Are Stated Preferences Invariant to the Prospect of Real-Money Choice?

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Due to space constraints with this submittal, copies of the tables are available upon request.

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Abstract

This paper reports on a choice experiment where respondents stated their preferences for different wetland parcels. The study used hypothetical surveys to measure respondents' preferences, but in one survey version respondents expected and received a follow-up question involving real monetary payments. The results indicate that those respondents who received hypothetical surveys that included a real-money question registered a different preference function from those respondents who received a survey that asked respondents to answer hypothetical questions only. The study finds that respondents may reverse their preferences for parcel attributes, such as public access to the parcel as related to presentation.

Introduction

A valuation method that measures an individual's willingness to pay for the level of the environmental good is a useful component to many resource allocation decisions. Policy makers also use valuation methods to determine the level of an environmental good that the public needs, by ensuring that the level of the good provided to society is balanced with the opportunity cost of providing it. Stated preference surveys are tools that may identify the value that individuals have for public goods. These surveys directly ask individuals to place value upon these goods (Mitchell and Carson, 1989). This valuation method is widely accepted by environmental economists, although many still consider it a controversial method by which to determine an individual's willingness to pay.

Controversy surrounds these surveys, and their validity is often questioned, because results are derived from questions that ask individuals directly what their willingness to pay is rather than inferring their willingness to pay from actual choices (Diamond and Hausman, 1994). This dependence on hypothetical questions causes skepticism because the validity of dollar-valued estimates of amenity benefits are based on the results of hypothetical surveys in which the respondent does not have to follow through with the consequences of his decisions. This paper is one in a series of studies that examines how introducing real-money choices, that carry real monetary and amenity-benefit consequences, affect models of respondent's preference and valuation based on stated-preference, hypothetical questions. As elaborated below, the present study focuses on the results derived from hypothetical questions.

Although still the source of lively debate, CVM is considered a very useful tool to approximate real-money willingness to pay for environmental goods (Mitchell and Carson, 1989;

National Oceanic and Atmospheric Administration, 1993). Many contingent valuation studies indicate that results derived are an overestimate of the real-money value of the good in question, while others claim that the hypothetical surveys can accurately measure real WTP (Johannesson et al, 1998; Blumenschein et al, 1998; Taylor, 1998; Adamowicz et al, 1994; Spencer et al, 1998). Using a voluntary contributions payment mechanism, Brown et al. (1996) showed that hypothetical willingness to pay was found to be significantly different from the values elicited by their real-money question for a public good. Neill et al.'s (1994) study indicated that hypothetical willingness to pay was consistently and significantly higher than the payments that reflected real economic commitments for two deliverable private goods. They concluded that the hypothetical payment aspect of the survey resulted in biases and the overestimates were exacerbated by the response format. Freeman (1993) stated that the format of the contingent valuation survey that a person is given might have important impacts on his willingness to pay response. The validity of stated preference surveys is important to academics and policy makers, since greater numbers of public policies are being implemented based on the estimates derived from these survey methods.

The choice experiment methodology (CE), a variant of contingent valuation method, is employed here. While contingent valuation surveys focus on a precise scenario and attempt to gather information about respondent choice regarding this scenario, the CE approach gives respondents a scenario described by a collection of attributes. The scenario describes a public good that the respondent may obtain, including an attribute listing a monetary cost to the respondent, if the corresponding scenario is chosen. CE questions ask respondents to select the most preferred scenario, or to choose neither scenario, thereby forgoing the financial obligation to the respondent.

This study compares value estimates obtained by two different approaches in which a hypothetical CE question is presented. Under the first approach, respondents receive a hypothetical choice question, as is the usual approach with CE. In the second approach, the respondent is given a traditional, hypothetical CE question, which is followed by another CE question wherein respondents are instructed to write a check to contribute toward the environmental good chosen in the second (real-money) question. In this case, the survey first informs respondents that there will be a question involving real-money following the hypothetical question, where a request to write a check for payment toward an environmental good will be made.

We denote the first presentation as a hypothetical-only survey (HH survey) and the second as a hypothetical-real survey (HR survey). The purpose of the present paper is to compare the stated-preference estimates obtained by the two different approaches by which we present a hypothetical CE question. We are concerned with whether the stated preference models are invariant to the prospect of a real-money choice. Comparisons of estimated WTP from hypothetical questions to the estimate from real-money questions remains outside the scope of this paper, but are considered in Whinstanley Newell (2002).

This study was also motivated, in part, by research that showed that characteristics of the mode of payment might affect the measurement of an individual's preferences for a public good. Johnston et al. (1999) used a hypothetical survey to show that the value that individuals exhibit for a good is conditional on the presentation of the mode of payment, even if respondents treated a marginal dollar equally under the different payment methods. Cherry et al. (2001) experimentally tested whether an individuals' preferences change with the context presented to them. Their results found that the value revealed by the hypothetical questions was higher than

the value revealed through the real questions. Once their research participants became more familiar with a contingent market experience due to repeated exposure, individuals decreased their stated values to be more consistent with their revealed preferences and the gap that existed between hypothetical and real-money surveys disappeared. Cherry et al.'s results suggest that an initially irrational person will learn how to match choices with their preferences, since irrational choices lead to unprofitable outcomes.

These studies and others (Brown et al.1996; Neill et al.1994), motivated us to examine whether or not respondents change their preferences, as revealed through hypothetical stated choice questions, when they become aware that a choice question to follow will request real-money payments. We are looking to see if the information that a real-money choice question is coming will affect the preferences that a respondent reveals in a hypothetical choice question.

Choice Experiment methods

In this study, Choice Experiment methods (CE) will be applied to the valuation of forested wetlands. The CE approach attempts to understand the respondent's preferences about the characteristics of the scenario rather than simply valuing the scenario itself. The hypothetical cost for the public good is simply seen as one of the attributes of the good and is not considered the focus of the question. The combinations of attributes comprise specific scenarios that are selected from a list of all possible scenarios (Adamowicz et al., 1998). Having variations in attributes allows the researcher to do a better job of evaluating the relative value of the attributes.

Adamowicz et al. (1994) found that choice experiments, as a method of evaluating non-market goods, were a useful variant of the contingent valuation methods. They used the choice experiment approach to elicit responses that allowed the estimation of preferences over attributes of an environmental good. They also combined information from choice experiments and

contingent valuation methods to test for differences in preferences and error variances arising from the two methods. Their results showed that advantages to using the CE method include examining the values of attributes, impacts on the choice of functional form, and estimates of the endowment effects which were difficult to examine in contingent valuation methods.

This approach will allow us to analyze public preference data. It will also be an instrument by which agencies and decision makers can prioritize their alternatives, since it offers them an analytical tool that can be used to tackle complex questions, such as ecosystem management decisions. In the present study, the key advantage of CE is in allowing simultaneous evaluation of many environmental attributes. In our application, these attributes are related to forested wetlands. If our case study is to conclude that stated-preference valuation is invariant to the prospect of real-money choices, that conclusion would be strengthened if obtained for multiple environmental attributes.

Survey Process and Implementation

The survey "Are Rhode Island's Wetlands Valuable?" was developed and mailed to respondents who live in the northwestern region of Rhode Island. Survey development began with personal interviews of approximately fifteen RI residents and with the first of eight focus groups, held in October 1997, to learn about residents' attitudes and views of forested wetland and other natural resources that were available in the state. Focus groups and interviews were conducted for the purpose of assuring clarity of presentation and facilitating discussion of the real-money section of the survey, using approaches of Johnston et al. (1996).

Participants in these focus groups included the Wood Pawcatuck Watershed Association, several school parents' organizations and members of the general public. Members of the general public were solicited from flyers that were distributed at the Rhode Island Division of Motor

Vehicles registry centers, parking lots and shopping malls. The final survey was developed through repeated testing of preliminary surveys and testing of the final draft of the survey through informal, one-on-one interviews.

Parcel choice questions

All questionnaires started with attitudinal statements where respondents were asked to state their level of agreement with statements that examined their attitude regarding the environment and development. These questions served as introductory questions and constituted a variation to the Wildlife Attitude and Value Scale that was first described by Purdy and Decker (1989). The next section of the questionnaire presented the choice experiment questions that described two wetland parcels and asked respondents to evaluate the parcels for potential conservation. Each survey asked respondents to review descriptions of two different forested wetlands described by eight attributes (Table 1). The attributes were: *type of road, character of surrounding land, level of wildlife diversity, level of public access, sustainability of habitat quality, role as conservation area, size of parcel and cost*. These attributes were chosen as important to wetland identification, based on feedback from conservation biologists, residents and focus group members. The eight attributes were assigned multiple levels identified as relevant by expert opinion. Attribute combinations, that defined parcels and choice questions, were created by a fractional factorial method provided by StatDesign Inc.[1]

Data Collection

Surveys were mailed to 1000 residents following the Dillman method.[2] These surveys were sent out in the summer of 2000. The sample was randomly drawn from residents in towns of North Smithfield and Scituate, Rhode Island. We used a split sample design. The first sub-sample received a traditional hypothetical-only survey (HH survey) where respondents were given

two hypothetical choice-experiment questions. Six hundred hypothetical-only surveys were mailed to respondents and 558 were delivered. Of the deliverables, 253 were returned, registering a 45% response rate. The second sub-sample of respondents received hypothetical-real (HR) surveys. Four hundred hypothetical-real surveys were mailed and 356 surveys were delivered. Of this amount, 125 surveys were returned, eliciting a 35% response rate. The hypothetical-real survey version involved a hypothetical choice-experiment question followed by a real-money choice question presented in the same format. Prior to answering the hypothetical question of the survey, respondents were informed that a real-money question would follow. In a separate paper (Whinstanley Newell, 2002) we evaluate whether there would be a change in estimated preference functions when the question was altered from a hypothetical question to a real-money question, within the same survey. Respondents were also asked the same set of attitude and demographic questions as were contained in the hypothetical-only surveys. The survey mailings for both sub-samples produced responses to 1041 hypothetical choice questions, 357 from the HR survey and the balance from the HH survey.

Each respondent received hypothetical choice questions that were presented in the same style and format. Wording differences were present only as they were related to the differences in presentation. That is, respondents who received the hypothetical-real surveys were given *additional* information stating that a real-money question would follow the hypothetical question analyzed here. Regardless of survey presentation, respondents were asked to make a decision among three choices (trichotomous choice). These choices included descriptions of the attributes of the two wetlands parcels. Respondents could choose among Parcel A, Parcel B, or Parcel N, the 'neither parcel.' All choices focused on a ten-year period to protect wetland parcels.[3] Choice statements differed in the two presentations. The hypothetical-only presentation was worded as:

> ***I would choose to protect Parcel A*** *<u>because</u> I would find it worthwhile for my household to pay $XX to assure the conservation of Parcel A for 10 years.*
>
> ***I would choose to protect Parcel B*** *<u>because</u> I would find it worthwhile for my household to pay $XX to assure the conservation of Parcel B for 10 years.*
>
> ***I would choose not to pay for Parcel A or Parcel B*** *<u>because</u> I would prefer to save our money rather than pay to protect either of these parcels.*

The hypothetical-real version stated:

> ***I choose to protect Parcel A*** *<u>and</u> I find it worthwhile for my household to pay $XX to assure the conservation of Parcel A for 10 years.*
>
> ***I choose to protect Parcel B*** *<u>and</u> I find it worthwhile for my household to pay $XX to assure the conservation of Parcel B for 10 years.*
>
> ***I choose not to pay for Parcel A or Parcel B*** *<u>and</u> I prefer to save our money rather than pay to protect either of these parcels.*

Surveys were designed using a fractional factorial process to develop descriptions consisting of a set of orthogonal attribute levels. There were 36 hypothetical questions from which to draw the parcel choices. These questions were systematically assigned to survey booklets, ensuring that the first hypothetical choice question was different from the second hypothetical choice question in the HH surveys.

Theoretical Framework

This study focuses on the differences that the survey presentations made to estimating public preferences, with the public good being forested wetlands. Individuals had to make a choice by stating a preference to protect one of the two parcels, described as Parcel A or Parcel B, or choosing not to protect either of the two parcels (choosing N = neither). It is assumed that an individual makes choices based on maximizing his utility (i.e., satisfaction). The discrete choice data from these responses is used to estimate a preference function that predicts a respondent's choice based on the characteristics of the parcels described in a particular question.

In modeling an individual's preferences for forested wetlands, utility (U_{in}) of individual i for alternative n is expressed as a function of the characteristics of the good (X_n), the price of protecting the good (C_n) and the socioeconomic characteristics of the individual (S_i). An individual's utility function $U(\cdot)$ determines U_{in} as follows:

$$U_{in} = U(X_n, M_i - C_n, S_i) = V(X_n, M_i - C_n, S_i) + \varepsilon_{in} \quad (1)$$

where X_n represents attributes describing alternative n (n = {A, B, N}) and M_i is the individual's income. V(.) is the measurable component of utility, and ε_{in} is the random or unobservable component and is defined as:

$$V_{in} = U_{in} - \varepsilon_{in} \quad (2)$$

The random component of the utility function may be a result of unobserved attributes of the choice, unobserved taste variations and measurement errors.

The individual compares the three alternative parcels presented to him. We assume that he will choose the parcel that maximizes his utility, such that:

$$U_{in} > U_{im} \qquad m \neq n, \text{ for } m = \{A, B, N\} \quad (3)$$

The choice probability of alternative n (n= {A, B, N}) by any individual i is:

$$P_i(n) = Pr[V(X_n, M_i - C_n, S_i) + \varepsilon_{in} > V(X_m, M_i - C_m, S_i) + \varepsilon_{im}$$
$$\text{for all } m \neq n,\ m = \{A, B, N\}] \quad (4)$$

The most commonly used distribution for the multinomial model is the log Weibull distribution that leads to the logit model (Cramer, 1991). The logit model is derived by assuming that the disturbance terms in equations (1) and (4) are independently and identically distributed. A logit model of the probability in equation (4) can be estimated to determine the probability that person i will choose alternative n:

$$P_i(n) = \frac{\exp(V_{in})}{\Sigma_m \exp(V_{im})} \qquad (5)$$

where n= {A, B, N} for parcels A, B, or neither choice; and where the summation in the denominator is over all three choices. The conditional logit model will be used in this study, and is distinguished from the multinomial logit model by the fact that the attributes of the alternatives are considered as determinants of choice probabilities, while the multinomial logit model considers only the characteristics of the individuals (Ben-Akiva and Lerman, 1985). The parameters of the model can be estimated using maximum likelihood techniques.

This research studies whether there is a change in estimated preference functions obtained under different survey presentations. This approach allows us to examine whether the model estimated to represent respondents' preferences might be different due to the presentation of the survey. That is, when there is a change in presentation, will the preference functions estimated for the two surveys be statistically equivalent?

To examine this hypothesis, we define the utility function (1) to be conditional on the presentation format using dummy variables D_{HH} and D_{HR} :

$$U(X_n, M_i - C_n, S_i; D_{HH}, D_{HR}) = V(X_n, M_i - C_n, S_i; D_{HH}, D_{HR}) + \varepsilon_{in}, \qquad (1')$$

where D_{HH} takes a value of one if the presentation was from the hypothetical-only survey (HH), a value of zero otherwise, and D_{HR} takes a value of one if the stated-preference presentation was from the survey in which a real-money question followed, zero otherwise; so $D_{HR} = 1 - D_{HH}$. If the model of respondent-preferences is invariant to the presentation format, then these dummy variables should have no impact on the estimation of U_{in} in (1)- (5).

All parcel attributes were treated as multiple level variables. For example, the level of wildlife diversity on a parcel was defined as low, medium, or high. The characteristics of the

parcels were defined as: the type of wildlife diversity that existed on the parcel, the level of public access that each parcel provided, the type of road running alongside the parcel, the level of sustainability for wildlife that the parcel could maintain, the role the parcel played with respect to conservation, the type of land that surrounded the parcel, the size or acreage and the cost to conserve the parcel.

Now, we model the utility function in equation (1') as linear in parameters, according to:

$$V_{in} = \beta_X X_n + \beta_S S_i DmyN + \beta_{XHR} X_n * D_{HR} + \beta_{SHR} S_i DmyN * D_{HR}$$
$$-\beta_{HHC} C_n * D_{HH} - \beta_{HRC} C_n * D_{HR} \qquad (6)$$

where the β's represent the parameter vectors that capture the contribution of each of the parcel characteristics to the respondent's utility; X and S are vectors that have been defined in Table 1; DmyN takes the value of 0 if n = Parcel A or Parcel B and takes the value of 1 if n = N, the neither alternative.[4] D_{HH} and D_{HR} are dummy variables that identify the presentation format, allowing for systematic variation in the parameters as related to presentation format.

Note in equation (6) that the estimated coefficients for vectors β_X and β_{XHR} capture the marginal utility of each parcel attribute, with the elements of β_{XHR} expected to be zero if these marginal utilities are invariant to the presentation format. That is, β_X measures the marginal utility of parcel attributes estimated from the HH presentation, while $\beta_X + \beta_{XHR}$ measures the marginal utility from the HR presentation. Similarly, the effect of socioeconomic characteristics (S_i) may differ under the two presentation formats, depending on whether β_{SHR} adds a non-zero adjustment to β_S in equation (6). In addition, equation (6) directly estimates the marginal utility of income separately under the two presentation formats, where β_{HHC} corresponds to the hypothetical-only presentation while β_{HRC} corresponds to the hypothetical-real presentation.[5] In the following

discussion we identify the variable C_n*D_{HH} as *HHcost* for the cost presented in the hypothetical-only survey, while C_n*D_{HR} is called *HRcost* for the cost presented in the hypothetical-real survey.

HHcost equals the payment that is required for protection of the corresponding parcel when a respondent receives a hypothetical-only survey. *HHcost* equals zero when the respondent receives a hypothetical-real money survey. *HRcost* equals the payment that is required for protection of the corresponding parcel when the respondent receives a hypothetical-real money (HR) survey and equals zero when the respondent receives a hypothetical-only (HH) survey. These cost variables, *HHcost* and *HRcost*, are expected to have a negative influence on a respondent's decision to choose to protect a parcel.

Empirical Results

Table 2 shows five model specifications that we estimated using STATA Software Release 7 (Stata 2001). Model 1 includes all the attributes describing a parcel and the hypothetical-real interaction terms in equation (6). [6, 7] Model 2 is a restricted model that excludes the socio-economic terms that are interacted with the HR dummy variable; some parcel attributes that are interacted with the HR dummy variable; and *HHcost* and *HRcost* which are replaced with the single variable *Cost*. This cost restriction forces the coefficients on *HHcost* and *HRcost* to be the same. Model 3 is a restricted model that excludes the socio-economic terms that were interacted with the hypothetical-real (HR) dummy variable. This restriction tests whether the socio-economic variables affect the desirability of the neither choice differently for the hypothetical-only questions (HH) than for the hypothetical-real questions (HR). That is, the coefficients on these variables are restricted to zero ($\beta_{SHR} = 0$) to determine whether the socio-economic interactions affect the way in which the individuals respond to the neither choice between the two presentations. Model 4 is a restricted model excluding socio-economic terms that are interacted

with the HR dummy variable and some parcel attributes that were interacted with the HR dummy variable; the terms that were dropped had a clear lack of statistical significance as discussed below. Models 1 through 4 included the variable DmyNHR. This variable was retained to prevent omitted variables bias in modeling how the presentation format affects the person's reaction not only to cost but also to the choice between the parcels and the neither-parcel choice. The final model excludes the variable DmyNHR in order to allow an assessment of any potential omitted variables bias. All models were shown to be statistically significant predictors of respondents' choices, with $P < 0.001$.

The Effects of Presentation on Preferences

This paper examines whether the presentation format might be associated with significant differences in the estimated preference functions. This issue is important to understanding other studies that claim to show a difference in estimates from the traditional stated preference survey as compared to the responses estimated from real-money surveys. Might the presentations cause respondents to react differently in their responses? We anticipate that the respondents who received the HR surveys might be more sensitive to increases in the money cost because they are aware that a real-money question will be following their hypothetical question. We also expect that respondents who receive the HH surveys may answer within the context of a hypothetical survey that bears no immediate relation to actual monetary costs. This expectation is similar to the rationality spillover developed in Cherry et al's paper. However, here we are looking to see not only if respondents state a different willingness to pay, but also if their stated-choices imply differences in the marginal utilities of environmental attributes.

First, we tested whether the preference functions implied from the two surveys were statistically equivalent. We performed this test by restricting the effects of survey presentation to

zero: testing if $\beta_{XHR} = \beta_{SHR} = (\beta_{HHC} - \beta_{HRC}) = 0$, in model 1, Table 2. That is, was there a difference in the estimated preference function associated with the presentations? The two preference functions for HH survey and HR survey were found to be statistically different from each other ($\chi^2 = 79.21$, 18 df, $P < 0.005$).

This leads us to examine whether these differences could be due to differences in the effects of the socio-economic attributes; the wetland attributes; or to the respondents valuing the two money costs differently, depending on the survey version that they were given. The result that the preference functions are different may be less than surprising if attributed solely to respondent's reactions to the cost variables under the two presentations.

To test whether socio-economic variables were different between the two presentations, we restrict the coefficients on the interaction terms to zero, such that $\beta_{SHR} = 0$. This restriction leads to a likelihood ratio test to examine whether the socio-economic variables have an impact on the choice between a parcel and the neither alternative, and whether they differ in relation to the survey presentation (model 3 versus model 1, Table 2). The likelihood ratio test showed that the restrictions on these socio-economic variables were not significantly different from zero ($\chi^2 = 2.38$, 3 df, $P > 0.50$). These socio-economic variables did not significantly affect the choice between a parcel and the neither choice differently between the two presentations.

Next we test whether the difference in the preference functions could have resulted from differences in the marginal utility of income under the two survey presentations. That is, are the coefficients on *HHcost* and *HRcost* different, or does $\beta_{HHC} - \beta_{HRC} = 0$? We anticipate that the coefficient on *HRcost* may be more negative than the coefficient on *HHcost*, because we expect that when respondents are told that a real-money question will be following, they may approach the monetary attribute more seriously. In model 1, the coefficient on the *HRcost* is significantly

different from zero at a one-tailed P<0.06, while the coefficient on *HHcost* was significantly different from zero at a one-tailed P < 0.04. Using Model 1 (Table 2) as the unrestricted model, we found that the null hypothesis holding the marginal utility of income invariant across the survey presentations could not be rejected (P>0.10), although the magnitude of the *HRcost* coefficient is larger than that on *HHcost*.

However, model 1 includes an interaction between each parcel attribute and the dummy variable identifying the presentation format. It is possible that these interactions are extraneous if the survey presentation did not affect the estimation of respondents' marginal utility for parcel attributes. Such extraneous variables might lead to an inefficient test, which may be more likely to fail to reject the null hypothesis that respondents treated the money attributes equivalently across survey presentations. Therefore, we further examine the effect of survey presentation on the estimated marginal utility of income using the restricted models 5, 4, and 2. Shortly, we will return to examine the restrictions involving non-monetary attributes imposed in these models.

We repeat the test involving the marginal utility of income using model 5 (Table 2), which omits all the individually insignificant coefficients associated with *HR* interactions. In model 5, the coefficient on *HRcost* is significantly different from zero with P < 0.001, but the coefficient on *HHcost*, while negative, is not significantly different from zero (P > 0.80). In fact the magnitude on *HHcost* has changed by a factor of 10. While the previous test with model 1 may have been inefficient, results with model 5 may have been affected by omitted variables bias. Therefore, we consider model 4, which includes the *DmyNHR* but otherwise follows model 5 in excluding the individually non-significant *HR* interactions from model 1. Comparing models 4 and 5 (Table 2), we see that without *DmyNHR*, the money coefficient on the HR survey (*HRcost*) becomes the only way to measure the effect of the presentation format on a respondent's choice between a

parcel and the neither alternative, and this coefficient is qualitatively affected by the deletion of *DmyNHR*. Model 4 produces results with respect to cost that are similar to model 1.

In Model 2, the *HRcost* and *HHcost* variables were replaced (compared to model 4) with the variable *Cost* to see if $\beta_{HHC} - \beta_{HRC} = 0$. Here, we still fail to reject the null hypothesis, because the likelihood ratio test showed that the restriction on these cost variables was not significantly different from zero ($\chi^2 = 0.272$, 1 df, $P > 0.90$). In this sample, the test indicates that presentation made no statistically significant difference in the estimated marginal utility of income (cost).

Returning to model 1 as our unrestricted model, we examine whether differences in the estimated preference functions associated with the presentations are due to differences in the marginal utilities for non-monetary attributes. The test concerns whether $\beta_{XHR} = 0$. The likelihood ratio test showed that the restrictions on these interaction terms (parcel attributes interacted with the *HR* dummy variable), were significantly different from a vector of zeros ($\chi^2 = 21.12$, 13 df, $P<0.071$) (see Appendix 1, model 8). This result is fairly surprising. It reveals that the presentation format may alter estimation of the marginal utilities of non-monetary attributes. We have found a departure between two models based on the presentation of a hypothetical choice, one of which informs respondents a choice involving real-money will follow. This presentation is intermediate to the changes necessary to ask respondents about a fully real choice, using real money and real environmental (or public) goods.

However, inspection of model 1 suggests that not all of the non-monetary attributes are affected significantly, with $P > 0.17$ (and often $P > 0.40$) for many of these attributes (Table 2). Therefore, we examined model 4 that omits these apparently extraneous, individually non-significant *HR* interactions as well as the insignificant socio-demographic variables. A likelihood ratio test between model 1 and model 4 shows that the exclusion of individually non-significant

HR interactions did not have a statistically significant impact on the model (χ^2 = 7.33, 14 df, P > 0.95). We now examine the specific wetlands attributes retained in the *HR* interactions.

Model 4 shows that in the hypothetical-only surveys, woodland that surrounded the parcel, *Woodland*, had a negative coefficient and was not significantly different from zero (P > 0.50), implying that HH respondents did not prefer parcels in wooded surroundings more than parcels in farmland surroundings. However, the hypothetical-real interaction involving surrounding land being woodland (*WoodlandHR*) suggests that individuals considered this to be a positive and significant variable, with the P < 0.010. HR respondents indicated a preference for parcels located within wooded surroundings. This shows that when there is a change in the presentation of the surveys, there can be a substantive change noted with some of the marginal utilities of the non-monetary attributes, either in sign on the coefficient or in significance level.

A surprising reversal in preferences is also noted with the variable that denotes access to the parcel. *FullAccess* in the hypothetical-only survey is positive and its coefficient is significant at the 1% level. In the hypothetical-real survey, the coefficient for full access (*FullAccessHR*) is *negative* and the variable is also significant at the 1% level. This is an unexpected result. The hypothetical-only (HH) respondents have a statistically significant preference *for* having public access to the parcel, while in the hypothetical-real (HR) surveys, we see respondents register a strong and statistically significant response *against* having public access to the parcel. We know of no previous study that uncovers such a reversal in relation to a presentation format. The effect of full public access on the utility estimated for a parcel in the HR survey is represented as the sum of the two coefficients, and the magnitude of *FullAccessHR* implies that the preferences are almost equal and opposite to the preferences implied by the HH respondents for this attribute. In

investigations of WTP based on real-money and hypothetical-money surveys, failure to detect such changes in preference structure could mislead analysts' conclusions.

These results are surprising, particularly since the surveys that both groups received were highly similar in appearance, style and format and the presentation of the attributes of the parcels were identical. Also, from the previous tests, we see that the socioeconomic variables did not appear to have a differential impact between the two presentation formats (cf. model 1 and 3, Table 2).

These results are noteworthy, because not only does the presentation lead to differences in marginal utilities, but there is also a preference reversal for these non-monetary attributes. These results may confound economists' ability to test the validity of willingness to pay estimates, since these estimates often depend on a comparison of estimates derived by hypothetical stated preference surveys to those derived by real-money surveys. Results from Johnston et al. (1999), that studied respondents' faith in the payment mechanism of the survey they received, revealed that attributes of the payment vehicle itself might be the cause of differences in WTP estimates, although not necessarily a reversal of preferences. To have confidence in *testing* the validity of CVM estimates, particular attention is needed to control for those *non-monetary* attributes that may cause differences between WTP estimated from hypothetical-money and real-money choices.

With a change in presentation, we observed that for specific attributes there was a reversal in preferences, either in sign on the coefficient or significance level of the variables. Presentation may alter valuation and may be affecting the estimated marginal utility of an attribute. A possible explanation for the preference reversal is that the prospect that a real money choice will follow alters the respondent's assessment of some attributes. In a hypothetical setting, respondents may feel their answers might affect expenditure of public dollars from *all* taxpayers. In a real setting,

respondents may view the project differently, if they believe that they are the only ones who have the financial responsibility of protecting the parcel. This conjecture may be consistent with results obtained for the attribute concerning public access to the site, *FullAccess*. Respondents may feel that other —potentially non-paying — individuals should not be allowed access. Also, respondents who received the HH surveys may have answered within the context of a hypothetical survey that bore a less-immediate relation to actual responsibilities. Respondents who received the HR surveys might have been more sensitive or careful in their evaluation of the attributes because of the prospect of a forthcoming, real-money choice. Unfortunately, data from the present survey does not allow an evaluation of these hypotheses or speculations regarding such preference reversals. These factors remain for future research.

Estimated Willingness to Pay for Parcel Attributes

An individual's willingness to pay (WTP) for protecting a parcel is calculated as that cost (C) which will make the individual indifferent between obtaining the parcel or not obtaining the parcel (the neither choice). WTP for a parcel with attributes X_n can be estimated using equation (7) and the coefficients in Table 2 such that:

$$U_{in} = U(X_n, M_i - WTP_{pn}, S_i; D_{HH}, D_{HR}) = U(X_N, M_i, S_i; D_{HH}, D_{HR}) \qquad (7)$$

where X_n represents attributes of a wetland parcel, X_N represents the attributes of the neither choice (no parcel alternative), and WTP_{pn} indicates the WTP for parcel n conditional on the model from survey presentation p. Given the linear functional form, this definition of WTP becomes

$$WTP_{pn} = (\beta_X{}^p X_n - \beta_X{}^{pN}) / \beta_{pC} \qquad (7')$$

where $\beta_X{}^p$ is the vector of parameters from (6) for survey presentation p, $\beta_X{}^{pN}$ is the value of the coefficient on *DmyN* when accounting for socio-demographic interactions and survey presentation p, and β_{pC} is the coefficient on the cost under presentation p, with p = HH or HR. From (7'), the

marginal WTP for a change in the *i*th attribute is calculated as the ratio of β_X^{pi} to β_{pC}, where β_X^{pi} is the parameter estimate for the *i*th attribute in survey presentation p and β_{pC} is the parameter estimate representing the cost of protecting the parcel, for presentation p = HH, HR:[8]

$$mWTP_{pi} = -\beta_X^{pi} / \beta_{pC} \quad (8)$$

Note that mWTP will be positive if adding the attribute to a parcel (or increasing the attribute) is preferred by respondents, and negative otherwise. The results in Table 3 are based on equation (8), where we use coefficients from model 4 and from model 2. Model 4 allows an assessment of the WTP differences from the two survey presentations if the separate estimates of the monetary coefficient (marginal utility of income) are retained. These calculations (Table 3) are intended to illustrate briefly the magnitude of potential differences arising from differences in money coefficients and the effects of presentation-induced changes in the marginal utility of an attribute.

As we can see from Table 3, for attributes that had the same marginal utility between the two surveys, attributes other than *FullAccess* and *Woodland*, mWTP differs by the ratio of the two money coefficients in model 4, with estimates based on the hypothetical-only survey about 60% larger than estimates from the HR survey. However, for attributes where the marginal utility depends upon survey presentation, the mWTP difference depends on both the monetary coefficient and the marginal utility of the variable. In the case of *FullAccess* under model 4 (Table 3), mWTP is almost two times the magnitude of the *FullAccess* in the HR survey and is of the opposite sign. The magnitude in the case of the variable, *Woodland* is about one-fourth the magnitude of *Woodland* in the HR presentation, and is also of the opposite sign. However, if the coefficient on cost is taken as statistically equivalent in the two survey presentations (model 2), then the only differences in mWTP depend on the statistical differences in marginal utility for the attributes – and only mWTP for *FullAccess* and *Woodland* differ between the two presentations.

The Neither-Choice, Yea-saying, and WTP

Table 3 also shows the implications of the *DmyN* coefficients in models 2 and 4 (Table 2) for WTP for a parcel, following equation (7'). The coefficients involving *DmyN* establish the base utility for the neither-choice, with socio-demographic interaction terms indicating that respondents who are male, have completed fewer years of education, and who are older were less likely to choose a parcel rather than the neither-choice (although only the education variable is significant at $P<0.05$, while age is significant at $P<0.07$, and gender is not statistically significant, for models 2 and 4). Evaluation of the socio-economic variables indicated that their effects on the relative preference for the neither-choice were *not* significantly related to the survey presentation. However, we conclude that the presentation *does* affect the relative preference for the neither-choice, as model 5 involves a significant set of restrictions relative to the fully unrestricted model 1 ($\chi^2 = 24.67$, 15 df, $P<0.055$); in comparison to model 5, model 4 does includes *DmyNHR* and the remaining restrictions relative to model 1 are not significant ($\chi^2 = 7.332$, 14 df, $P>0.75$).

Previously, Swallow (1994) presented a theoretical discussion that relates a coefficient such as β_X^{pN} on *DmyN* to a respondent's "propensity to say yes" – or yea-saying – when confronted with a choice between supporting a socially acceptable action (preserving a parcel) or not supporting such an action (e.g., Blamey et al. 1999). In Swallow's framework, this propensity to say yes may be identifiable from contingent choice data in which both price and quantity vary. The present study meets this condition in that parcel acreage (*Size*), other attributes, and cost all vary. The present results, then, indicate that in the hypothetical questions where respondents faced the prospect of a real-money choice, their propensity to say yes is substantially smaller. In particular, the coefficient on *DmyNHR* is positive, relatively large (near 2), and highly statistically significant ($P<0.001$) in models 2 and 4 (Table 2), indicating that the

base utility estimated for the neither-choice is substantially larger for the HR data than for the HH data. From equation (7') and Table 3, we see that this shift in the utility of the neither-choice implies a *deduction* of about $64 (model 4) to $104 (model 2) from WTP for a parcel, as estimated using the HR presentation rather than the HH presentation. Thus, while the results indicate that respondents likely viewed the cost-attribute equivalently between the two presentations, as the marginal utility of income is not found statistically different between the two presentations, the estimated WTP for a particular parcel would be substantially *lower* under the *HR* presentation where respondents anticipate a real-money choice. Overall, these results imply that marginal WTP for attributes (mWTP) is statistically *in*sensitive to the presentation (Table 3), while an estimate of gross WTP to preserve a wetland parcel *is* sensitive to presentation.

For example, consider the marginal value of adding an acre to a wetland parcel, about $1.20 from model 2 (Table 3). Specifically, consider estimated WTP for the average respondent, with socio-demographic variables evaluated at the means, and for a base parcel, with base attributes for all categorical attributes (all dummy-variable attributes at the "0" level for equation (7')). In this case, the preference model for the HH survey indicates that WTP is positive for parcels of 6.5 acres or more ($1.20/acre x 6.5 acres > $7.79), while for the HR survey, estimated WTP is not positive until the parcel exceeds 93.6 acres ($1.20/acre x 93.6 acres > $112.3).[9]

These results indicate that the survey presentation implies a difference in gross WTP – analogous to the difference observed by researchers comparing WTP or willingness to donate from hypothetical and real-money surveys (e.g., Loomis et al. 1996; Brown et al. 1996; Champ et al. 1997; Champ and Bishop 2001). However, valuation at the margin may be relatively unaffected, and marginal valuation may be of greatest interest to economic analysis. If presentation format primarily affects the discrepancy in WTP through a fixed component

associated with yea-saying behavior,[10] developing stated preference approaches that remove this component while leaving marginal valuations intact may lead to greater congruence between stated-preference and revealed-preference valuation.

Conclusion

This paper studies the preferences that individuals have for attributes of an environmental good using stated-preference methods. This research uses both a traditional hypothetical-only choice experiment format and a hypothetical-real choice experiment format to test whether estimation of respondents' stated-preferences changes data derive from hypothetical survey questions answered by respondents who face the prospect of a real-money choice later in the survey. Results show that when there is a change in the presentation of the surveys, there can be a substantive change in estimated marginal utility of some of the non-monetary attributes. This result suggests that assessments of the validity of stated-preference valuation may depend critically on whether the prospect of real-money payments leads respondents to modify their view of the desirability of the environmental good under consideration in a manner that is not directly related to the prospect of actual payment.

In addition, results suggest that respondents may state preferences that imply very different gross WTP for a good, while at the margin they may treat a marginal dollar equivalently across presentation formats. If such a result actually holds in future comparisons of hypothetical questions to questions where payment is required, it may be that stated-preference valuation will be valid at the margin once analysis controls for factors such as yea-saying. Future research is important to ensure that changes in preference functions and differences in willingness to pay are not due to the differences in the presentation of surveys used to elicit WTP with real-money payments.

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Table 1

Variable	Description
Parcel Attributes (X_n)	
DmyN	The neither alternative (=1); Parcel A or Parcel B (=0). The attributes below will (=0) for the neither alternative.
HH	The hypothetical-only presentation format (=1); else (=0)
HR	The hypothetical-real presentation format (=1); else (=0)
Road	Describes type of road adjacent to the parcel: *LocalRoad*—locally traveled road (=1); else (=0) *CommonRoad*—Commonly traveled road (=1); else (=0) *HeavyRoad*—Heavily traveled road (=1); else (=0)
Character of surrounding land	Describes type of land surrounding parcel: *Woodland*—Parcel is surrounded by woodlands (=1); else (=0) *Residential*—Parcel is surrounded by rural residential land (=1); else (=0) *Farmland*—Parcel is surrounded by farmland (=1); else (=0)
Wildlife Diversity	Describes the wildlife diversity of the parcel: *LowWilddiv*—Low wildlife diversity (=1); else (=0) *MedWilddiv*—Medium wildlife diversity (=1); else (=0) *HighWilddiv*—High wildlife diversity (=1); else (=0)
Public Access	Describes the level of access the public has: *NoAccess*—No access to the parcel (=1); else (=0) *LimitedAccess*—Limited access: permission required (=1); else (=0) *FullAccess*—Full access to the parcel by the public (=1); else (=0)
Sustainability of habitat quality	Describes the level by which the parcel sustains habitat quality: *LowSustain*—Low sustainability (=1); else (=0) *MedSustain*—Medium sustainability (=1); else (=0) *HighSustain*—High sustainability (=1); else (=0)
Role as conservation area	Describes the role the parcel plays as a conservation area: *Isolated*—parcel is isolated from other protected areas (=1); else (=0) *Expands*—parcel expands an existing protected area (=1); else (=0) *Connects*—parcel connects two protected areas (=1); else (=0)
Size of parcel	Describes the different sizes: *Size*—29 acres, 45 acres, 60 acres
Cost	Describes the monetary payment that the respondent is required to make: $5, $10, $15, $20, $25 and $30
	HHcost—Dummy variable for hypothetical-only survey interacted with the cost variable. (C_n*D_{HH}) *HRcost*—Dummy variable for hypothetical-real survey interacted with the cost variable. (C_n*D_{HR})
Parcel Attribute Interaction terms	Attributes interacted with the dummy variable for the hypothetical- real presentation (X_n*D_{HR})
Respondent Attributes (S_i)	
Male	Dummy variable (=1) if male; else (=0) Women: 32.6%; Men: 67.4 %
Education	High school graduate or less (= 0): 24.8% Some college or more (=1): 75.2%
Age	Age for respondent: mean 50
Socio-economic Interaction terms	Socio-economic variables interacted with the dummy variable for the hypothetical- real presentation (S_i*D_{HR})

Footnotes

1. Donald Anderson, President, StatDesign Inc. Evergreen, CO.
2. The Dillman method involved mailing a packet including a cover letter, survey and a financial incentive ($1 coin). For non-respondents, a reminder postcard, followed by a letter with a replacement questionnaire, a second reminder postcard, and a letter with a post card asking non-respondents about their demographic information were also sent.
3. This 10-year period corresponded to the actual conservation contracts that the university held with land-owners whose parcels could be presented in the real-money questions.
4. DmyN is sometimes called a choice-specific dummy variable in the CE literature.
5. Income (M_i) is dropped from the linear form of the utility function because income does not change across alternatives faced by individual *i* and therefore cancels out upon estimation. The estimated coefficients are interpreted as the marginal utilities of the attributes and are used to identify the relative impact of a change in the attributes on the likelihood that the respondent prefers a particular parcel.
6. The Hausman test was used to test the first model for violations of the Independence of Irrelevant Alternatives (IIA). If a subset of the choice set truly is irrelevant with respect to other alternatives, omitting it from the model will not lead to inconsistent estimates (STATA 2001, pps. 435-436) with the null hypothesis that choices are independent of omitted alternatives. That test fails to reject the null hypothesis. The large p-value indicates that the IIA assumption has not been violated and the model is appropriate ($\chi^2 = 19.58$, 21 df., $P > 0.54$).

7. During focus groups and administration of the surveys, we received feedback from respondents and potential respondents that there was a land conservation issue that was upsetting some town's people in the town of North Smithfield. To capture any effect of the controversy, we used a TOWN dummy variable. A preliminary test was run where the TOWN dummy (Town*DmyN) was included with the variables in Model 1. A log-likelihood ratio test of this model 1 with the TOWN dummy variable. The test indicates that the exclusion of the TOWN variable does not have a statistically significant impact on the model (χ^2= 0.64, 1 df, P > 0.60).
8. Willingness to pay (C=Cost) can be measured by identifying the cost that would make the respondent choose to protect one of the parcels or forgo the parcels, thereby opting to save the cost to his household. Calculations for WTP are as follows: $U(X_n, M_i - WTP_{pn}, S_i) = U(X_N, M_i, S_i)$; $\beta_x X_n + \beta_i S_i + \beta_C(M_i - WTP_{pn}) = \beta_{DmyN} + 0 + \beta_i S_i + \beta_C M_i$; $\beta_x X_n - \beta_C WTP_{pn} = \beta_{DmyN;}$ $WTP_{pn} = (\beta_x X_n - \beta_{DmyN}) / \beta_C$, and, differentiating with respect to element *i* in X_n, $mWTP_{pi} = \beta_x / \beta_C$. Here, all coefficients are appropriate to the presentation p. In equation (8), we carry the negative sign because the estimate of β_{pc} from table 2 is the negative of the marginal utility of income.
9. These values are significantly different because the coefficient on *DmyNHR* is significantly different from zero at P<0.001.
10. In addition to yea-saying behavior, motivations for free-riding could also play a role that is beyond the scope of the present analysis.