individuals form their preferences, the key factors which change preferences and their stability. The answers will determine how much reliability can be placed upon public valuations arising from processes such as CVM surveys.

In this paper arguments from cognitive and social psychology are presented as giving potential insight into the information and preference formation issue. Section 1.1 describes briefly how information has been addressed in the CVM literature. Next two broad models, from psychology, are outlined to explain how information may motivate individual behaviour. This leads to a selection of initial hypotheses concerning the impact of even a short (e.g. 30 or less minute) survey instrument on intended behaviour within the context of complex environmental problems. The role of ‘moral satisfaction’ or ethical beliefs has been a neglected aspect of this behavioural intent which is brought to the fore by empirical evidence from a case study on the value of biodiversity in the coral reefs of the West Indies.

### *1.1. Information provision and CVM*

The aim in CVM is for ‘... a “true” or accurate measure of value’ which means that, at least during the interview, ‘values offered by subjects reflect thoughtful consideration of implied trade-offs...’ to obtain ‘... a meaningfully complete preference research process...’ (Cummings et al., 1986, pp. 54–55). The true value is meant to be achieved through a process of convergence; that is, the term  $V$  should converge to some number. Indeed different forms of introducing and encouraging respondents to think about information have then been attempted to reach the ‘true’ value. For example, information on other public goods may be followed by a chance for changing the bid, or an induced introspection technique might be used such as a bidding game where an initial bid is followed by a request for an increase. The basis for such approaches is that values in economics are meant to be directly related to underlying preferences. Divergence from the underlying preferences and resulting true value is meant to result in a loss of utility (Freeman, 1979, p. 916). The difficulty of matching theory and practice lies in the need to inform those preferences about the trade-off being requested.

Ideally a CVM entity for valuation is meant to be described in ways designed to bring individual perceptions of environmental change into line with those which would actually occur e.g., using photographs, text, illustrations, video clips, interviewer elaboration. Problems in achieving this ideal led the NOAA panel to recommend under-estimating the benefits of removing environmental damages due to an oil spill (or other human induced natural resource disaster). They term this approach ‘conservative’ valuation, which they linked strongly with information provision. The report states:

A ‘conservative’ CV study, i.e., one that avoids overestimating true willingness to pay, will no doubt exceed the minimum standard of information and will also lean over backwards to avoid providing information in a way that might bias the response upwards. In particular, a conservative study will provide the respondent with some perspective concerning the overall frequency and magnitude of oil spills, the amount of money currently being spent on preventing and remedying them, the overall scale of their consequences, the peculiar features of the spill in question, and similar relevant information. (Arrow et al., 1993, p. 4607).

The work of Baron and Maxwell (1996) on the interaction of cost information with stated benefits provides one example of the difficulties with such recommendations. They found judgements of WTP for goods were affected by even unrelated cost information. Cost information affected WTP when it took the form of estimated cost or when it was simply implied by past expenditures or by descriptions of how a good would be provided. They suggest that CVM be improved by eliminating information from which costs could be inferred (e.g. the cost of similar public good provision), so that respondents can focus more easily on benefits alone.

Acceptance that any presentation of information must be moulded and environmental issues explained within a given frame means the information issue is often conceptualised in terms of a 'framing' problem (e.g., Boyle, 1989). A separation is then attempted between the substance of information (objective data) and the way in which information is supplied or questions asked (framing). Changes in the former are expected to impact perceptions and valuations while if the latter do so this is regarded as a bias. Objective data is meant to describe the 'commodity' to be valued while the framing is merely the method of obtaining intended behaviour (i.e., a WTP or WTA measure).

Only if an actual environmental change can be defined 'objectively' can the aim of bringing all individuals to a common understanding of that change have a certain logic. This may be questionable even for a common market commodity such as a house. Certainly the perception that a house has more rooms than exist is then clearly erroneous and a set of physical attributes of the commodity might be defined to ensure that all individuals have the 'accurate' set of information. Yet, there are often disagreements between different individuals over the condition of the commodity (e.g. the property with "much potential") and definition of attributes (e.g. is a small room a single bedroom or a store room). A divergence between actual and perceived conditions then becomes harder to define and reliance falls upon subjective perception. The problem is compounded for complex environmental issues. The situation is one where "...the CVM practitioner has no practical anchor for accuracy". and "...must then rely upon individual perceptions of environmental change-related effects...", which means "...variations across individuals of CVM values *may* reflect differences in perceptions of the hypothesized commodity" (Cummings et al., 1986, pp. 57–58).

In addition, disagreement has existed over what exactly constitutes a framing problem as opposed to defining attributes of the 'commodity'. In particular unresolved issues surround whether the payment mechanism (e.g. income tax, trust fund) or institutional arrangements (government, charity) are to be included as framing issues. Leading authors in the area can be rather unclear on their position. For example, the cookbook for CVM is the work by Mitchell and Carson (1989) which dismisses all concerns over information and argues that the commodity should be defined so as to include such things as payment mechanism. A different payment mechanism then effectively defines another commodity rather than causing bias (an argument taken directly from the first major CVM text Cummings et al., 1986, pp. 209–210). However, the concept of payment vehicle bias is maintained by Mitchell and Carson, and Ajzen and Peterson cited to support the importance

of bias (1989, pp. 123–124). They go on to state that: “. . . if some respondents hold a strongly negative attitude towards the particular payment vehicle used in a CV study, or toward the notion of accepting payments for a degradation of environmental quality, the use of these elements in a scenario could bias willingness to pay for a good” (1989, pp. 181–182). The difference in treatment means such factors are either a cause of bias to be avoided or individuals should be regarded as valuing ‘different’ commodities constituted of the various attributes widely defined. The bias position implies qualification of the results as an under or over estimate of some ‘true’ value, while the commodity change position limits any generalisation of values outside the specific context described.

A practical response is to choose the least controversial vehicle which is most likely to be implemented in practice (Hanley & Spash, 1993, p. 60). Of course such choices made by one analysts mean exclusion of what may be regarded as relevant information by others. The more general basis for such selection and exclusion of information is that preferences relating to environmental entities and their provision should rely upon welfare theoretic measures such as suggested by Hicks (1940) and developed under new welfare economics. While such a theoretical model might help define ‘bias’ due to irrelevant information for benefit assessment, such as the cost of provision, much of the practical design would remain undefined. Although, Payne, Bettman, and Schkade (1999) take the position of trying to define an entire process to force individual conformity with their own perception of how preferences should be constructed to conform with an economic model of behaviour. Clearly, the role of the analyst or survey design team remains central to bounding the information set. Which issues need to be presented, in what format and detail are matters where differences of opinion will result and the outcome can be expected to impact peoples perception of the valuation question.

### *1.2. Information, values and ethics*

The importance of divergence between different individual’s perception of a commodity has, as noted, been recognised for some time (e.g., see Cummings et al., 1986, p. 57). However, this takes on more prominence when the divergence is between survey designers/economists and respondents/the public. The NOAA Panel suggested the public may be less expert and therefore give less reliable valuations, and suggested using expert panels for calibration (Arrow et al., 1993). In contrast, Burgess, Clark, and Harrison (1997) have suggested that problems in the framing of the decision problem can occur as a divergence between encoding and decoding of information. That is, the analyst forms information in one way and has an expectation as to its interpretation by respondents, while respondents interpret that same information in unexpected ways as far as the analyst is concerned. The result could be anything from misinterpretation due to the use of excessively technical language through to fundamental disagreement over the role of intended payments being offered. Indeed, Burgess, Clark, and Harrison (1995, 1998) have found evidence for the latter when they re-interviewed respondents after a CVM survey had been conducted by economists. Some respondents expressed surprise and dismay at the way in which

their intended payments were interpreted and the use they would have in the policy process. Fischhoff, Welch, and Frederick (1999, p. 155) also found respondents' support for CVM valuations declined the more they learned about the task both from being informed and trying to perform it. This raises concerns over the basis upon which any information set is compiled and the various motives which drive individual (and group) understanding of that information.

One aspect of divergence in understanding arises because environmental issues concern value conflicts. These may, for example, relate to fundamental disagreements over the role of markets and how environmental issues should be addressed. Environmentalists might then be expected to see concerns of justice and rights as central aspects while economists always look for the implicit trade-off. The former may reject the very commensurability which the latter take as given and design into their surveys. When tests have been conducted, the relevance of preferences which reject trade-offs has been evident in CVM (Spash, 1998, 2000b). Rather than accept such positions as valid they are seen as problems to be removed. Thus, Payne et al. (1999, p. 257) recommend "remedies for tradeoff avoidance".

Similarly, a range of value orientations such as altruism, ecocentrism, and socialism may be relevant in addition to the typical emphasis in economics on egoism. This means information can unintentionally or intentionally play upon related beliefs. In this regard, there has been some attempt by social psychologists to investigate the underlying basis for economic values arising from CVM (for example Guagnano, Dietz, & Stern, 1994; Kahneman, Ritov, Jacowitz, & Grant, 1993). However, the relevance of this work to a modern CVM is questionable because the trade-offs implied are poorly defined, environmental payments are for generalised good outcomes and the design of surveys bears little relationship to typical CVM studies (see Spash, 2000c). Despite this, the literature in this area has suggested new avenues of research relating to attitudes, and other underlying motives, which lie behind the intention to pay or accept payments in the face of environmental change.

One suggestion is that the motive to process information can be high leading to use of central processing mode where information is scrutinised and evaluated, or it can be low with peripheral processing being used and reliance falling upon moods and cueing. The motivation to process information is postulated to depend upon personal relevance of the issue and ability to understand information. Stimulation of the motivational basis may then influence the results of a CVM exercise. Ajzen, Brown, and Rosenthal (1996) tested for such a potential 'information bias' in a CVM survey. WTP was found to increase with the quality of arguments used to describe the good, especially under conditions of high personal relevance. Under low personal relevance, WTP for a public (but not for a private) good was higher when an altruistic, as opposed to an individualistic, orientation was activated. They concluded that the nature of the information provided in CVM surveys can profoundly affect WTP estimates, and that subtle contextual cues can seriously bias these estimates under conditions of low personal relevance.

Ajzen et al. argue in favour of a model which combines the theory of planned behaviour with a theory of persuasion. This is a development of earlier work on attitudes and beliefs and their role in predicting behaviour. A behavioural intention

(such as WTP or WTA) is regarded as dependent upon attitudes, defined in terms of beliefs about consequences, and acceptance of social norms. The latter are beliefs about the views of an individual's social reference groups towards the action (Fishbein & Ajzen, 1975). These concepts form the theory of reasoned action which is supplemented by perceived behavioural control, or the ease with which the action can be performed, to give the theory of planned behaviour (Ajzen, 1991). Three factors (attitudes, social norms and behavioural control) are then seen to be influenced by the quality of arguments and the way in which different motives are stimulated by information.

An aspect missing from this theory which seems particularly relevant to environmental change is the role of fundamental ethical beliefs which are differentiated from social norms. That is a set of beliefs may be held distinctly from the reference to one social groupings, although the two may of course interact e.g. as in religious beliefs. Fundamental ethical beliefs are however defined more globally and cover the moral basis for action including issues such as rights and justice. Moral 'satisfaction' has been raised as relevant to stated WTP bids given in response to CVM surveys (Kahneman & Knetsch, 1992).

Environmental attitudes and fundamental ethical beliefs have also been found to affect bid category (Spash, 1997, 2000b). One interpretation of such results is that altruism is stimulated by the public goods context. If this is correct then the information provided in CVM surveys on environmental entities might raise altruistic motives to action as opposed to individualistic ones (Ajzen et al., 1996). Yet because the definition of 'public goods' is itself often a strained concept this leaves unanswered exactly what is the *modus operandi*.

Ajzen et al. (1996) regard one of the matters brought to bear under peripheral processing to be moral perspectives. In their empirical work they used cues on altruism versus individualism to test for the impact on the subsequent WTP for a new cinema and a personal noise reduction system. These cues were seen as "unrelated to the contents of the description" (p. 45) and "relatively superficial motivational cues" (p. 56) with regards to the goods. They found that for the cinema, regarded as a public good, using a description which made this personally relevant encouraged careful scrutiny of arguments, while priming with an altruistic or individualistic motive had largely no effect. When personal relevance was lacking, from the information provided, individuals were less affected by argument quality and more significantly influenced by the motivational cues. However, this failed to apply to WTP for the noise reduction system, regarded as a private good.

The explanation of the role of information and ethical motives (e.g., altruism) under this model can be summarised as follows and shown in Fig. 1. The information presented about an environmental good or service is seen to operate upon the motive to process information. This motive is determined by an individual's ability to understand the issue and their perception of the personal relevance of the issue to them. If their motivation is high then they enter central processing mode and scrutinise and evaluate information with regard to the substance of the argument. This allows WTP to be increased by favourable reporting of the benefits. Alternatively, a low motivation means peripheral processing mode is entered and moods and subtle cues become

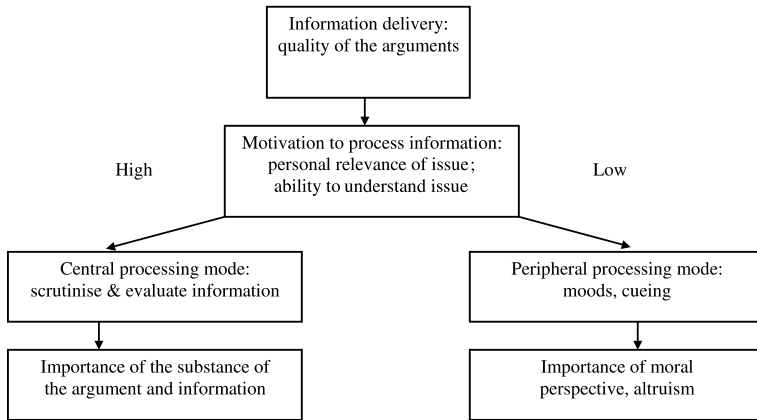


Fig. 1. Information provision and environmental valuation.

determining factors in responses. WTP for a public or communal good is then affected more by stimulating a moral perspective such as altruism.

An alternative model is to develop the theory of reasoned action in a different way. Just as behavioural control has been added to give one variation (a theory of planned behaviour) so might fundamental ethical beliefs to give an alternative theory of moral behaviour. That is, the model would now appear as in Fig. 2. Attitudes and social norms are included as in the work of Fishbein and Ajzen (1975) as feeding into reasoned action but now they are supplemented by a range of ethical beliefs. In terms of contingent valuation of an environmental change, any concerns which an individual holds as ethical beliefs such as altruism, animal rights or regard for future generations might come into play directly. That is, rather than being ‘peripheral’ to the description of environmental changes these are often key issues. Along with environmental attitudes and social norms, such ethical beliefs would feed into the reasoning over whether to make a monetary trade-off. A stated preference, which is the inten-

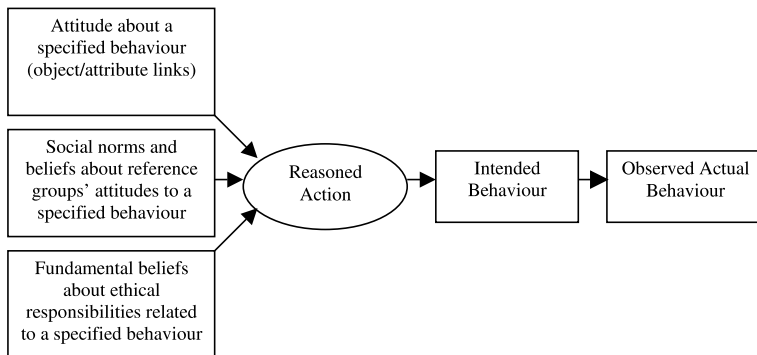


Fig. 2. Attitudes and beliefs in the prediction of behaviour.

tion to undertake an action, is then determined by attitudes, social norms and fundamental ethical beliefs. The link to actually performing that intention is the final step and would be observed as a revealed preference in economic terminology.

## 2. Case study and results

As part of a project for The World Bank on coral reef biodiversity valuation two surveys were administered, one in Jamaica and one in Curaçao. Survey design requires framing a realistic decision concerning the environment so that the monetary question to be asked is accepted as a possible state of the world in which individual respondents might find themselves. Thus, several decisions must be taken by the analyst including the reason for the payment requested, how funds will be raised, whether to use willingness to pay or accept, and the arrangements for and regularity of payments (for details on conducting a CVM see Hanley & Spash, 1993). Similar CVM surveys were designed for Jamaica and Curaçao employing the same layout and type of questions. The main difference between the surveys, besides geographical and institutional context, arose in the development of the biodiversity improvement scenarios and management options to achieve them (for more detail on all aspects of the coral survey see Spash, 2000a).

The survey was designed in sections with framing, knowledge of and use of the site, and knowledge of biodiversity concepts coming first. Knowledge of coral reef degradation and marine biodiversity were both measured on ten point scales from totally unfamiliar to totally familiar after having been shown brief information on each. This was followed by further information on coral reef quality in the area and the need for a Marine Park to improve quality, which set the context for the WTP question. Follow-up questions were asked about reasons for payment, zero bid or refusal. Next a series of questions addressing ethical stance towards the rights of various entities to protection from harm were asked. The survey ended with typical socio-economic questions on age, income, occupation and education.

The survey was pre-tested and design changes made in light of feedback; this mainly consisted of simplifying information in order to aid comprehension. Administration of the survey was by personal interview. A realistic payment question was set within the institutional setting of a local Marine Park. Respondents were asked to contribute towards a trust fund which would be managed by the Marine Park in order to increase marine biodiversity within the park boundaries. The payment was to be on a per annum basis for five years. The technique for elicitation of WTP was an open-ended question chosen as being straight forward and realistic. The environmental improvement being purchased was a rise in marine biodiversity within the areas by 25% and the no management scenario a 15% reduction in biodiversity. The proposed park for Curaçao was relatively much larger than that for Jamaica while the level of increase in biodiversity was lower from 50% to 75%. The concept of coral reef abundance was used as the best approximation to a measure of coral reef species diversity and health. Coral abundance was then described in terms of area covered. An abundance of zero ( $ABU = 0$ ) would mean that all of the coral had disappeared,

and an abundance of 100 (ABU = 100%) that the reef was in its natural pristine state. A mixture of in-house interviews and the equivalent of ‘in-street’ interviews were conducted with the aim of semi-random sampling of both locals and tourists. Samples of over 1000 were the aim to achieve statistical robustness and final samples were 1058 for Jamaica and 1152 for Curaçao.

On the basis of previous work, discussed above, one interest was with variations in information delivery and their influence on WTP by appealing to motivational factors. The factor of ability to understand the issue implies that any given set of information will have differential impacts on individuals in a non-uniform population. Rather than manipulating information to stimulate different orientations towards a requested bid, the same set of information can be expected to have alternative impacts for different individuals. Following on from this, if the formation of preferences occurs during the process of survey delivery this is likely to impact the bid differently than if preferences were already formed. The first null hypothesis is then as follows.

$H_0$ : Any given information set influences individuals in the same way.

That is all individuals either find themselves being informed, by what experts (economists or scientists) might regard as ‘objective’ facts, or they all find their preferences are being formed, in which case economists would assume information had been ‘biased’.

A simple test of this hypothesis was performed by directly asking respondents about the impact they felt due to the information supplied. “Do you feel the information given to you so far in this survey has: (i) changed your preferences about whether extra resources should be spent on marine biodiversity preservation; (ii) merely given you more information than you had before; (iii) both informed you and changed your preferences; (iv) had no effect?”. The results in Table 1 show that just over 37% of the Curaçao and 19% of the Jamaican samples felt their preferences had been changed by the information or both changed and informed. Thus, the majority of the samples could be classified as having well formed preferences in as far as the information left their preferences unaffected. However, due to the divergence in information impacts on preferences the first null hypothesis is rejected. Neither the

Table 1  
Preference change

	Jamaica		Curaçao	
	Frequency	Percent	Frequency	Percent
Preferences changed by information	40	3.8	85	7.4
Preferences changed and informed by information	165	15.6	344	29.9
Information only informed preferences	780	73.7	597	51.8
Information had no effect	73	6.9	126	10.9
Total	1058	100.0	1152	100.0

constructed preference model favoured in psychology nor the well formed preference model of economics is supported as an exclusive explanation.

This data also allows classification of sub-samples by the impact of information on preferences which provides a dummy variable (PREFINFO) for use in bid curve analysis. The aim of using such a dummy is to test the relationship between preference change and WTP. The null hypothesis formed on the basis of the literature is as follows.

$H_0$ : Information impacts on preferences as perceived by individuals have no influence upon WTP.

That is, more information may be associated with higher WTP but whether preferences are felt to be formed or informed during a contingent valuation process should be uncorrelated with WTP. Bid curve analysis shows the dummy to be positively correlated with WTP and significant (above 95% level in both case studies). This means those who felt the information provided had changed their preferences were prepared to pay more towards the biodiversity improvement project as a result. Full reporting of the bid curve analysis follows the third hypothesis.

The third hypothesis arises from the concern within the literature for the role of ethical beliefs and their relationship to the mode of information processing. Ethical motives are generally deemed irrelevant, biases to be removed or, in the cognitive model of Fig. 1, only important where the motive to process information is low. However, empirical support for such positions is limited. The null hypothesis of interest here is:

$H_0$ : Preferences as expressed by willingness to pay for environmental improvements are unrelated to ethical positions, especially where central processing mode is operative.

Thus the ethical positions of respondents should be unrelated to the bid results of a contingent valuation survey as long as people are evaluating the information and substance of the argument.

In order to test this hypothesis, the surveys focused on classifying rights based ethical positions as signifying an ethical stance compatible with the lexicographic preference hypothesis. More specifically, respondents were initially asked to use the following categories in attributing or denying rights:

- (a) An absolute right to be protected from harm applies to this case;
- (b) A right applies which depends upon the circumstances and may therefore be withdrawn under certain conditions;
- (c) No such rights to protection from harm applies to this case.

They could attribute these categories to each of five groups: (i) other humans now living, (ii) future human generations, (iii) marine animals (iv) marine plants, (v) marine ecosystems. For example, current humans might be attributed rights while marine ecosystems were given none. These general attributions of rights were then

probed further in the context of the Marine Park. The aim here was to provide case study specific context to the trade-off and see if this influenced those expressing a general rejection of trade-offs under their attribution of rights. Follow-up questions were design to introduce the potential need to make trade-offs and to confront the respondent with a reasonably extreme case. The question was also made more specific and related to the Marine Park in order to give the rights based position a context linked to the WTP questions. Next respondents were asked to reflect upon the extent to which their refusal to trade was absolute by considering a potential conflict with their own standard of living. This allowed some refinement in the definition of various positions being adopted by the respondents and their stated acceptance of a position compatible with lexicographic preferences.

Almost all the sample were prepared to attribute rights to humans. In Curaçao this declined moving from humans to marine ecosystems, while for Jamaica no decline occurred. More than just attributing rights the respondents in the majority of cases attributed an absolute right to protection from harm. Even marine animals, plants and ecosystems were seen as having these absolute rights by approximately 60% of the Curaçao sample and over 80% of the Jamaican sample. Respondents could answer that they just 'did not know' but only 0.2% in Jamaica and 2.1% in Curaçao found this necessary.

The respondents who had attributed any rights to one of the five categories were next asked whether, in the case of the relevant Marine Park, they believed the rights they had attributed meant a personal responsibility to prevent harm regardless of the cost. This was equivalent to reflecting that a duty for an individual would result from enforcing a right. The result was similar to the previous general attribution of rights question, that was approximately 79% of the Jamaican and 68% of the Curaçao sample answered affirmatively.

Next respondents were channelled into two separate questions. Those affirming that they had a personal responsibility regardless of the cost were asked whether they would accept harm to the relevant island's marine life and habitat if trying to prevent it would threaten their current living standard. The other group of respondents, who had denied rights in this case, were also asked to reconsider given a more specific scenario. In their case they were asked whether they would accept a personal duty to avoid harming the relevant island's marine life and habitat if their current standard of living would remain unaffected. The outcome of these questions was to enable the sample to be split into four categories. These groups were:

1. Those who attributed rights and accepted a strong personal responsibility to protect marine life and habitats from harm even when their standard of living was threatened.
2. Those who attributed rights and accepted a personal responsibility to protect marine life and habitats from harm only if their own current standard of living was unaffected.
3. Those who withdrew rights and any personal responsibility to avoid harm to marine life and habitats when the cost of doing so was in terms of their current standard of living.

4. Those who rejected rights and any personal responsibility to protect marine life and habitats from harm regardless of whether their own current standard of living was unaffected.

In addition, there were those who rejected rights in general, rather than in this particular case who formed a minority fifth category.

The two middle categories, 2 and 3 above show a willingness to make trade-offs which might be consistent with a modified lexicographic position, that is once a basic standard of living is obtained a stronger ethical position for other species is adopted (Spash, 1998). A readiness to consider the trade-off circumstances and the subjectivity of the relevant standard of living mean that individuals in these categories may be regarded as acting as consequentialist over certain ranges and weighing-up the trade-offs. The results for Jamaica showed a dramatic reduction in those attributing absolute or strong rights from 79% down to 14%. Similarly, although slightly less dramatically, for Curaçao the reduction was from 68% to 28%. Despite this large reduction there was still a sizeable hard core of individuals taking a position consistent with strong duties and lexicographic preferences.

A set of variables measuring different aspects of the ethical stance being taken by the respondent were included in bid curve analysis. First was the attitude of the individual towards rights. A seven point scale was developed covering the attribution of a right to be protected from harm to marine animals, plants and ecosystems (RIGHTSEA). The idea was to create a scale on the basis of the consistent attribution of rights. Respondents who answered “don’t know” to any the three groups were treated as missing data and so no position on the scale was given to these respondents. Those attributing absolute rights to all three aspects of the marine environment were ranked highest, and those denying rights in all three cases ranked lowest, with a graduating scale between these two extremes. The rights scale for the marine environment was positively related to WTP. This means these individuals held a position inconsistent with economic assumptions about their motives for paying and also that focusing on protest refusals to pay anything fails to identify all those rejecting trade-offs. Observing that people give a positive payment says nothing of their motive or their own understanding of that payment but economists have assumed all positive bids are consistent with their own model of behaviour.

The role of ethical positions was confirmed by the significance of the dummy variables on the personal duty to protect the life and habitats of the Marine Park. The dummy variables represent those respondents taking the strong duty perspective (STRDUTY) and those rejecting any duty (NODUTY). A strong personal duty regardless of the cost was positively correlated with WTP, while the rejection of this duty reduced WTP. Thus WTP for biodiversity improvement was partially related to the ethical concern people showed for marine animals, plants and ecosystems.

Interviewers were asked to collect data on the difficulty the respondent had in answering each section of the survey. A variable on the difficulty found with Section C, where the ethical questions were asked, was significant and positively correlated with WTP. Individuals who cared less about marine biodiversity seemed to find little problem in stating their lack of belief in rights, i.e. supporting no duty. In contrast

those concerned about biodiversity improvement struggled more with their precise ethical position and the extent to which duties were for them weak (tradable) or strong (lexical).

Thus, the overall results for Curaçao, shown in Tables 2 and 3, give a model of WTP being dependent upon standard socio-economic variables plus rights and duty based variables. The RIGHTSEA variable was a recognition at an aggregate level of rights in the marine environment. The STRDUTY and NODUTY variables were specific to the Marine Park itself and the extent to which individuals were prepared to prevent harm at the risk of a loss in terms of their own living standards. In addition, the dummy variable included to account for whether individuals felt their pref-

Table 2  
Variable definitions and basic statistics for Curaçao

Variable	Mean	Min	Max	Valid <i>N</i>	Label
LNWTP	1.9	0.0	7.6	1151	Natural log of WTP plus 1
TL	0.4	0.0	1.0	1152	Tourist or Local
BENUM	1.4	0.0	5.0	1151	Number of benefits by categories
KNOWMBD	4.7	1.0	10.0	1152	Knowledge of marine biodiversity
PREFINFO	0.4	0.0	1.0	1152	Preference change
RIGHTSEA	4.9	0.0	6.0	988	Index showing strength of belief in rights for marine animal/plant/ecosystems
NODUTY	0.2	0.0	1.0	1128	No duty to protect the marine park life
STRDUTY	0.3	0.0	1.0	1128	Strong duty to protect marine park life
PROBC	2.4	1.0	10.0	1149	Ease/difficulty with section C ethical questions
SEX	0.5	0.0	1.0	1152	Gender
AGE	4.2	1.0	10.0	1151	Age by category
EDUC	2.9	1.0	5.0	1139	Level of educational attainment

Table 3  
TOBIT analysis of model for Curaçao

Variable	Normalised coefficient	Standard error	<i>T</i> -ratio	Regression coefficient
SEX	-0.17	0.07	2.35	-0.52
AGE	+0.05	0.02	3.03	+0.17
EDUC	+0.18	0.04	4.63	+0.56
KNOWMBD	+0.05	0.01	3.81	+0.15
BENUM	+0.19	0.04	4.69	+0.56
PREFINFO	+0.60	0.07	8.10	+1.82
RIGHTSEA	+0.16	0.02	6.31	+0.47
NODUTY	-0.32	0.11	2.79	-0.96
STRDUTY	+0.17	0.08	2.07	+0.50
PROBC	+0.04	0.02	2.11	+0.12
Constant	-2.04	0.21	9.66	-6.16
LNWTP	+0.33	0.01		

All variables significant at 97.5% level.

erences about marine biodiversity preservation had been changed by the survey PREFINFO was found to be highly significant and positive.

In Jamaica the set of variables on ethical stance were less relevant; see results in Tables 4 and 5. However the role of ethical positions was confirmed by the significance of the dummy variable rejecting any duty (NODUTY). This was also negatively correlated to WTP as was the case for Curaçao. The dummy variable PREFINFO was found to be highly significant and positive as in Curaçao. What was different here was the strong positive relationship of a second dummy representing the case of individuals whose preferences had remained unchanged but who felt they had been informed.

Table 4  
Variable definitions and basic statistics for Jamaica

Variable	Mean	Min	Max	Valid <i>N</i>	Label
LNWTP	1.54	0.00	7.96	1058	Natural log of WTP plus 1
TL	0.47	0.00	1.00	1058	Tourist (1) or Local (0)
INCOME	3.47	1.00	10.00	839	Level of gross income (coded)
KNOWCD	4.67	1.00	10.00	1058	Knowledge of coral degradation
VISITC	0.47	0.00	1.00	1058	Ever visited Marine Park
VISITF	0.88	0.00	7.00	1056	Visit site in future
PREFINFO	0.19	0.00	1.00	1058	Preference change
INFO	0.74	0.00	1.00	1058	Informed only
ENVIROAT	1.47	0.00	4.00	1058	Number of environmental concerns
NODUTY	0.11	0.00	1.00	1056	No duty to protect marine life/ habitats
PROBC	1.83	1.00	10.00	1058	Difficulty with section C

Table 5  
TOBIT analysis of model for Jamaica

Variable	Normalised coefficient	Standard error	<i>T</i> -ratio	Regression coefficient
TL	-0.20	0.08	2.35	-0.45
INCOME	+0.06	0.02	4.03	+0.14
KNOWCD	+0.04	0.01	3.20	+0.09
VISITC	-0.23	0.08	3.00	-0.52
VISITF	+0.47	0.13	3.76	+1.07
PREFINFO	+0.36	0.19	1.93	+0.83
INFO	+0.49	0.17	2.81	+1.12
ENVIROAT	+0.05	0.02	2.20	+0.12
NODUTY	-0.49	0.13	3.67	-1.11
PROBC	+0.09	0.03	2.99	+0.20
Constant	-0.82	0.23	3.54	-1.86
LNWTP	+0.44	0.02		

All variables significant at 95% level.

Table 6  
Ranks marine (animal/plant/ecosystem) rights (0–6)

	Curaçao				Jamaica			
	N	Mean	Mean rank	Rank	N	Mean	Mean rank	Rank
Changed preferences only	67	4.4	434.09	3	39	5.5	489.47	2
More informed only	538	4.9	509.29	2	762	5.6	532.81	1
Informed and preference change	283	5.0	512.06	1	159	5.1	462.78	3
No effect	100	4.2	405.73	4	68	5.0	444.56	4
Total	988				1028			

Kruskal Wallis Test, grouping variable: preferences and information effects; chi-square Curaçao 19.192 Jamaica 24.505, df 3, asymp. sig. 0.000 for both cases.

The Kruskal Wallis test shows a highly significant relationships between the type of information impact people feel and their position on the marine rights scale (where consistent attribution of rights to prevent harm to marine animals, plants and ecosystems scores highest and total rejection of such rights lowest). The results are given in Table 6 for both countries. There is a consistent ranking of the strength of rights in association with three categories in the following order: being only informed, having preferences changed, and there being no effect. This might be ex-

Table 7  
Curaçao ranks

Preference and information effects	Marine rights		Mean rank				N	
	N	Rank	Visit future	Know CD	Know MB	WTP		
<i>Panel A</i>								
Changes preferences	67	3	601.06	543.96	633.16	607.49	85	
More informed	538	2	567.45	583.17	555.79	541.78	597	
Preference change and informed	283	1	609.99	535.89	574.43	675.79	344	
No effect	100	4	511.36	677.70	642.08	449.00	126	
Total	988						1152	
Chi-square			28.101	18.107	9.853	75.176		
df			3	3	3	3		
Asymp. sig.			0.000	0.000	0.020	0.000		
			Rank					
			Ethics	Visit F	Know CD	Know MB	WTP	
<i>Panel B</i>								
Changes preferences	3	2	3	2	2			
More informed	2	3	2	4	3			
Preference change & informed	1	1	4	3	1			
No effect	4	4	1	1	4			

plained by stronger rights holders taking information on board but having fundamental ethical beliefs which prevent their preferences from changing. At the opposite extreme those least concerned with rights or marine entities may pay little attention to the information presented or the issue at hand. The confusing factor for this explanation is the ranking of those being simultaneously informed and having their preferences changed in the Curaçao sample where they out rank other categories on the rights scale. This might be explained by the change in preference being specifically related to the payment rather than the rights position. In the absence of further qualitative data the reasons for these results can only be speculative. However, the strength of the association between the information impacts individuals feel and their ethical stance in terms of rights remains and some further light can be shed on the associated reasons behind the results.

Curaçao data is further analysed in Table 7(Panel A) which shows rankings of knowledge, future visitation over the next 5 years and WTP variables, as well as marine rights, categorised by information effects. The ranks are summarised in Table 7(Panel B). These results show those with no impact from the information had the highest ranking in terms of knowledge of both coral degradation and marine biodiversity. They were the least ethically concerned in terms of marine rights and were also least likely to visit the Marine Park in the future and least likely to have a

Table 8  
Chi-square WTP and information effects for Curaçao

	WTP category		N (%)
	Zero	Positive	
<i>Changed preferences</i>			
Actual	38.0	47.0	85
Expected	42.6	42.4	(7.4)
Adj. standard residual	-1.0	1.0	
<i>More information</i>			
Actual	335.0	262.0	597
Expected	299.0	298.0	(51.8)
Adj. standard residual	4.2	-4.2	
<i>Informed and preferences changed</i>			
Actual	113.0	231.0	344
Expected	172.3	171.7	(29.9)
Adj. standard residual	-7.6	7.6	
<i>No impact</i>			
Actual	91.0	35.0	126
Expected	63.1	62.9	(10.9)
Adj. standard residual	5.3	-5.3	
Total N	577	575	1152
(%)	(50.1)	(49.9)	(100.0)

Pearson chi-square 75.242, likelihood ratio 76.991, asymp. sig. (2-sided) 0.000, 3 degrees of freedom; 0 cells (0.0%) have expected count less than 5. The minimum expected count is 42.43.

positive WTP. This is consistent with the above explanation of the no impact group being least concerned with rights and the information supplied. Those who were ‘more informed only’ had, before the survey, the lowest ranking in terms of marine biodiversity knowledge. Note 33% (330 people) of the total Curaçao sample scored a strong marine rights position while being in the more informed category. So this group represents a strong ethical position and feels preferences have not changed. Those whose preferences changed and were informed had the lowest rank in terms of coral degradation knowledge prior to the survey information and 17% of the total sample in the strong rights position. Thus being less aware of the coral degradation problem leads to a preference change in respect to WTP. This is supported by the chi-square results in Table 8 which show the two groups whose preferences changed both had a higher than expected count under positive WTP.

The same data analysis was conducted for Jamaica and is reported in Tables 9 and 10. The rank differences are again highly significant except for future visits. The results for those having no impact from the information are identical to those for Curaçao. They are the best informed, least concerned about marine rights and less willing to pay for biodiversity improvement. Those who were ‘more informed only’ had, before the survey, the lowest ranking in terms of coral degradation knowledge and

Table 9  
Jamaica ranks

Preference and information effects	Marine rights		Visit Future	Know CD	Know MB	WTP	N <sup>a</sup>
	N	Rank	Mean rank	Mean rank	Mean rank	Mean rank	
<i>Panel A</i>							
Changes preferences	39	2	530.56	526.89	551.13	586.25	40
More informed	762	1	532.08	515.69	519.38	538.78	780
Preference changed and informed	159	3	535.39	540.12	514.98	542.17	165
No effect	68	4	473.66	654.49	643.83	370.66	73
Total N	1028		1056	1058	1056	1058	1058
Chi-square			7.491	14.526	14.245	32.091	
df			3	3	3	3	
Asymp. sig.			0.058	0.002	0.003	0.000	
		Rank					
		Ethics	Visit F <sup>b</sup>	K CD	K MB	WTP	
<i>Panel B</i>							
Changes preferences	2	3	3	2	1		
More informed	1	2	4	3	3		
Preference change and informed	3	1	2	4	2		
No effect	4	4	1	1	4		

<sup>a</sup> Where total N = 1056 one missing data from each of ‘more information’ and ‘preference changed and informed’.

<sup>b</sup> Rank difference not significant at 95% level.

Table 10  
Chi-square WTP and information effects for Jamaica

	WTP category		N (%)
	Zero	Positive	
<i>Changed preferences</i>			
Actual	10.0	30.0	40
Expected	14.3	25.7	(3.8)
Adj. standard residual	-1.4	1.4	
<i>More information</i>			
Actual	265.0	515.0	780
Expected	278.7	501.3	(73.7)
Adj. standard residual	-2.0	2.0	
<i>Informed and preferences changed</i>			
Actual	55.0	110.0	165
Expected	59.0	106.0	(15.6)
Adj. standard residual	-0.7	0.7	
<i>No impact</i>			
Actual	48.0	25.0	73
Expected	26.1	46.9	(6.9)
Adj. standard residual	5.5	-5.5	
Total N	378	680	1058
(%)	(35.7)	(64.3)	(100.0)

Pearson chi-square 32.121, likelihood ratio 30.670, asymp. sig. (2-sided) 0.000, 3 degrees of freedom; 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.29.

second lowest on marine biodiversity knowledge. Note 62% (637 people) of the total Jamaican sample scored a strong marine rights position while being in the 'more informed' category. Thus, again the results are consistent with those from Curaçao. That is, this group represents a strong ethical position and maintains their preferences as expected, but gains information from the survey. Those whose preferences 'changed and were informed' had the lowest rank in terms of marine biodiversity knowledge prior to the survey information and 11% of the total sample in the strong rights position. Thus being less aware of marine biodiversity (as opposed to coral degradation in the Curaçao sample) leads to a preference change with respect to WTP. Again this is supported by chi-square results which in Table 10 show the two groups whose preferences changed both had a higher than expected positive WTP frequency. They also had a positive correlation with WTP in the Tobit analysis.

Overall, those holding consistently that marine entities have rights to protection from harm are less likely to change their preferences concerning whether extra resources should be spent on marine biodiversity preservation in light of new information. They admit often relatively low levels of knowledge and find the survey informative. At the opposite extreme those who reject absolute rights of marine ecosystems, plants or animals to protection from harm claim relatively high levels of knowledge and are least likely to be WTP for biodiversity improvement. Between

these two groups are those, some of whom hold a consistent strong rights position, who find the survey changes their preferences about biodiversity preservation and then state they are prepared to pay for this. This group includes those who maintain they gained no more information than before the survey and who held moderate rankings in terms of knowledge prior to the survey information being delivered.

### **3. Discussion and conclusions**

Environmental problems are notoriously complex with numerous connections across physical media, time and space. Thus, calls for more scientific research to provide 'better' information are continuous. Some arguments for increasing the role of the public or interest groups in decisions are formulated on the basis that expert judgement over complex environmental problems where societal stakes are high cannot be left to experts whose judgements are no more valid than those of the general public (De Marchi & Ravetz, 2001). Information is routinely gathered and summarised with the aim of informing decision processes but there is a need to bound that information in order to make it comprehensible. This inevitably raises questions over the type of information required and how it should be communicated. Information issues are therefore relevant across all dimensions of environmental policy.

The results here show that the same information influences individuals differently so that some individuals find they are being informed while others feel their preferences are being formed during an identical contingent valuation. The formation of preferences during a contingent valuation process also influences the bid. Thus the idea of a neutral or objective set of data on an environmental change seems impossible and the meaning of information bias is brought into question. While social psychologists accept a model of constructed preferences, here the findings only partially support the construction of preferences by some individuals. There do appear to be individuals whose preferences are stable in the face of new information and who have a strong moral value basis underlying their position.

Moral perspectives or fundamental ethical positions have been argued to be operative only as a type of bias under circumstances where individuals lack interest and enter peripheral processing mode. For normal commodities they can be stimulated and have been argued to be important for goods having a public characteristic and where information provision is poor. In terms of environmental valuation many of the applications for which contingent valuation is suggested involve public goods characteristics and are associated with low levels of understanding of complex interactions amongst the general public (and also often by experts). They may therefore be regarded as differentiable from privately traded commodities on the grounds of their basic nature. Ethical positions would then seem likely to influence the results of contingent valuation surveys where the environmental trade-off involves complex issues such as biodiversity.

However, rather than finding fundamental ethical beliefs to be peripheral matters which can be cued to distort valuation processes, such beliefs are found to be key

determinants of the values expressed. Assuming WTP can be taken as a surrogate for personal relevance, the model in Fig. 1 would argue that those with higher WTP are in central processing mode and ethical positions are then irrelevant. However the results here show positive correlation of rights attribution with WTP. Alternatively the extent to which information is seen as relevant and has informed the individual would seem to qualify as central processing mode. In this case those claiming they have been informed by the survey should be least related to ethical concerns but in fact the opposite is true. Fundamental ethical beliefs are strongly related to the way in which information is processed but the model as in Fig. 1 is rejected, and that of Fig. 2 seems more appropriate.

In discussing how social psychology might improve CVM studies, Harris, Driver, and McLaughlin (1989, p. 221) recognised that individual's values "... may be influenced by an elicitation process that invalidates existing perspectives on the value-judgement problem or creates new ones". They later (p. 222) state that CVM "... studies frequently focus on environmental amenities that many people believe are either priceless or beyond market-like transactions because of intergenerational, spiritual, and other factors, including perceptions that moral rights rather than exchangeable property rights should predominate for certain amenities". The results here support the role of moral rights in determining responses to WTP questions but show how people conform to the process rather than rejecting it. Thus, despite holding rights positions people do give positive WTP amounts. They can be found to have done so on the basis of the survey instrument and regard their preferences (not morals) have been changed.

This study shows information can inform the majority of people but still change individual preferences for a substantial minority. The possibility of designing an information set with uniform impacts on a given population seems remote. For those who feel their preferences have changed there is a significant positive relationship to WTP. Thus generally 'neutral' factual information supplied during the interview can lead to an increased WTP for a substantial minority. Ethical variables were found to be significant and this shows that moral duties do have a key role in the amount someone states in a CVM survey. The combined effect of these results suggests that people who enter central processing mode also rely upon their fundamental ethical beliefs as well as the scientific substance of information provided. Moral considerations are a key part of valuing environmental entities and cannot be regarded as only relevant to individuals with low motivation to process information or as a type of bias to be removed.

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