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Abstract

This paper investigates the sensitivity of choice experiment values for ecosystem services to “attribute non-attendance”. We consider three cases of attendance, namely that people may always, sometimes or never pay attention to a given attribute in making their choices. This allows a series of models to be estimated which address the following questions: To what extent do respondents attend to attributes in choice experiments? What is the impact of alternative strategies for dealing with attribute non-attendance? Can respondents self-report non-attendance? Do respondents partially attend to attributes, and what are the implications of this for willingness to pay estimates? Our results show that allowing for the instance of “sometimes attending” to attributes in making choices offers advantages over methods employed thus far in the literature.

Keywords: Choice experiments, attribute non-attendance, Biodiversity, ecosystem services, stated preference.

JEL Codes:Q50; Q51; Q57

1. Introduction

For good reason, much academic and policy focus has recently fallen on the question of how to place economic values on changes in ecosystem services. Developing from the Millennium Ecosystem Assessment (MEA, 2005), substantial exercises such as the TEEB project and the UK National Ecosystem Assessment have tried to assess the economic values of changes in a range of ecosystem service flows due to increasing pressures on ecosystem functioning and habitat loss (TEEB, 2010; UK NEA, 2011). This activity represents an acceleration and re-focussing of a much longer-term concern in environmental economics since the mid 1970s to develop and refine methods for valuing changes in non-market environmental goods (Barbier, 2011).

Amongst the valuation methods developed by economists, stated preference approaches have proved to be the most adaptable and widely-applicable, although their use still excites controversy (Hanley and Barbier, 2009). Within the field of stated preferences, choice experiments have developed into a widely-employed approach since their first use in environmental economics in the mid-1990s (Adamowicz et al, 1997; Carson and Louviere, 2011). The attraction of choice experiments lies in the ability of the researcher to estimate values for changes in a number of attributes (for example, a number of ecosystem services supplied by a biome), as well as compensating or equivalent surplus measures of multiple changes in attribute levels. The Choice Experiment (CE) method is based on a fundamental assumption that people are willing to make trade-offs between different levels of the included attributes in order to maximise utility. However, since the work of Hensher et al (2005), evidence is emerging that a sub-set of respondents in CE are not willing to make trade-offs between certain attributes; and that not all attributes are considered by respondents in making their choices. This raises a concern that choices violate the continuity axiom which underlies the conventional framework for analysing individual choice and for deriving welfare measures.

In this paper, we use a CE focussed on a range of ecosystem services associated with UK habitats to test for the presence of attribute non-attendance and to examine the effects that allowing for non-attendance econometrically has for preference estimation and willingness to pay calculations. Unlike previous studies, respondents are allowed to select an option that they ‘sometimes considered’ an attribute in choosing a policy option, rather than just that they ‘always considered’ or ‘never considered’ the attribute. Data is collected in a valuation workshop setting, which we argue should reduce the likelihood of respondents not including attributes in their choice calculations as a way of reducing the difficulty of choosing (that is, as a choice heuristic). Finding evidence of attribute non-attendance in such participatory contexts poses greater challenges to the standard compensatory choice paradigm, since it is likely to reflect an unwillingness to make trade-offs, rather than mental difficulties in making trade-offs.

To preview our main results, we find that allowing people to state that they ‘sometimes’ ignore an attribute has significant effects on both estimated preferences and welfare measures, compared to either a situation where we reclassify ‘sometimes’ as ‘never’; or where we ignore attribute non-attendance completely. Unlike some of the existing literature, we do not find that price is the most ignored attribute. Ignoring prices would be especially troublesome, since this undermines the calculation of willingness to pay.

2. Attribute non-attendance in choice models

The conventional approach to choice modelling is to assume that respondents’ utility is determined by a utility function which is defined over a number of attributes of a good, one of which is its price. Most typically, a linear additively separable form is used. The random utility perspective means that the researcher is only able to observe and thus model the deterministic aspects of utility maximisation. A key assumption is that individuals are willing and able to make trade-offs between the attributes of a good within the deterministic part of their utility function over the entire range of values that each attribute can take. Thus, there is always an additional amount of X_1 that will compensate for a reduction in another, positively-valued attribute X_2 and keep the respondent on a given indifference curve. Whilst it is not necessary to assume that indifference curves between any two attributes are smooth, it is necessary that indifference curves are continuous. If this is not the case, then willingness to pay for some changes in attributes is not defined (Scarpa et al, 2009a).

Several researchers have looked for evidence to suggest that this assumption of compensatory preferences is un-tenable. Within the contingent valuation literature, one group of studies considered evidence for lexicographic preferences (eg Spash and Hanley, 1995; Rekola, 2003). Lexicographic preferences imply that certain attributes or goods are always preferred to other goods or attributes, no matter what level they are supplied at. Lexicographic preferences are often taken to be incompatible with the derivation of WTP or WTA measures of value, since, for example, such preferences would not allow a reduction in environmental quality in exchange for an increase in income. Within choice modelling, evidence for non-compensatory preferences has followed a different tack, focussing on attribute non-attendance. Studies of this type include Hensher et al (2005), Campbell et al (2008) and Carlsson et al (2010). Before reviewing the empirical findings of this work, we first consider the possible implications of different responses to non-attendance questions.

Consider a choice experiment where the researcher assumes that the deterministic portion of utility depends on three non-price attributes for a good (X_1, X_2, X_3), and a price attribute, X_4. Choice tasks are constructed which feature combinations of these four attributes at various levels. Respondents are then asked whether they gave attention to all four attributes in making their choices. Four types of response are possible, with a range of implications for how the researcher can interpret the resultant choice data.

First, some individuals may state that they always pay attention to all of the attributes in making their choices. Such individuals are behaving according to the standard model of choice in the choice experiment approach. Second, people may state that they did not pay attention to X_1, or perhaps to X_1 and X_2, in making their choices. One interpretation of this is that they do not care about the levels of these attributes over the range specified in the design, and that the researcher was wrong in assuming this in her experimental design. In this case, a marginal utility of zero should be allocated for this respondent for this attribute in coding responses. If the individual says they paid no attention to X_4 (the price), then this is particularly serious, since it mitigates against the calculation of any welfare measures. Such responses may imply that the researcher has done a bad job of constructing a credible payment scenario, or set price levels which are much too low. If many individuals do not care about X_1, then the parameter estimated for X_1 in the choice model should be statistically insignificant.

An alternative interpretation is that respondents are ignoring X_1, and perhaps X_1 and X_2, as a way of simplifying their task in choosing between alternatives (Carlsson et al, 2010). Use of this boundedly-rational heuristic complicates matters for the researcher, since it does not signal that the individual places no value on X_1. Failing to allow for this motivation for ignoring X_1 will mean that welfare measures for changes in X_1 are biased downwards. Note that the respondent may state that they ignored an attribute despite statistical evidence suggesting otherwise (we return to this point below).

A third possible response is that an individual says that they only paid attention to one attribute (X_3) in choosing. Again, this makes possible a number of interpretations. It may signal that the individual has lexicographic preferences with respect to X_3, so that all bundles are ranked solely with regard to the amount of X_3 supplied. In such cases, WTP is un-defined for this attribute (although see Rekola, 2003). Alternatively, this may suggest that the respondent uses X_3 to choose in order to simplify choices. This might be true of respondents who focus, for example, solely on the price attribute.

A final possible response is that the individual states that they sometimes pay attention to X_3. This could suggest that X_3 becomes relevant to choice only when its level is within bounds. This would suggest use of a cut-offs model to analyse choice data (Bush et al, 2009); or that the statistical modelling of choice should take such "sometimes consider" responses into account in some other way. Allowing people to state that they "sometimes" consider an attribute, as well as "always" or "never" considering it would seem appropriate if this better describes how people actually choose. This is the approach followed in the experiment reported here. Before explaining its design, however, we first review the main findings that have been reported so far in the literature on attribute non-attendance (Lanscar and Louviere, 2006).

Hensher et al (2005) was the first contribution to the CE literature on attribute non-attendance. In a study of commuters in Sydney, Australia, they show that allowing for the fact that some respondents stated that they did not pay attention to some attributes changed their estimates of the value of travel time savings. Campbell et al (2008) applied choice modelling to the valuation of landscape attributes in Ireland which were affected by implementation of an agri-environment scheme. Respondents were asked whether they paid attention to all attributes in making their choices. Those who did were labelled as having “continuous” preferences, and those who said they did not were labelled as having “discontinuous” preferences. The authors found that 64% of the sample considered all attributes and 34% did not, but around one fifth focussed on one attribute alone, and thus did not engage in any trade-offs. Price was the attribute which was least-attended to, and only 2/3rds of respondents were willing to trade off at least one attribute against price. Campbell et al found that explicitly accounting for attribute non-attendance in the choice model improved its fit, and also reduced estimated WTP, although it did not change the ranking of attributes in terms of their implicit prices. They found that adjusting for relative scale differences between continuous and discontinuous preferences was also effective.

Carlsson et al (2010) questioned respondents as to which attributes they took into account in choosing between the design of three different environmental policies in Sweden (policy on freshwater quality in lakes and streams; policies on the marine environment; and policies on air pollution). They found that around one-half of respondents claimed to ignore at least one attribute in choosing, and around one-third claimed to ignore at least 2 attributes. Price was the attribute most ignored according to these responses. One interesting feature of this work is that the authors find evidence that what people say about whether they ignore an attribute or not is not a very robust predictor of whether it statistically impacts on their choices. They interacted dummy variables for stated ignoring of an attribute with the level of this attribute, and found that the parameter on this interaction was often insignificant, implying no significant difference in estimated preferences between those who said they ignored an attribute and those who did not make this claim.

So far, the studies described have involved asking respondents about which attributes they attended to at the end of the set of choice tasks. However, there is evidence that respondents may attend to different attributes in different choice tasks. Scarpa et al. (2009b) and Meyerhoff and Liebe (2009) tested this by asking individuals about ignored attributes at the end of each choice task, comparing the results with those resulting from asking about attribute (non-)attendance at the end of the set of choice tasks. Both studies found advantages in monitoring attribute attendance at the choice task level instead of at choice sequence level. Scarpa et al. found efficiency gains for estimated

WTP at the choice task level, whereas Meyerhoff and Leibe found little difference in implicit prices according to how respondents attribute attendance is classified.

The papers described above make use of de-briefing questions to identify and classify whether people attend to all attributes in making choices. This approach is classified by Mariel et al (2011) as Stated Non-Attendance (SNA), which they contrast with an alternative approach of Inferred Non-Attendance (INA). The latter does not make use of de-briefing questions, but instead searches for patterns in the choice data which indicates non-attendance to attributes. Scarpa et al (2009a) use two approaches, latent class models and a Bayesian stochastic attribute selection model, to estimate non-attendance to a range of landscape attributes and a cost attribute. They find that in the latent class model, for example, respondents paid most attention to "mountain land" and least to "farmyard tidiness", although cost is also (probabilistically) ignored by many respondents. These results depend on the nature of the latent class model specified. The existence of an Inferred Non-Attendance approach begs the question of whether this is preferable to a Stated Non-Attendance approach. Mariel et al (2011) use a simulation model to investigate the likely bias in welfare estimates produced by both SNA and INA. They find that, under certain conditions relating to serial versus choice task-specific attribute non-attendance, SNA produces un-biased welfare estimates, whilst INA does not. A conclusion is thus that de-briefing questions are a valuable method of dealing with non-attendance in choice models. This is the approach followed in our survey described below.

3. Case Study

The case study used in this research was a choice experiment that aimed to determine the values people place on ecosystem services delivered by the UK Biodiversity Action Plan (UK BAP), a set of policy instruments that aim to conserve and enhance the UK's most important habitats and species. Given the complexity of the choice tasks and potential unfamiliarity with the goods being valued, valuation workshops (sometimes called a market stall approach) were used to carry out the survey (MacMillan et al, 2003; Christie et al, 2006; Alvarez-Farizo and Hanley, 2006). This sampling strategy allowed more time for the provision of information (including a specially-produced documentary film) on the complex relationship between BAPs, services and values, and promoted reflective learning amongst participants.

Each workshop group involved around 12 respondents, who met for around 2 hours in a convenient public venue (eg museums). Participants were paid a small fee for coming to the workshop. Following information provision, participants were asked to complete a series of five choice tasks, where each task required respondents to select their preferred 'action plan' from a series of three plans: Action Plan A, Action Plan B and a Baseline Plan (see Figure 1 for an example). Each Action Plan was described in terms of seven ecosystem service attributes (Wild food, Non-food products, Climate regulation, Water regulation, Sense of place, Charismatic species and Non-charismatic species) and a monetary attribute. The services used were identified and defined through both public and expert focus groups and therefore represent the services people could most readily understand and valued. The levels of ecosystem service delivery in the Baseline Plan relate to a 'No further BAP funding' policy scenario in which the level of services declined, but at no additional cost to the respondent. The ecosystem service attributes in Plans A and B took one of three levels of delivery based on a 'Full policy implementation' scenario (where service delivery increased), a 'Present BAP' scenario (where services were retained at current levels), and a 'No further BAP funding' scenario (where services declined). The attribute levels were allocated to choice tasks using a 'shifted' experimental design (Ferrini and Scarpa, 2007). Detail of the levels of the ecosystem services delivered by the three UK BAP scenarios are summarised in Table 1 and fully described in Christie et al (2011). The monetary attribute in the CE was specified as an annual increase in taxation over the next 10 years. Following the choice tasks, respondents were asked to indicate whether they 'always considered', 'sometimes considered' or 'never considered' each of the CE attributes when they made their choices. The responses to this question form the basis of much of the analysis reported in this paper.

A total of 618 people were interviewed during 54 valuation workshops, which were administered across the whole of the UK. Of these, the data from 441 respondents were used in the analysis. Our sample was found to be generally representative of that of the UK National Census; the exception was that our sample included a higher proportion of people that had attained a higher education qualification compared with the national average.

4. Methodology

The model chosen for the parametric analysis of responses is a mixed logit, an approach which has grown rapidly in popularity with discrete choice modellers. Mixed logit provides a flexible econometric method, which may be used to approximate any discrete choice model derived from random utility maximization (Mc Fadden and Train 2000). Under the mixed logit approach the utility of respondent n from alternative *j* in choice situation *t* can be described as:

$$U_{njt} = \beta_n X_{njt} + \varepsilon_{njt} \quad (1)$$

where X_{njt} is a vector of observed attributes for the good in question, β_n is the vector of coefficients for respondent *n* associated with these attributes, and ε_{njt} is an unobserved random term which is independent of the other terms in the equation, and independently and identically Gumbel distributed. The probability of individual *n*'s observed sequence of choices $[y_1, y_{2,...}, y_T]$ is calculated by solving the integral[1]:

$$P_{n[y1,y2,....yT]} = \int \dots \int \prod_{t}^{T} \left[\frac{e^{X_{njt}\beta_n}}{\sum_{i=1}^{J} e^{X_{nit}\beta_n}} \right] f(\beta_n) d\beta_n \quad (2)$$

where *j* is the alternative chosen in choice occasion *t.* The above integral has no analytical solution but can be approximated by simulation. To estimate the model, the analyst must make assumptions about how the β coefficients are distributed over the population. In this case we assumed that all the non-monetary attributes are distributed following a triangular distribution whilst the price attribute is considered constant to facilitate the estimation of the WTP measures and to guarantee the existence of the WTP distribution (Daly et al, 2011).

[1] This specification assumes that the person's taste, as represented by β_n, are the same for all choice situations.

To consider the impacts of attribute attendance, the probability of choice must be conditioned to the situations of full attendance, partial attendance and non-attendance to each attribute. To do that, the probabilities of choices are constructed in such a way that for those individuals who attended to all the attributes the *k* elements of β_n that enter in the likelihood are β_{nkac}; for those individuals who attended only sometimes to a given attribute the elements of β_n that enter in the likelihood are β_{nksc}; and for those individuals who stated that they ignore a given attribute the elements of β_n that enter in the likelihood are β_{nknc}. We thus partition the values of $\beta_{n,}$ entering in the likelihood function as follows:

$$\beta_{\mathrm{n}} = \left\{ \begin{matrix} \beta_{\mathrm{nkac}}\ if\ responent\ n\ declared\ that\ always\ considered\ the\ k^{th}\ attribute \\ \beta_{\mathrm{nksc}}\ if\ responent\ n\ declared\ that\ only\ sometimes\ considered\ the\ k^{th}\ attribute \\ \beta_{\mathrm{nknc}}\ if\ responent\ n\ declared\ that\ never\ considered\ the\ k^{th}\ attribute \end{matrix} \right\}$$

This re-parameterization of the β_n is simply accommodated into the probability of choice by considering that each subset of coefficients has its own distribution, such that the probability of the sequence of choice for respondent *n* becomes:

$$P_{n[\mathrm{y1,y2,....yT}]} = \int \cdots \int \prod_{t}^{T} \left[\frac{e^{Y_{nkac} X_{njt} \beta_{nkac}}}{\sum_{i=1}^{J} e^{Y_{nkac} X_{nit} \beta_{nkac}}} * \frac{e^{Y_{nksc} X_{njt} \beta_{nksc}}}{\sum_{i=1}^{J} e^{Y_{nksc} X_{nit} \beta_{nksc}}} * \frac{e^{Y_{nknc} X_{njt} \beta_{nknc}}}{\sum_{i=1}^{J} e^{Y_{nknc} X_{nit} \beta_{nknc}}} \right] f(\beta_{nkac} \vee \beta_{nksc} \vee \beta_{nknc})\, d(\beta_{nkac} \vee \beta_{nksc} \vee \beta_{nknc}) \quad (3)$$

where Y_{nkac}, Y_{nksc}, Y_{nknc} are indicator variables which assume the value of 1 when respondent *n* said that he 'always considered', 'sometimes considered' or 'never considered' the attribute *k* , and zero otherwise.

Previous approaches in the literature either restrict the coefficients of the non-attended attributes to zero (e.g Hensher et. al., 2005; Campbell et al. 2008) or estimate different coefficients for the attended and non-attended attributes (Campbell and Lorrimer, 2009). In the first case, the non-attended attributes do not contribute to the likelihood function, so that the analyst implicitly assumes that these attributes are not relevant to respondents. Although this may be true when indeed the ignored attributes are not relevant to respondents, there is evidence that respondents may commit errors in self-stated responses, saying that they ignore an attribute when they did not (Carlsson 2010, Hess and Hensher 2010). In the second case, the non-attended attributes are left in the likelihood function and their utility parameters are separately estimated. As pointed out by Campbell and Lorrimer (2009), this approach provides a convenient method for assessing the accuracy of self-stated attribute processing responses.

To demonstrate the impact of attribute processing strategies on valuation we estimate and compare seven different models (see Table 2 for a summary of the strategies used in the models). Model 1 represents the standard approach in CE which does not account for attribute attendance, i.e. all attributes are assumed to be fully considered by respondents in making their choices. Models 2, 3, 4 and 5 follow the approaches used so far in the literature to address attribute non-attendance. In these models, we assume that we do not have information about the ‘sometimes considered’ case but only the two extreme ‘always considered’ and ‘never considered’ cases. Model 2 is specified by assuming all the ‘sometimes considered’ attributes are non-attended and is estimated by constraining the coefficients for these attributes equal to zero, i.e. assuming a marginal utility from this attribute equal to zero. Model 3 is a variation on Model 2, where the ‘sometimes considered’ attributes are assumed to be fully attended and only the parameters of the ‘never considered’ attributes are constrained to zero. Model 4 again assumes the ‘sometimes considered’ attributes as attended attributes but is estimated without placing any restrictions on the parameters for these attributes. Model 5 differs from Model 4 by assuming the ‘sometimes considered’ attribute as ‘never considered’ and allowing a free estimation for the coefficients of this group.

It is important to keep in mind that in these models we construct the attendance analysis by assuming that the ‘sometime considered’ attributes may fall either into the ‘always considered’ group or ‘never considered’ group. This is a strong assumption used for demonstration purposes of approaches followed in the literature to date, given that for each of the ‘sometime considered attribute we do not know the share which would have fallen into the ‘always considered’ and “never considered’ group if this would have been asked to respondents. In Models 6 and 7 we thus explicitly utilise our data on ‘sometimes considered’ responses to represent partial attendance. Model 6 assumes that respondents ignore attributes when they do not affect their utility. Thus, in Model 6 we estimate separate parameters for fully attended ('always considered') and partially attended ('sometimes considered') attributes, but constrain non-attended ('never considered') attributes to equal zero. Model 7 again explicitly accounts for partial attendance, but this time the analysis estimates separate parameters for the fully attended, partially attended and non-attended attributes.

The seven models outlined above allow us to address a number of questions relating to respondent's attendance in choice experiments, and approaches to accounting for non-attendance.

1. *To what extent do respondents attend to all of the attributes included in a choice experiment?* This question will be addressed by examining the frequency to which respondents 'always consider', 'sometimes consider' and 'never consider' attributes in this choice experiment.
2. *What is the impact of alternative strategies for dealing with attribute non-attendance proposed in the literature*? To address this question we compare the standard CE approach that does not account for non-attendance (Model 1) with all other models which adopt alternative approaches to accounting for attribute non-attendance.
3. *Can respondents accurately self-report non-attendance*? Following Carlsson et al. (2010), we compare models where non-attended attributes are constraint to zero (models 2,3,6) with models where non-attended attributes are estimated (models 4,5,7).
4. *Do respondents partially attend to attributes, and what are the implications of this*?

   There is evidence that respondents may attend to an attribute in some but not all choice tasks. In our study, we included an option where respondents could specify that they 'sometimes considered' an attribute. In models 6 and 7, we explicitly specify partially attended attributes, testing both the significance and size of the relevant coefficients.

5. Results

In this section, we address each of the four questions highlighted above, and then explore the impacts of the different de-briefing and estimation strategies on welfare measures.

5.1 To what extent do respondents attend to attributes in choice experiments?

In our study, respondents were asked to state whether they 'always considered', 'sometimes considered' or 'never considered' the attributes. Table 3 reports the frequencies of attendance for each attribute as declared by respondents.

The frequency of attribute attendance varies greatly across the attributes. Respondents were most likely to 'always consider' the protection of Charismatic species (63% of respondents), Non-charismatic species (62%) and Climate regulation (58%). Only 34% of respondents stated that they 'always consider' Price, while Wild food and Non-food products were 'always considered' in 27% and 16% of cases. The frequencies of the non-attendance found in this study are lower than those reported in the literature: the highest level of non-attendance was found for the Wild Food attribute in which 15% of respondents stating that they 'Never considered' this attribute. The low levels of non-attendance in this study is largely due to the fact that we separately identify respondents who 'Never considered' an attribute from those who 'Sometime considered' an attribute, but may also be due to the valuation workshop context in which choice responses were elicited. The 'sometimes considered' case was the most frequent response for five of the eight attributes.

5.2 What is the impact of alternative strategies to dealing with attribute non-attendance?

A series of models were estimated to investigate the impact of alternative strategies for accounting for attribute non-attendance. A total sample of 2205 choice observations were used for model estimation. Table 4 reports the coefficients for the seven models investigated[2].

[2] For the sake of space we do not report the standard deviations of the random parameters. Briefly we can say that there exists a degree of heterogeneity in respondents preferences for all attributes save the Non-charismatic species attribute, and that the degree of heterogeneity decreases when the attribute attendance analysis is considered. Full model results are available from authors upon request.

In Model 1 (which represents a standard CE model that does not account for attribute attendance) most parameters are significant at the 95% level or higher and have the expected signs: the exceptions are the Wild food and Non-food product attributes which have statistically-insignificant parameter estimates. These results reveal that respondents have positive values for most of the ecosystem services delivered by the UK BAP, but that they are not interested in the effect of the plans on Wild food and Non-food wild products. The positive and significant values of the alternative specific constant (ASC) show that respondents had a propensity to choose any policy options over the status quo option. The fit of this basic model is good with an adjusted rho^2 value of 0.315.

In Models 2, 3, 4 and 5 we assume that we do not have information on partial attendance, but only on "always" or "never" attending, and model the four alternative approaches to accounting for attribute non-attendance listed in Table 3. In Model 2 we only estimated parameters for responses that are fully attended. Attributes that were 'sometimes considered' or 'never considered' are assume to be non-attended and their parameters are restricted to zero. Although all the ecosystem service attributes are significant in this restricted model, this model had the lowest explanatory power with a log likelihood value of 1765 and an adjusted $rho^2 = 0.27$. As may be expected, treating the large share of responses that were partially attended as being not attended, and in addition assuming that all these attributes do not have any effect on utility, lead to a reduction of the statistical power of the model.

In Model 3 we join the 'sometimes considered' group to the 'always considered' and model these combined responses as fully attended, maintaining the parameters of the 'not considered' attributes equal to zero. Model 3 is statistically superior to the previous models indicating that it is better to assume the parameters of the 'never considered' attribute are equal to 0, and that the preferences for the 'sometimes considered' attributes are more similar to the 'always considered' than to 'never considered' ones.

Model 4 is similar in spirit to Model 3 although it allows a free estimation of the parameter for the ignored (never considered) attributes. It is interesting that none of the parameters for the 'never considered' attributes are statistically different from zero revealing that indeed people who declared that they ignored an attribute did not derive utility from it. This model is statistically superior to all the previous models except model 3[3], due to the extra degree of freedom necessary for estimating the set of coefficients for the ignored attributes.

Similar to Model 2, Model 5 treats the 'sometimes considered' responses as non-attended. However, Model 5 is specified to estimate coefficients for both full attendance and non-attendance (where the latter comprises the 'sometimes considered' and 'never considered' cases). The important finding here is that the coefficients of the non-attended attributes are mostly significant. This indicates that the group of people who sometimes or never considered the attributes still derived utility from these attributes; albeit at a lower level of utility than those in the fully attended group. However, statistically this model is inferior to all the previous models (save model 2), indicating that it is not beneficial to pool the 'sometimes considered' with "never considered" responses.

5.3 Can respondents accurately self-report non-attendance ?

Following Carlsson et al (2010), we test whether respondents can accurately self-report attendance by comparing Models 3, 4 and 5. When we disentangle the effect of the "sometime considered" attributes from the "not considered" group (Models 3 and 4) we find that respondents can indeed accurately self-report attribute (non-)attendance. If we treat respondents who "sometime considered" an attribute as if they have ignored it, then one derives the erroneous result that people cannot accurately self-report attribute attendance. This suggests that the main issue in tracing non-attendance is not whether people can accurately state this, but rather how researchers choose to measure it. When we assume that the analyst would have elicited the attribute attendance in a dichotomous way, i.e. by assuming either that the 'sometime considered' attribute are fully attended or not attended, we can conclude that the best model is obtained when the 'sometimes considered' attribute is treated as 'always considered, if at the same time we assume the parameters of the 'not considered' attribute are equal to zero (Model 3). Any other treatment reduces the statistical performance of the model.

[3] A comparison of model fit cannot be carried out using conventional log likelihood ratio tests because models are non-nested. Hence, we use the test proposed by Ben-Akiva and Swait (1986) for non-nested choice models.

5.4 Do respondents partially attend to attributes, and what are the implications of this?

Unlike the previous models, Models 6 and 7 explicitly account for partial attendance. In Model 6 we included those responses where individuals declared that they 'always considered' (full attendance) or 'sometimes considered' (partial attendance), whilst the parameters of 'never considered' responses (non attendance) were restricted to zero for each person. Model 6 thus more fully describes respondents' statements about the attribute attendance, because its specification exactly follows from what respondents declared. The values of the coefficients estimated for the 'sometimes considered' case are lower than the values for the 'always considered' case, thus showing that people who only 'sometimes consider' an attribute have a lower marginal utility for these ecosystem services. This model is statistically superior to all the previous models, showing the importance of explicitly considering the "sometimes consider" responses in addition to the 'always' and 'never' categories.

In Model 7 we use the same model specification as in Model 6 but we freely estimate the parameters of the 'never considered' attributes rather than restricting them to be zero. This allows us to determine to what extent respondents made their choice consistently to what they stated regarding attribute attendance. Very interesting results emerge. First, all the significant coefficients in Model 6 for the 'always considered' and 'sometimes considered' attributes are still significant with the same signs. Second, the diminishing of the marginal utility of each attribute is still observed for the 'sometimes considered' case relative to the 'always considered' case. Third, and importantly, all the coefficients for the 'never considered' attributes are not significantly different from zero. This result differs from what has been found in other studies. For instance, Campbell and Lorimer (2009), Carlsson et al. (2010) and Hess and Hensher (2010) find significant coefficients for many attributes that respondents declared to have ignored. In the light of our results, we attribute this behaviour not to errors in respondent's stated attendance but in the design of the debriefing questions on attendance. The high frequencies observed in our study for the 'sometimes considered' case confirms the existence of partial attendance (Table 3). A design which allows identification of partial attendance is thus desirable since it helps to avoid self-reporting errors.

6. Welfare impacts

In the preceding section, we explored the effects of attribute attendance on the modelling of respondent's preferences. We now explore the impacts of attribute attendance on welfare estimates for changes in ecosystem attributes.

Before describing these Willingness To Pay (WTP) results, it is worth restating the assumptions made for their estimation. In the case of Model 1, we simply divide the marginal utility of a specific attribute by the marginal utility of income to obtain WTP values (implicit prices) for each attribute. In Models 2 and 3 we use the same formula but we assume that WTP= 0 in all cases where an attribute was not attended to. In Model 4, we estimated separate coefficients for respondents who 'always considered', 'sometimes considered' and 'never considered' an attribute. This leads to four alternatives for WTP estimation: when both the attribute in question and the price are 'always or sometimes considered' ($WTP_1 = \beta_{asc}/\beta_{asc\text{-}price}$); when the attribute is 'always or sometimes considered', but price is not ($WTP_2 = \beta_{asc}/\beta_{nc\text{-}price}$); when the attribute of interest is 'never considered', but price is ($WTP_3 = \beta_{nc}/\beta_{asc\text{-}price}$); and when neither the attribute nor the price is considered ($WTP_4 = \beta_{nc}/\beta_{nc\text{-}price}$). However, given that all the estimated attribute preference parameters for the not-considered group are statistically not different from zero, we constrained the WTP for these respondents to zero. Strictly speaking we could not estimate the WTP for respondents who have a zero coefficient for the price attribute, given we do not have an estimate of their marginal utility of income[4]. However, we assume these respondents to have a zero WTP[5]. The resulting WTP is thus the sum of these four WTP alternatives, weighted according to its frequency. The same procedure is followed in Model 5, with the difference being that the two groups of interest are 'always considered'; and 'sometimes or never considered'. Note that the WTP has been calculated for all significant parameters in this case.

[4] As pointed out by Carlsson et al. (2010) these respondents are a rather special case. The zero disutility of the price can be attributed to a protest against making a trade off between money and the environment, or to an extreme yea-saying. As such, considering the WTP of this group =0 is a conservative estimation of the mean WTP for the total sample.

[5] This is a conservative way of treating the responses of respondents who declared to have ignored the price attribute, given that an alternative assumption may be to consider that those who ignored the price have the same mean marginal utility of income as those who did not.

In Models 6 and 7, a similar process was followed. However, in these models we also needed to consider the effect of ‘sometimes considered’ for attribute and for price in the WTP estimation. So WTP estimates also include: $WTP_5 = \beta_{ac}/\beta_{sc\text{-}price}$; $WTP_6 = \beta_{sc}/\beta_{ac\text{-}price}$; $WTP_7 = \beta_{sc}/\beta_{sc\text{-}price}$; $WTP_8 = \beta_{nc}/\beta_{sc\text{-}price}$; $WTP_9 = \beta_{nc}/\beta_{sc\text{-}price}$). As in Model 4, respondents who declared they have ‘never considered’ a certain attribute were assigned a WTP equal to zero. Table 5 reports the marginal WTP estimated using the mean coefficient values shown in Table 4 along with the 95% confidence intervals calculated by mean of bootstrapping (Krinsky and Robbs, 1986). Focusing on the significant attributes only, WTP values are highest in Model 1 (where all responses were considered in the model) and lowest for Model 2 (where we constrained the coefficients of the ‘sometimes considered’ and ‘never considered’ attributes to equal zero). The WTP amounts for Models 3 – 6 (which account for attribute attendance) are quite similar and generally lie in between the WTP estimates of Model 1 and 2.

We formally test for differences in WTP amounts between models using the Poe et al. (2005) test (Table 6). As expected, we find that WTP amounts for attributes in Model 1 are significantly higher than in Model 2. The reason for this is that the ‘sometimes considered’ and ‘never considered’ attributes were constrained to zero in Model 2. Further, all of the WTP measures from Models 1 and 2 are significantly different from those in the models that better account for attribute attendance (Models 3 – 7), showing the importance of properly measuring the extent to which people attend to attributes. No significant differences are observed across the WTP measures estimated in all other models. The similarity between the welfare measures of Model 3 and 4, and Model 6 and 7 were expected: the coefficients for the ‘never considered’ attributes in Model 4 and 7 are not different from zero (Table 6), while those in Model 3 and 6 were restricted to equal zero. The similarity between the welfare measures of these models and Model 5 is because the coefficients of the group formed by the ’sometimes and never considered’ in Model 5 represent the weighted mixture between the preferences of the sometimes and never considered groups where the latter has only a marginal effect due to the low percentage of respondents who declared to have never attended an attribute. As can be seen, this effect reduces slightly the values of the coefficients relative to the ones estimated for the ‘sometimes considered’ group in Models 6 and 7.

Thus, consideration of attribute attendance has a variable impact on estimates of respondent's preferences and on WTP measures. What this impact is depends on the assumptions which are made when modelling attribute attendance. If we assume that the welfare measures of Model 7 are the most accurate, results indicate that it does not matter whether the analyst constrains parameters of the people who declared to have 'never considered' some attribute to zero. Also it does not matter, on a WTP basis, whether the analyst treats the 'sometimes considered' group as though they have the same preferences of either the 'always considered' or 'never considered' group, so long as one attaches a zero utility to people who ignored the attributes in the first case and allows a free estimation of parameter in the second case.

7. Conclusions

This paper looks at the issue of whether respondents consider trade-offs between all attributes used in a choice experiment design, and the implications of different ways of monitoring attribute non-attendance. We introduce an intermediate case of 'sometimes considering' an attribute, in addition to 'always' or 'never' considering this characteristic of the choice set. The use of this intermediate case of 'sometimes considered' for attributes turns out to be useful to better describe respondents' choice processes, and thus to better infer preference parameters. The fact that respondents declared that they only attended to a particular attribute sometimes, and that this statement is the one with the largest share of responses, reveals that allowing for this class of response is valuable.

We find that a model which explicitly models those who 'sometimes consider' an attribute is statistically superior to all models which do not do so, showing the importance of explicitly considering the 'sometimes' considered responses, in addition to the 'always' and 'never' considered categories. Another important finding is that when we model the group of people who declared they have ignored an attribute independently from the other groups, all the attribute parameters are not different from zero. This result contrasts with previous results such as Carlsson et al (2010). Carlsson et al observed that when an individual declared that they did not attend to a particular attribute, it did not mean that the attribute's marginal utility is zero. Indeed this happens in our data when we fail to distinguish the 'sometimes considered' group from the ‘never considered’ group (Model 5). In the light of these results we put stress the importance of disentangling the effects of “partial attendance” from those of “full” or “non-” attendance to better describe respondents preferences. Relying on a measure of attribute attendance through a dichotomous question lead to erroneous conclusions due to the allocation of respondents who only sometimes consider an attribute into either the full- or non-attendance group.

One possible reason for the mismatch between respondents’ declarations on attribute attendance and choices is that people ignore an attribute in some of their choices but consider them in others. This partial attendance may be due to respondents finding a specific attribute level unrealistic in some choice cards, or because they use a disjunctive choice rule when the attribute level in question does not meet a minimum acceptable level. Our analysis extends the standard approaches to considering attribute attendance by incorporating partial attendance into the models. We argue that this approach is better for assessing the accuracy of the self-stated attribute processing strategy.

Asking respondents about their attribute attendance after each choice occasion (such as done by Scarpa et al, 2009b and Meyerhoff and Liebe, 2009) may increase the burden of the choice task and would not always be a reasonable response to request, especially when valuing unfamiliar environmental goods and services. The use of the ‘sometimes considered’ case at the end of a choice sequence can be an alternative and easier approach to deal with the heterogeneous pattern of attribute attendance. Future research aimed to compare the approach presented here and the approach where the attendance is elicited after each choice may determine whether the two approaches provide similar results in term of preferences and aggregate welfare measures.

The design followed in this study did not allow us to determine the reasons which led respondents to attend to a specific attribute in some choice cards but not in others. One possible reason is that respondents consider attributes only when their level is over or below a specific threshold value (Bush et al, 2009). This also may explain the large ’partial‘ attendance to the tax attribute, which is the third most frequently ’sometimes considered‘ attribute. In this case, respondents who seem to have ignored an attribute simply because its value is below or above a specific amount are indeed considering the attribute albeit that they declare they are not. This may explain the discrepancies between the attribute processing strategies declared by respondents and the statistical results found in previous studies (Carlsson, et al 2010, Campbell and Lorimer 2009). However, further investigation of why respondents act as if an attribute is of varying importance to them across choice tasks seems warranted.

Taken together, findings from the choice experiment literature suggest that the conventional economic model of respondents exercising fully rational choices by trading off across all attributes in their choice set may not be the best way of representing behaviour. Ignoring the varying attention which people place on the characteristics of environmental goods in making choices can lead to a loss of explanatory power in choice models and bias in welfare estimates.

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Table 1: Summary of the levels of the ecosystem service attributes used in the choice experiment.

	Full implementation	**Present BAP**	**No further BAP funding**
Wild Food *Change in availability of wild food* *(%)*	14%	No change	-16
Non-food products *Change in availability of wild food* *(%)*	14%	No change	-16
Climate change *Annual changes in CO2 sequestration* *('000 tonnes CO2 Yr^{-1})*	708	No change	-749
Water regulation *Change in no. of people at risk* *('000 people)*	-67	No change	+69
Sense of Place *Habitat achieving condition* *(%)*	41.3	37.3	27.6
Charismatic species *Status of species* *(No. of species stabilised)* *(No. of species declined)*	273 0	105 168	0 273
Non-charismatic species *Status of species* *(No. of species stabilised)* *(No. of species declined)*	876 0	337 539	0 876

Table 2: Approaches used to model attribute attendance

Original attendance response	**Approach used to model attribute attendance**						
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
Always considered	Fully attended	Fully attended	Fully attended	Fully attended	Fully attended	Fully attended	Fully attended
Sometimes considered	Fully attended	Constrained $\beta = 0$	Fully attended	Fully attended	Not attended	Partially attended	Partially attended
Never considered	Fully attended	Constrained $\beta = 0$	Constrained $\beta = 0$	Not attended	Not attended	Constrained $\beta = 0$	Not attended

Table 3: Respondents' self-reported attribute attendance.

Attribute	Always considered	Sometimes considered	Never considered
Wild Food	27.2	65.8	7.0
Non Food products	16.6	67.8	15.6
Climate regulation	58.5	39.2	2.3
Water regulation	43.8	51.5	4.8
Sense of Place	34.5	55.8	9.8
Charismatic species	63.0	35.1	1.8
Non-charismatic species	61.9	33.8	4.3
Price	34.0	57.4	8.6

Table 4: **Model coefficients and statistics**

Variable	Model 1	Model 2	Model 3[a]	Model 4[a]	Model 5[b]	Model 6	Model 7
'Always Considered'							
ASC	1.740*	1.890	1.770*	1.727*	1.787*	1.780*	1.837*
Wild Food	.056	.010*	.040	.053	.043	.038	.046
Non Food Products	.004	0.15*	.025	.019	.140	.150*	.130
Climate Regulation	.025*	0.02*	.025*	.026*	.026*	.028*	.027*
Water Regulation	-.006*	-.004*	-.006*	-.006*	-.006*	-.006*	-.007*
Sense of Place	.235*	.228*	.205*	.223*	.357*	.337*	.401*
Charismatic species	.064*	.051*	.058*	.060*	.063*	.062*	.065*
Non-charismatic species	.016*	.010*	.016*	.017*	.018*	.018*	.020*
Price	-.062*	-.061*	-.066*	-.067*	-.076*	-.074*	-.081*
Sometimes considered							
Wild Food						.043	.064
Non Food Products						-.014	-.029
Climate Regulation						.021*	.020*
Water Regulation						-.005*	-.006*
Sense of Place						.123*	.145*
Charismatic species						.046*	.045*
Non-charismatic species						.011*	.015*
Price						-.064*	-.068*
Never considered							
Wild Food				.103	.066		.206
Non Food Products				-.061	-.036		-.092
Climate Regulation				-.019	.017		-.044
Water Regulation				-.001	-.005*		-.001
Sense of Place				.141	.144*		.190
Charismatic species				.052	.044*		.050
Non-charismatic species				.007	.010*		.009
Price				.0004	-.055*		-.001
Model Statistics							
N (Observations)	2205	2205	2205	2205	2205	2205	2205
Log Likelihood	-1653.9	-1765.1	-1643.5	-1639.2	-1643.0	-1633.6	-1615.5
McFadden Adjusted ρ^2	0.315	0.269	0.319	0.320	0.317	0.321	0.326
χ^2	1536.9*	1314.6	1557.8*	1566.4*	1588.8*	1577.7*	1613.9*

Notes: Asterisks denote significance at the 95% level or superior.
a: the always considered coefficients represent the always considered and sometimes considered group
b: the never considered coefficients represent the sometimes considered and never considered group

Table 5: Attribute marginal WTP (£) and 95% confidence intervals

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Wild Food	NDF 0	NDF 0	NDF 0	NDF 0	NDF 0	NDF 0	NDF 0
Non-Food Products	NDF 0	**0.19** (0.05 0.34)	NDF 0	NDF 0	NDF 0	NDF 0	NDF 0
Climate regulation	**0.41** (0.24 0.59)	**0.06** (0.03 0.08)	**0.28** (0.13 0.45)	**0.29** (0.22 0.35)	**0.28** (0.18 0.38)	**0.28** (0.19 0.37)	**0.25** (0.17 0.33)
Water regulation	**-0.09** (-0.12 -0.06)	**-0.01** (-0.00 -0.02)	**-0.06** (-0.09 -0.04)	**-0.06** (-0.07 -0.05)	**-0.07** (-0.09 -0.05)	**-0.06** (-0.08 -0.05)	**-0.07** (-0.08 -0.05)
Sense of Place	**3.83** (2.26 5.48)	**0.36** (0.18 0.58)	**1.97** (0.75 3.20)	**2.35** (1.77 3.00)	**2.43** (1.61 3.33)	**1.97** (1.28 2.69)	**2.19** (1.49 2.97)
Charismatic species	**0.99** (0.76 1.27)	**0.12** (0.08 0.17)	**0.64** (0.41 0.89)	**0.67** (0.58 0.77)	**0.70** (0.55 0.87)	**0.64** (0.51 0.76)	**0.61** (0.48 0.75)
Non-charismatic species	**0.26** (0.17 0.36)	**0.02** (0.01 0.04)	**0.17** (0.08 0.26)	**0.18** (0.15 0.22)	**0.19** (0.14 0.25)	**0.17** (0.12 0.22)	**0.19** (0.14 0.24)

Note: NDF means Not Different From 0 at the 95% level)

Table 6: Poe et al. (2005) test results

	Wild Food	Non-Food Products	Climate regulation	Water regulation	Sense of Place	Charismatic species	Non-charismatic species
Model 1 vs Model 2	NA	NA	**1.00**	**0.00**	**1.00**	**1.00**	**1.00**
Model 1 vs Model 3	NA	NA	**0.93**	**0.03**	**0.97**	**1.00**	**0.95**
Model 1 vs Model 4	NA	NA	**0.91**	**0.03**	**0.96**	**0.99**	**0.92**
Model 1 vs Model 5	NA	NA	**0.90**	**0.09**	**0.94**	**0.98**	0.88
Model 1 vs Model 6	NA	NA	**0.91**	**0.04**	**0.98**	**1.00**	**0.95**
Model 1 vs Model 7	NA	NA	**0.95**	**0.07**	**0.97**	**1.00**	**0.90**
Model 2 vs Model 3	NA	NA	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**
Model 2 vs Model 4	NA	NA	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**
Model 2 vs Model 5	NA	NA	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**
Model 2 vs Model 6	NA	NA	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**
Model 2 vs Model 7	NA	NA	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**
Model 3 vs Model 4	NA	NA	0.43	0.51	0.35	0.44	0.36
Model 3 vs Model 5	NA	NA	0.51	0.24	0.67	0.67	0.67
Model 3 vs Model 6	NA	NA	0.48	0.55	0.68	0.61	0.56
Model 3 vs Model 7	NA	NA	0.67	0.67	0.50	0.73	0.33
Model 4 vs Model 5	NA	NA	0.46	0.25	0.55	0.63	0.56
Model 4 vs Model 6	NA	NA	0.46	0.45	0.21	0.34	0.32
Model 4 vs Model 7	NA	NA	0.27	0.33	0.37	0.23	0.55
Model 5 vs Model 6	NA	NA	0.50	0.69	0.20	0.26	0.30
Model 5 vs Model 7	NA	NA	0.36	0.59	0.34	0.18	0.49
Model 6 vs Model 7	NA	NA	0.66	0.61	0.34	0.61	0.30

Note: Bolded denote as significance level at p-values lower than 0.10 or greater than 0.90 (i.e., Reject the null hypothesis that WTPs or CSs are equivalent)

	OPTION A	OPTION B	BASELINE
Wild food	LESS WILD FOOD *8.5% less wild food in Wales*	WILD FOOD *No change to wild food in Wales*	LESS WILD FOOD *8.5% less wild food in Wales*
Non-food	LESS NON-FOOD *8.5% **less** non food products in Wales*	MORE NON-FOOD *7% **more** non food products in Wales*	LESS NON-FOOD *8.5% **less** non food products in Wales*
Climate regulation	LESS CO_2 ***Habitats absorb 44,000 tonnes CO_2 (0.18% of UK total) helping to <u>reduce global warming</u>***	MORE CO_2 ***Habitats release 51,000 tonnes CO_2 (0.21% of UK total) which <u>contributes to global warming</u>***	MORE CO_2 ***HabitatsCO_2 (0.21% of UK total) which <u>contributes to global warming</u>***
Water regulation	NO CHANGE ***260,000 people at risk***	LESS FLOODING ***5,000 fewer people at risk***	MORE FLOODING ***5,000 more people at risk***
Sense of place	FEWER HABITATS MAINTAINED ***26% of semi-natural and natural habitats maintained***	MORE HABITATS MAINTAINED ***41% of semi-natural and natural habitats maintained***	FEWER HABITATS MAINTAINED ***26% of semi-natural and natural habitats maintained***
Threatened mammals, birds, amphibians, reptiles, moths and butterflies	NO CHANGE ***67 species stabilised 136 species decline***	MORE SPECIES MAINTAINED ***203 species stabilised 0 species decline***	FEWER SPECIES MAINTAINED ***0 species stabilised 203 species decline***
Threatened trees, plants, insects and bugs	NO CHANGE 120 species stabilised 180 species decline	MORE SPECIES MAINTAINED 300 species stabilised 0 species decline	FEWER SPECIES MAINTAINED 0 species stabilised 300 species decline
Cost per household (per year for 10 years)	**£150 per year** (total =£1500 over 10 years)	**£100 per year** (total =£1000 over 10 years)	**£0 per year**

Figure 1: Example of a choice experiment choice task from valuation workshops held in Wales.