Asymmetric Dominance Effects in Choice Experiments and Contingent Valuation

Ian J. Bateman[1,*], Alistair Munro[2] and Gregory L. Poe[3]

1. Centre for Social and Economic Research on the Global Environment (CSERGE), University of East Anglia, Norwich, NR4 7TJ, United Kingdom.

2. Economics Department, Royal Holloway University of London, Egham, TW20 0EX, United Kingdom.

3. Department of Applied Economics and Management, Warren Hall, Cornell University, Ithaca NY 14853, USA.

* Corresponding author: Contact details: Ian J. Bateman, e-mail i.bateman@uea.ac.uk,
tel.: +44 (0)1603 593125, fax.: +44 (0)1603 507719.

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Abstract

While a dominated choice involves a situation in which one option clearly dominates another on all relevant dimensions, an asymmetrically dominated choice typically involves more than two options in which at least two options do not dominate each other but one (but not both) of those options does dominate a third option. We demonstrate that the introduction of an asymmetrically dominated option can significantly impact upon choices between non-dominated options within the same choice set. Furthermore, we show that this effect can then translate into significant impacts upon subsequent valuations for those non-dominated options. Such findings are at odds with standard theory yet accord with a substantial number of findings within the marketing and experimental economics literatures. More fundamentally these results show that the introduction of alternatives which are, from a formal perspective, irrelevant can significantly impact upon non-market valuation estimates derived from both choice experiments and contingent valuation studies. We consider the impact of such effects and their implications for future valuation research.

Keywords.

Choice Experiment, Contingent Valuation, Asymmetric Dominance, Willingness to pay, Lakes.

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1. Introduction

In recent years, a number of "anomalies" observed in stated preference studies for non-market goods have subsequently been found to occur in purchases of market priced goods (see for example the 'part-whole' effect; Diamond and Hausman, 1994; Bateman et al., 1997). In this paper we reverse this demonstrative flow by examining whether a particular choice set phenomenon widely demonstrated in the marketing and psychological literatures, and borne out in experimental economic settings and real market observations, carries over to hypothetical non-market valuation and public goods choice settings. Our particular focus here is on asymmetric dominance effects. While a dominated choice involves a situation in which one option clearly dominates another on all relevant dimensions, an asymmetrically dominated choice typically involves more than two options in which one option is dominated by at least one other option, but not by all options. Figure 1 illustrates asymmetric dominance in the case where options vary along two dimensions, which are labelled in accordance with the goods that are discussed later in the article. In this figure, d is dominated by t, but not by c. An asymmetric dominance effect is an example of a broader class of decoy phenomena (Herne, 1997, 1999), which refer to the effects on choices between two options (the target: *t* and the competitor: *c*) that results from the introduction of an additional option (the decoy: *d*). An asymmetric dominance effect is then said to occur if the addition of an asymmetrically dominated decoy increases the share of the target (Huber, Payne, and Puto, 1982).

[Figure 1 here]

Decoy effects in general and asymmetric dominance effects in particular have attracted attention of psychologists and experimental economists because rational choice theory posits that preferences between two options should not depend upon the presence or absence of any other options. It follows that if *t* is not chosen from a binary choice set B={*c*, *t*}, then *t* cannot be the preferred choice in the more encompassing choice set E={*c*,*t*,*d*}. This principle, known as expansion consistency (Sen, 1982) is embodied in standard models of rational choice (Tversky and Simonson, 1993) and, given monotonicity, implies the absence of asymmetric dominance effects. At an aggregate level, the parallel to the expansion consistency restrictions on individual choice is the regularity condition (Huber, Payne and Puto, 1982). Formally, letting C(B) = c denote that alternative c is chosen from the choice set B and P(c, B) indicate the proportion of people for whom C(B) = c, the regularity condition is defined as

$$P(c, B) \geq P(c,E) \qquad (1)$$

Regularity is a weaker condition than expansion consistency, because even when regularity holds at the aggregate, individuals may still violate expansion consistency. Nevertheless, from the perspective of choice experiments, regularity remains a minimally desirable condition. It follows that failure of the regularity condition, in the form of an asymmetric dominance effect may have serious consequences for the acceptability of choice experiments.

Evidence of asymmetric dominance effects are widely demonstrated in the experimental and consumer choice literature (see for example Huber, Payne and Puto, 1982; Ranteshwar, Shocker and Stewart, 1987; Lehman and Pan, 1994). As an example, Rabin (1998) discusses an asymmetric dominance experiment conducted by Simonson and Tversky (1992) that examined choices between receiving $6 and a Cross pen. (Cross is a manufacture of elegant pens in the United States)

> "While only 36 percent of the subjects choosing only between the Cross pen and $6 chose the Cross pen, 46 percent of subjects who were also given the choice of a less attractive pen chose the Cross pen…the addition of an option that compared unfavorably (as more expensive or lower quality) to an existing option enhanced the perceived attractiveness of the existing option" (p. 38)

Other researchers have demonstrated that such effects appear to be general, and extend to other choice situations such as political candidates (Pan, O'Curry and Pitts, 1995), job candidates (Highhouse, 1996) and policy issues (Herne, 1997). While much of this research has utilized hypothetical choice tasks, Simonson and Tversky (1992) and Herne (1999) demonstrate that asymmetric dominance effects persist in choice experiments involving real incentives. More recently asymmetric dominance effects have been observed in real markets for commonly purchased goods. An interesting example of such phenomena is provided by Doyle et al. (1999), who conduct a real world investigation regarding purchases of tins of baked beans in a supermarket. Here the researchers initially monitored sales of two brands of beans, both sold in the same large can size, over the course of a week. This showed that one brand, which we can designate as Brand X, accounted for just 19% of sales despite being cheaper than the leading brand. The researchers then introduced a decoy good, namely a line of small tins of Brand X sold at the same price as a large can. Sales from the following week showed that, while (unsurprisingly) no purchases of the decoy were made, market share of Brand X had increased significantly ($p = 0.034$) to 33% of sales so cutting sales of the leading brand from 81% to 67%.

The fact that the asymmetric dominance effect increases the relative, and in some cases the absolute, proportion of choices favouring the more proximate target runs counter to the "similarity hypothesis" that new items take share from existing items that are the most similar (Tversky, 1972). Efforts by psychologists and market researchers to explain this phenomenon can be broadly categorized as perceptual effects and decision-making processes. With regards to the former, the addition of an asymmetrically dominated decoy extends the unfavourable dimension of the target more than the favourable dimension, making the target's deficit in the unfavourable dimension seem less great (Huber, Payne and Puto, 1982; Huber and Puto, 1983). Increased frequency of items in the dimension on which the target is superior may increase the weight placed on that dimension (Huber, Payne and Puto, 1982). With respect to decision-making processes, Simonson (1989) argues that individuals seek to justify their choices in the face of uncertainty, especially in cases that they may be concerned about external evaluation of their decisions: the target may be more "attractive" because its superiority is unambiguous and independent of subjective preferences; the target may be regarded as a "compromise" that combines desirable attributes of the other choices. Underlying decision processes may be driven by an "extremeness aversion" (Simonsen and Tversky, 1992) or the application of simplifying decision heuristics to minimize decision costs (Wedell, 1991). Wedell (1991) identifies further psychological, decision-making processes that may engender such effects.

It is evident, however, that the asymmetric dominance effect is not isolated to the human psyche – it may be that we are "hard wired" to make choices using comparative, context-dependent criteria rather than to value options independently. Shafir, Waite and Smith (2002) note:

> "We tested the choices of honeybees and gray jays in binary and trinary contexts. According to the theories of rational choice and optimal foraging, the subjective values assigned to two preexisting options should not be affected by the presence or absence of a third option. However, our subjects were affected by the presence of an asymmetrically dominated decoy just like human subjects…" (p. 185)

Given the clear impact on familiar and regularly purchased products in humans and replication in foraging by other species, we feel justified in investigating whether this effect will replicate for less familiar environmental non-market goods for which preferences should, if anything, be more malleable.

Our research extends the literature on asymmetric dominance in two key ways: first by demonstrating that this phenomenon is exhibited in choices and expressed preferences for non-marketed environmental goods. Perhaps more importantly, this research also provides the first demonstration that values, and not just choices, are affected by the introduction of an asymmetrically dominated decoy. Such a result is of general economic interest, but is particularly critical in the context of the recent increased use of choice experiments in valuing non-market goods, since it suggests that conjoint and other choice methods may be subject to the same systematic biases documented in the psychology and marketing literatures. We further argue that the findings presented in this paper provide a possible explanation of why non-market values derived from choice experiments seem to exceed values obtained from methods that elicit values for only one good (Cameron et al. 2002).

2. Design and Hypotheses.

The data are taken from a study of proposed environmental management strategy options for Ranworth Broad in East Anglia, U.K. (a Broad is a colloquial East Anglian term for lake). In an in-person, on-site survey of visitors to the Broad, respondents were presented with information concerning two distinct environmental attributes (A1, A2) which were increased from present day levels by different extents: the first attribute (A1) concerned an increase in the number of birds at the Broad; the second attribute (A2) concerned an increase in the amount of plant cover at the Broad. Increases in attribute A1 were measured as numbers of additional birds whereas increases in attribute A2 were measured as percentages over the current level of plant cover. The analysis presented in this paper concerns responses to linked choice and valuation questions, both concerning changes in bird numbers and plant cover detailed above. The choice task was presented prior to the valuation task with a principle aim being to see (i) if asymmetric dominance effects occurred in the former and if so (ii) whether such an effect would then impact upon a subsequent valuation task concerning the same provision change.

A split sample design was employed with one subsample being presented with a choice between options c = (100, 30) and t = (150, 20), i.e. the choice set $\{c,t\}$. The second subsample was offered an expanded choice set $\{c,t,d\}$, that is c and t plus d=(140, 15).[1] As demonstrated in Figure 1, d is dominated in both dimensions by t. In contrast the movement

[1] This design represents a sharp simplification of the typical conjoint design, where usually attribute levels are varied across subjects in order to estimate values attached to the attributes. We use such a simple design to concentrate on the point at issue (asymmetric dominance)

in outcome space from *c* to *d* would involve an increase in A1 by 40 and a decrease in A2 by 15. Thus, *d* is dominated by *t* but not *c*.

In both subsamples, respondents made their decisions based upon numerical information presented to them on a showcard (letters *c*, *t* and *d* were not used on the cards). The cards were structured in a table format so as to make assimilation of the information as easy as possible. In the choice task respondents were simply asked to identify their preferred option from the two or three presented to them. The subsequent valuation exercise used a simple open-ended question to elicit willingness to pay for the chosen (preferred) option, payment being made via a general tax vehicle as used in previous in-person CV survey research on the Norfolk Broads (Bateman et al., 1995).

The questionnaire survey was conducted at the Ranworth Broad Nature Reserve visitor centre in the Norfolk Broads employing face-to-face interviewing techniques. Approximately half of the questionnaires were completed within the visitor centre (beside the entrance) and the other half outside the entrance as they entered the building. Members of the public who agreed to respond to a ten-minute questionnaire were assigned at random to one of the two treatments. The refusal rate was only 4 percent reflecting the prior commitment of visitors to this area. A total of 294 subjects were interviewed. Prior to each decision task, all respondents were provided with some background information to the scenario. This material was designed so as to be as unbiased towards any particular attribute as possible. Furthermore, it was emphasized that there were no correct answers and that the respondent should respond according to their own preferences. As will be demonstrated later, the random assignment of surveys provided samples with statistically identical characteristics.

Given this data, we examine four hypotheses. The first hypothesis is concerned with testing the null hypothesis of description invariance, with the alternative hypothesis being that the regularity conditions are violated. Formally,

$$H^{o}_{1}: P(t,B) = P(t, E) \qquad\qquad H^{A}_{1}: P(t,B) < P(t, E)$$

Hypothesis H^{o}_{1} states that the probability of choosing the target good *t* does not vary systematically according to whether or not the dominated decoy *d* is present or absent in the choice set; it tests the standard assertion that *d* is an irrelevant alternative. Testing H^{o}_{1} is accomplished by standard contingency table analyses to test whether the relative shares of *t* and *c* change with the addition of an asymmetrically dominated decoy. A one-sided test of proportions is used to explore the alternative hypothesis that the regularity condition is violated for the target *t*.

The second hypothesis involves conditional tests of asymmetric dominance effects upon choice. This is assessed by modelling individual choice as a function of covariates. Formally this hypothesis is stated as follows,

H^o_2: P(t,B; **m**) = P(t,E; **m**) H^A_2: P(t,B; **m**) < P(t,E; **m**) ,

where **m** is a vector of exogenously determined preferences and socio-economic characteristics of the respondents. Adopting a random utility modelling framework, this hypothesis test is conducted using a probit model in which the dependent variable is whether *t* is chosen or not. The significance of the coefficient for the binary variable indicating whether the decoy was present in the choice set provides the test of whether the null hypotheses H^o_2 can be rejected in a manner consistent with an asymmetric dominance effect. This, in conjunction with the sign of the coefficient, provide insights into whether or not the alternative hypothesis should be accepted.

Finally, in our last two hypothesis tests, we examine the procedural variance null hypothesis that values are not affected by the addition of a decoy to the choice set. This investigation takes two forms. First we focus on whether the "average" valuation is affected by the addition of the decoy, where μ indicates that the preferred choice in a costless setting is the choice being valued:

H^o_3: V(μ(B)) = V(μ(E))

No alternative directional hypothesis is specified. Rejection of H^o_3 simply provides an indicator of whether the addition of an asymmetrically dominated decoy influences values placed on the preferred option expressed by individuals without distinguishing between which option, *c* or *t*, was chosen.

We next examine whether stated values for the preferred choice vary with the choice set.

H^o_4: V(x,B) = V(x,E)   for x = c, t

Because expectations associated with this test may depend upon the outcome of the previous hypotheses, and because of the possibility of preference reversals (Lichtenstein and Slovic, 1971; Irwin et al., 1993), no alternative directional hypothesis is specified at this point. Nevertheless, the empirical direction of any impact remains a primary interest of this research, as will be discussed.

The third and fourth hypotheses are evaluated following the treatment effects modelling framework initially discussed in Barnow, Cain and Goldberger (1980). Although a full information maximum likelihood estimator is used, this model is most readily described by analogy to the well-known "two-step" selection model developed by Heckman (1976) wherein z is an indicator variable for the presence or absence of a treatment. In our situation, z distinguishes between the choice of *t* (z=1) or *c* (z=0), which is modelled in the "first step" or selection model using a binomial probit model. The differentiating feature of the treatment effects model from the standard selection model is that the treatment effect is endogenous in the "second step" of the modelling process and all observations (rather than a selected subsample) are included in the second step. Formally, following Greene (2002, 2003, 2004), letting WTP = the observed willingness to pay value and WTP* be the corresponding latent variable, the specification of the tobit model[i] with treatment effects is

$$
\begin{aligned}
&\text{WTP*} = \boldsymbol{\beta}'\mathbf{x} + \delta z + \varepsilon,\\
&\text{WTP} \;=\; 0 \text{ if } \text{WTP*} \le 0,\ \text{WTP} = \text{WTP* otherwise},\\
&\text{z*} \quad = \boldsymbol{\alpha}'\mathbf{w} + u,\\
&z \qquad = 1 \text{ if } \text{z*} > 0,\\
&z \qquad = 0 \text{ if } \text{z*} \le 0,\\
&\varepsilon, u \quad \sim N[0,0,\sigma_\varepsilon^2,\sigma_u^2,\rho],
\end{aligned}
$$

where **x** and **w** are vectors of covariates and $\boldsymbol{\beta},\boldsymbol{\alpha}$ and δ are coefficients to be estimated. The standard deviations are σ_ε^2 and σ_u^2, and the covariance is $\rho\sigma_\varepsilon^2\sigma_u^2$ (Greene, 2002, 2003).

3. Results

3.1. Regularity test of asymmetric dominance effects on choice shares: H_1

Table 1 details the choice shares for the various options offered to our two choice task subsamples. Consideration of these findings reveals clear evidence of asymmetric dominance effects. When no decoy is included in the choice set, the choice between target and competitor are approximately evenly split. With the addition of the asymmetrically dominated decoy, it is evident that the choice shares change substantially with the proportion of respondents choosing t increasing noticeably. Only one of the respondents acted "irrationally", choosing the decoy rather than the preferred alternative. This individual is excluded from subsequent analyses. Using standard chi-square tests, the choice shares of *c* and *t* are significantly different (Table 1, All data: $\chi_1^2 = 11.14$, p < 0.01; Table 1, Respondents reporting WTP data: $\chi_1^2 = 8.91$, p<0.01) across choice sets. This leads to a rejection of the null hypothesis H^o_1, indicating that the addition of an asymmetrically dominated decoy does indeed affect the choice shares. A one-sided test of proportions indicates that the alternative hypothesis, that the regularity conditions with respect to *t*, are violated, a finding that demonstrates that asymmetric dominance effects carry over to violations of the regularity conditions in choices involving environmental goods.

[Table 1 here]

3.2. Conditional tests of asymmetric dominance effects on individual choice: H_2.

For both the 'With Decoy' and 'No Decoy' subsamples, Table 2 provides, descriptive statistics for the exogenous choice covariates included in the econometric analysis. These include standard demographic and socio-economic characteristics such as gender, age and income. Also included are indicators of how frequently the individual uses the resource and membership in environmental organizations. Using Chi-square contingency table analyses for the binary variables and independent difference of mean t-tests for the continuous variables, none of the covariates used were found to be significantly different between the 'With Decoy' and 'No Decoy' subsamples.

[Table 2 here]

Binomial Probit selection models allowing for exogenous socio-economic covariates are provided in Table 3 using both the full sample and the observations for which WTP values were reported. The "long" analyses includes all the aforementioned covariates, regardless of significance level. The "short" analysis retain only those that passed a pre-test criteria of 20 percent: i.e., income, and membership in specific environmental organizations. The two membership covariates tend to shift choices in alternative directions: membership in the Royal Society for the Protection of Birds (RSPB) is associated with a rise in the likelihood of choosing the alternative that favoured birds (a reassuringly common sense result); membership in less specific "Green" organizations such as Friends of the Earth is correlated with choosing the competitor (more plants – again this seems a plausible and interesting result). As might be expected for a costless choice, income is not significant in any of the selection models.

[Table 3 here]

Given these covariates, the probit results demonstrate significant impacts of adding the decoy to the choice set ($p < 0.01$) as demonstrated by the coefficient on the With Decoy variable. As such, H^o_2, the null hypothesis of no asymmetric dominance effect, can be rejected. The positive and significant sign on the With Decoy variable further suggests that asymmetric dominance effects observed in other choice settings can be extended to the realm of tradeoffs between environmental goods.

3.3Expansion of the Choice Set and Average WTP – H3

Willingness to pay values by choice set and choice are provided in Table 4. Examination of this 2X2 matrix of values suggests that, ignoring for the moment issues of the endogeneity of treatment choices, average WTP for *t* is higher than average WTP for *c*, and that the addition of the decoy increases the average WTP for *t*. There appears to be a smaller downward effect on average WTP for c when an asymmetrically dominated *t* is added.

[Table 4 here]

The selection model described above was expanded to the treatment effects framework by including the predicted choice as an endogenous variable in the second stage Tobit regression. In the "Average WTP" regression, depicted in the left-hand columns of Table 5, WTP is the dependent variable, and the independent variables include the set of covariates in the long model discussed above. In addition, the "treatment" variable (i.e. the choice of *c* or *t* as represented by "Chose t") is included as an endogenous variable as previously specified – that is the predicted value for "Chose t" from the "first stage" probit analysis is used as an endogenous variable in the "second stage" Tobit analysis.[ii]

[Table 5 here]

Evaluating first the socio-economic covariates, only gender and age do not pass the pre-test significance level of 20 percent. Hence they are not included in the short Tobit model. Income and frequency of visits are each significant and positive, reflecting standard expectations for WTP. WTP is positively correlated with membership in the RSPB, and negatively correlated with membership in a Green organization.

Focusing on the With Decoy effect, we see that adding a decoy is correlated with a positive and significant increase in WTP. This suggests that, on average, the addition of a decoy to a choice set will elevate the WTP function for the remaining options in the choice set. The existence of a treatment effect is indicated by the positive and significant ρ.

3.4 Expansion of the Choice Set and Conditional WTP: H4

The last two columns of Table 5 provide the corrected Tobit estimates in the treatment effects model that distinguishes between the preferred choice (i.e. *c* or *t*) for which values were subsequently elicited. We focus on the coefficients of the binary variables D(chose c), D(decoy) and D(chose t)*D(decoy), which replace the With Decoy variable in the previous analyses. These variables, in conjunction with the Chose T variable, allow us to isolate the WTP values for each of the quadrants in Table 4. If we define D(chose t) = 1- D(chose c), then the four possible combinations are provided below.

	c	*t*
B ={*c*,*t*}	Chose c = 1 D(decoy) = 0	Chose t = 1 D(Decoy) = 0
E={*c*,*t*,*d*}	Chose c = 1 D(decoy) = 1	Chose t = 1 D(decoy) = 1

As such, c=C(B) serves as the baseline in the regression. Our interest at this point is on the binary variables represented in the shaded portion of the above. That is, relative to the baseline, D(chose c)*D(decoy) isolates the effect on WTP of adding the decoy for those individuals that chose c. Similarly, D(chose t)*D(decoy) isolates the effect on WTP of adding the decoy for those individuals that chose t.

As indicated in Table 5 the sign of the decoy effect is positive in both cases. WTP for *c* is not significantly affected by the addition of the decoy to the choice set. However, the decoy effect on WTP for *t* is large and statistically significant at the 1% level by the addition of the decoy to the choice set. To put this is in an economic perspective, note that the size of the decoy effect on WTP is of a similar order of magnitude to the impact of being a frequent visitor to the area. Again ρ is significant, indicated the presence of a treatment effect.

Using sample means of the covariates associated with each of the samples corresponding to the 2X2 matrix above, the estimated conditional willingness to pay values (and corresponding standard errors) are 13.52 (0.09), 14.14 (0.09), 10.46 (0.15) and 22.63 (0.10) for the No Decoy/Chose c, No Decoy/Chose t, With Decoy/Chose c, and With Decoy/Chose t samples, respectively. These predicted, sample specific and treatment corrected values, mirror trends observed in the raw data: the addition of a decoy has a strong upward effect on WTP for the target; there is evidence of a downward effect on WTP for the competitor for this sample.

4. Discussion

Using a data set from a study of proposed environmental management strategy options for a lake in the U.K., this research demonstrates that the asymmetric dominance decoy effects widely observed in the psychological and marketing literatures are also manifested in environmental management choice situations. Furthermore, we demonstrate that this choice anomaly carries over to subsequent valuation exercises. Specifically, we find that the average WTP for a good is significantly larger when it dominates an inferior option in a prior choice set.

The demonstration of asymmetric dominance effects within choice experiments for non-market environmental goods, and the consequential effect upon stated values is we contend an important result. It continues the tradition noted at the start of this paper of anomalies being established within both market priced and non-market goods. Indeed the presence of the asymmetric dominance effect simply confirms the fact that preferences for non-markets goods are generally speaking not inherently different from those for market priced goods; they even share the same anomalies.

This research suggests that biases or anomalies found in other choice settings will also be found in choices regarding public environmental goods. One perspective of this result is positive: hypothetical decisions about public issues are subject to similar inconsistencies that are found in everyday decisions involving real commitments. However, these results also suggest caution as researchers endeavour to expand non-market valuation analyses into decision settings involving wider and more varied choice sets. Since the early work on conjoint analysis in marketing (e.g. Green and Wind, 1973, Malhotra, 1982) it is been well known that the size of the choice set and the numbers of attributes can affect estimates of welfare values. In that context DeShazo and Fermo, 2002, demonstrate the value of building in to the design of a choice experiment the systematic exploration of the impact of choice complexity. They recommend such a procedure to practitioners. In a similar manner, we suggest that researchers using stated preference techniques build into the instrument design tests of asymmetric dominance and the wider class of decoy effects.

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Figure 1. Asymmetric Dominance.

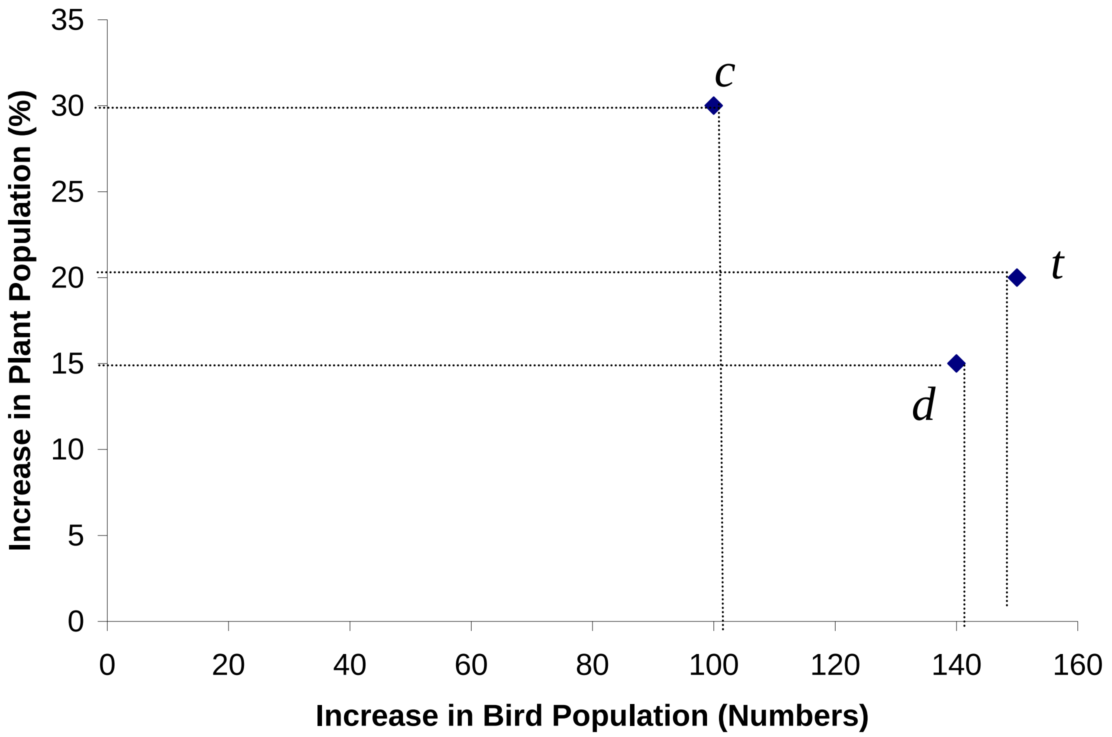

Table 1. Choice Shares by Choice Set (Cell contents are counts with corresponding subsample proportions given in parentheses)

	c	*t*	*d*
	All Data		
{*c*,*t*}	72 (50%)	72 (50%)	-----
{*c*,*t*,*d*}	46 (31%)	103 (69%)	1 (<1%)
	Respondents Reporting WTP		
{*c*,*t*}	62 (48%)	68 (52%)	-----
{*c*,*t*,*d*}	42 (30%)	97 (70%)	1 (<1%)

Note: As defined in the text and demonstrated in Figures 1 and 2, c refers to the competitor, t refers to the target, and d refers to the decoy. Note that d is asymmetrically dominated by t.

Table 2: Descriptive Statistics

Variable	Mean (s.d.)			Mean (s.d.)		
	All Respondents	"No Decoy" Sample	"With Decoy" Sample	Respondents Reporting WTP	"No Decoy" sample	"With Decoy" sample
With Decoy (binary, 1 if{c,t,d,}, zero if {c,t})	0.508	0	1	0.519	0	1
Household Income (£000, continuous, set at midpoint of income brackets)	25.14 (14,183)	23.976 (14,473)	26.275 (13,852)	25.000 (14,174)	23.923 (14,565)	26.000 (13,778)
Frequent visitors (binary, 1 if visits/year > 2, zero otherwise)	0.184	0.188	0.181	0.193	0.192	0.193
Gender (binary, 1 if female, zero otherwise)	0.495	0.500	0.490	0.496	0.500	0.493
Age (continuous, in years)	41.57 (16.87)	41.31 (16.88)	41.82 (16.91)	41.10 (16.97)	40.51 (16.92)	41.65 (17.06)
RSPB (binary, 1 if member of the Royal Society for the Protection of Birds, zero otherwise.)	0.177	0.153	0.201	0.178	0.169	0.186
Greens (binary, 1 if member of green organization[a], zero otherwise)	0.191	0.188	0.195	0.185	0.177	0.193
n	293	144	149	270	130	140

a. "Green" organizations include Greenpeace, Friends of the Earth, and WWFN.

Table 3. Selection Equation, Binomial Probit (target = 1, competitor = 0)

Variable	Estimated Coefficient – All Data (s.e.)		Estimated Coefficient – Respondents Reporting WTP (s.e.)	
	Long Model	Short Model	Short Model	Long Model
Constant	-0.117 (0.279)	-0.164 (0.173)	-0.199 (0.288)	-0.201 (0.182)
With Decoy (binary, 1 if{c,t,d,}, zero if {c,t})	0.512 (0.159)**	0.512 (0.158)**	0.521 (1.67)**	0.522 (0.166)**
Household Income (continuous, set at midpoint of income brackets)	0.00793 (0.00601)	0.00776 (0.00579)	0.0118 (0.00642)	0.0109 (0.00612)
Frequent visitors (binary, 1 if visits/year > 2, zero otherwise)	-0.0667 (0.222)		-0.134 (0.234)	
Gender (binary, 1 if female, zero otherwise)	0.0425 (0.160)		0.063 (0.167)	
Age (continuous, in years)	-0.00150 (0.00471)		-0.00081 (0.00489)	
RSPB (binary, 1 if member of the Royal Society for the Protection of Birds, zero otherwise.)	1.058 (0.252)**	1.046 (0.250)**	1.106 (0.272)**	1.081 (0.268)**
Greens (binary, 1 if member of green organization[a], zero otherwise)	-0.956 (0.211)**	-0.960 (0.209)**	-0.976 (0.223)**	-0.982 (0.221)**
n	293	293	270	270

Note: * and ** denote 5% and 1% significance levels, respectively. Standard errors in parentheses.

Table 4. Mean WTP Values (£'s) by Choice Set and Choice (s.d.)

	C	*t*
{*c*,*t*}	15.45 (21.31)	18.49 (24.10)
{*c*,*t*,*d*}	13.81 (18.42)	24.61 (30.33)

Note: As defined in the text and illustrated in Figures 1 and 2, *c* refers to the competitor, *t* refers to the target, and *d* refers to the decoy. Note: *d* is asymmetrically dominated by *t*. Standard errors are in parentheses.

Table 5. Treatment Effects Model, Corrected Tobit Specification

Variable	Tobit Regression, Accounting for Treatment Effect Coefficient Estimates (s.e.)			
	Average Value Shift		Value Shift by Choice	
	Long Model	Short Model	Long Model	Short Model
Constant	2.67 (6.87)	5.69 (5.44)	4.96 (6.87)	8.15 (5.48)
Chose T	-31.16 (5.84)**	-30.97 (5.67)**	-34.30 (6.31)**	-34.09 (6.18)**
With Decoy	9.58 (4.08)**	9.57 (3.93)**		
D(Chose C)* D(decoy)			6.40 (9.20)	6.45 (8.96)
D(Chose T)*D(decoy)			16.23 (6.15)**	16.24 (6.06)**
Income	0.841 (0.133)**	0.838 (0.118)**	0.818 (0.132)**	0.813 (0.117)**
Frequent Visitor	22.94 (4.31)**	23.55 (4.31)***	22.97 (4.32)**	23.58 (4.31)**
Gender (female =1)	2.86 (3.60)		2.72 (3.56)	
Age	0.041 (0.102)		0.047 (0.100)	
RSPB	10.95 (4.88)*	10.62 (4.77)*	8.91 (4.88)	8.57 (4.80)
Greens	-13.41 (5.38)**	-13.27 (5.28)*	-11.31 (5.33)*	-11.18 (5.20)*
σ	28.32 (1.12)**	28.30 (1.11)**	28.26 (1.15)**	28.24 (1.14)**
ρ	0.809 (0.0474)**	0.807 (0.0473)**	0.813 (0.0480)**	0.810 (0.0471)**
N	270	270	270	270
Log Likelihood Function	-1196.69	-1197.32	-1195.91	-1196.53

Note: * and ** denote 5% and 1% significance levels, respectively. Standard errors in parentheses.

Endnotes

[i] 44 of the 270 WTP responses were £0.00. Corrected ordinary least squares models, do not censor the WTP data at zero, provide qualitatively the same results as reported for the Tobit specification are available from the authors.
[ii] As noted previously the econometric estimation was conducted using full information maximum likelihood procedures developed in Greene (2002).