

## EXTENDING THE SCOPE OF THE SCOPE TEST IN CHOICE EXPERIMENT STUDIES

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**Abstract:** An external scope test is developed and applied to a CE study of nature protection to investigate respondents' sensitivity to scope in relation to substitutes to the project in question. Most of the literature within this field is based on CVM, and scope tests related to increases in the amount of specific goods, e.g. number of endangered species, or scope related to geographical scale. Within-project scope tests are often captured in CE as internal scope. In the present study the external scope test at project level is performed by telling respondents in N-1 splits that the specific project is only one in a series of specific projects to be implemented. Information on other nature restoration projects which will be implemented prior to the project in question is given as well, as a reminder of the scale context. Furthermore, detailed follow-up questions were included to evaluate whether respondents were indeed aware of the scale context in which they stated their choices. Answers to these follow-up questions are used to increase the strength of the external scope test. As a whole, the set-up and the scope analyses are new to the literature, and demonstrate the possible fragility of also the CE method in securing scope sensitivity on a large scale. More importantly, the results also indicate the potential of a suitable and detailed debriefing with follow-up questions for the general accuracy of estimates and more specifically for scope test results.

**Keywords:** External scope, Choice Experiment, biodiversity, archaeological preservation, Mixed Logit models.

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## 1. Introduction

The entire field of environmental valuation is concerned with the valuation of changes in the state of environmental goods (or 'bads'). A key challenge here is the fact that many of these goods are not traded in the marketplace, and for this reason the use of Stated Preference methods has long been widespread. While these methods have obvious strengths, they are by no means perfect. One weakness is the issue of sensitivity to scope. Since the seminal paper by Kahnemann and Knetsch (1992), much of the methodological development has focused on respondents' sensitivity to the amount of the goods provided.

A terminology has also developed for categorising scope tests; that is tests for respondents' sensitivity to scope. An internal scope test analyses whether the same set of respondents is (on average) able to respond to differences in scale when the respondents are presented with various scales of the environmental good(s) in question. In an external scope test, different respondents are presented with the same environmental goods but on different scales, and the analyses will reveal if the groups presented with the better alternatives also signal a higher willingness-to-pay (WTP). This terminology has been developed in connection with the Contingent Valuation Method (CVM) and e.g. Giraud et al. (1999) is a state-of-art example of the application.

In recent years, however, the use of the Choice Experiment method (CE) has grown remarkably, and this method is believed to do better than CVM with regard to the issue of sensitivity to scale (Adamowicz et al., 1998). By construction, it would appear that a CE allows the respondent to evaluate and perform trade-offs among attributes at various levels, and indeed nice examples of internal scope consistency can be found in the literature (e.g. Jacobsen et al., 2007). An *external* scope test in CE can be based on split samples just as with CV, but the scope test needs to be

constructed differently from CV as the good which varies in quantity cannot form part of the attributes in the choice sets themselves. The main purpose of this study is therefore to design and perform such an external scope test. The test is based on a CE study of the Danish population's willingness-to-pay for a nature restoration project in the Great Aamose area in West Zealand.

The nature restoration project in Great Aamose, however, is only one of several projects currently considered to be of relevance in the realm of publicly funded nature restoration projects in coming years. For instance, establishment of a number of national nature parks in the near future is currently under consideration. The natural question raised by policy makers is: Do the values derived from an environmental valuation study of one restoration project depend on the overall scale of Danish nature restoration activities? For instance, would people state differing WTP for one particular project if they knew it was going to be one out of three, seven or ten projects producing environmental goods and services of a similar character, i.e. could the projects be considered as substitutes?

These questions form an obvious basis for the design of an external scope test applied to the case of the nature restoration project in Great Aamose. Three different versions of the CE instrument have been developed which differ from each other only in one aspect. In the first version (split), the Great Aamose project is presented alone. In the second, it is specified that future implementation of two national park projects has already been decided upon, and that the Great Aamose project will be additional to these. In the third, the number of national park projects decided upon is increased to 7. This setup is novel, and it may also be complex for respondents. To evaluate respondents' ability to grasp the overall scale context, we have developed detailed follow-up questions intended to reveal if the respondent answers the choice sets with the appropriate overall scale context in mind.

The remainder of the paper is organised as follows. In section two the methodological background is outlined, comprising a detailed review of the literature relating our contribution to the state-of-the-art. The econometric theory and models applied are briefly described. Section three comprises a short, detailed description of the study area and a description of the questionnaire design and data collection method. The results are presented in section four and in section five we discuss various implications of the results. We provide a brief conclusion and some recommendations for further work in section six.

## **2. Theory and Methods**

### *2.1 The issue of embedding vs. scope sensitivity*

Though criticised a great deal (by e.g. Carson and Mitchell, 1995; Smith, 1992), the paper by Kahnemann and Knetsch (1992) remains one of the most important studies addressing the problem of embedding in Stated Preference studies, i.e. that people tend to state the same WTP irrespective of the quantity provided of a given environmental good. Carson and Mitchell (1995) argue that some embedding problems may in fact be caused by goods/attributes being nested within each other, and hence the comparison across scales is complicated. In a meta-study of WTP estimates for species preservation, primarily in the USA, Loomis and White (1996) find that overall embedding is a small problem. Also Smith and Osborne (1996) perform a meta-study and find a clear response to scope related to the visibility in national parks. Giraud et al. (1999) analyse sensitivity to scope in a dichotomous choice study of the Mexican spotted owl and 62 unnamed species. They find larger WTP for the 62 species than for the one named species when tested with an external test (split sample) but not when tested internally, i.e. the respondents were given two dichotomous choice questions in a row. Jakobsson and Dragun (2001) and White et al. (1997) argue along the lines of

Carson and Mitchell (1995) that, for example, one species presented to respondents might represent wider biodiversity to respondents than just the one species in question. More recently, Veisten et al. (2004) evaluate scope sensitivity in a study of species preservation on various scales. Most of the abovementioned studies use a scope test related to the amount or scale of the specific good, e.g. number of endangered species. Other studies use geographical extension as the basis for scope variation (e.g. Berrens et al., 2000; Jorgensen et al., 2001). As described above, in this paper we present the respondents with implementation of additional nature preservation projects which could serve as substitute goods for the case study area. Obviously, we expect respondents to consider this and attach a lower value to the implementation of the Great Aamose project if it is presented to them as coming on top of two or more similar or related projects.

Heberlein et al. (2005) discuss the concept of sensitivity to scope, and question the usual tests based on psychological reasons. One of their main arguments is that the part may be worth more if respondents know more about it than about the whole. Bateman et al. (2004) also question the usual internal scope tests as undertaken in CVM studies, and especially they question self-administered surveys, as respondents are able to look ahead and thereby create an internal consistency in their response.

All of the abovementioned studies of embedding and scope sensitivity (internal as well as external) rely on the CV method. Evidently, results have been mixed and hence confidence in the method is still an issue. As pointed out earlier, the use of CE may perhaps reduce embedding problems (Adamowicz et al., 1998) and several studies have tested this, at least with respect to internal scope (Foster and Mourato, 2003; Boxall et al., 1996; Hanley et al., 1998; Lehtonen et al., 2003). By means of its construction, it would appear that a CE allows the respondent to better relate to trade-

offs among attributes at various levels; and one may find quite nice examples of responsiveness to scale, such as e.g. in Jacobsen et al. (2007) who finds that the method passes the ‘internal scope test’. Studies undertaking an external scope test in a CE are however scarce.

Sensitivity to scope may depend on respondents’ reasons for revealing a positive WTP. For example, if respondents see the good in question as a more or less unique good and are less willing to trade, sensitivity will not be as pronounced. It is standard to use follow-up questions, e.g. for recoding of given answers, when evaluating stated WTP-measures. For example, Foster and Mourato (2003) test the implications of coding ‘Don’t know’ responses as ‘yes’ and ‘no’, respectively. Bateman et al. (2004) used screening questions to identify protest bidders, but did not find that the scope result was dependent on this practice. Giraud et al. (1999) included follow-up questions in their questionnaire, but not in the model and analysis presented. Heberlein et al. (2005) discuss the implication of protest voters and the associated possible bias. Also, Jorgensen et al. (2001) discuss protest bidders with respect to the payment vehicle. They find insensitivity to scope when respondents revealed that they dislike the valuation process, and find that the distribution of protest voters is independent of scope. All these studies are related to CVM and, furthermore, focus mainly on the effect of follow-up questions designed to reveal protest bidders but not designed to test the respondents’ understanding of scope.

In the present study we design follow-up questions for all respondents to induce them to state their perception of the scale context in which they answered the choice questions. We use these answers to improve our analysis of the sensitivity to scope.

## 2.2. The econometric foundation of Choice Experiments

The main results focused upon in this paper were produced using the stated preference technique known as CE. This method relies on McFadden's (1974) random utility model, where the utility of a good is described as a function of its attributes, and people choose among complex goods by evaluating their attributes. Since observation of utility can only be made imperfectly, the random utility model is the fundament for estimation:

$$U_{ij} = V_{ij}(x_j, z_i, t_j) + \varepsilon_{ij} \quad (1)$$

Here  $U_{ij}$  is the  $i$ 'th individual's utility of the good described by alternative  $j$ .  $V_{ij}$  is a deterministic term depending on the alternatives' attributes  $x_j$ , the individual's characteristics,  $z_i$ , and the price  $t$ . The term  $\varepsilon_{ij}$  is stochastic in the sense that its variation cannot be observed by the analyst. Faced with the choice between two alternatives, the probability that the respondent will choose alternative  $k$  (over alternative  $j$ ) can then be described as:

$$\Pr_{ki} = \Pr\left(u_{ki}(y_i - t_k, z_i, \varepsilon_{ki}) > u_{ji}(y_i, z_i, \varepsilon_{ji}) \quad \forall j \neq k\right) \quad (2)$$

where  $u_{ki}$  is the utility of alternative  $k$ ,  $u_{ji}$  of alternative  $j$  and  $y_i$  is the individual's income. The other parameters are as above. It is assumed that  $u$  is linear in income and its other deterministic parameters  $u_{ki}$  are replaced with  $\beta'x_{ki}$ , where  $x_{ki}$  represents a vector of variables related to alternative  $k$  that we are able to observe. Also, assuming that  $\varepsilon_{ki}$  is logistically distributed, the probability of an individual  $i$  choosing alternative  $k$  can be defined by the Conditional Logit model:

$$\Pr(ki) = \frac{\exp^{\beta'x_{ki}}}{\sum_j^J \exp^{\beta'x_{ji}}} \quad (3)$$

Following Train (2003) the Mixed Logit probabilities can be described as integrals of the standard logit function evaluated at different  $\beta$ 's with a density function as the mixing distribution. If the density, as in this paper, is specified to be normal the probabilities of the model becomes:

$$\Pr(ki) = \int \left( \frac{\exp^{\beta'x_{ki}}}{\sum_j \exp^{\beta'x_{ji}}} \right) \phi(\beta|b, W) d\beta \quad (4)$$

where  $\phi(\beta|b, W)$  is the distribution function for  $\beta$ , with mean  $b$  and covariance  $W$ . The analyst chooses the appropriate distribution for each parameter in  $\beta$ . This is a standard and well-known setup, which is applied to the CE data analysed here.

### 3. The design of the survey

This section contains a description of the data collection procedure followed by a brief introduction to the Great Aamose nature restoration project and the proposed national parks. Finally the survey design is described in detail.

#### 3.1 Data collection

Data were collected through an internet-based questionnaire managed by the professional survey institute GALLUP using their internet panel of approx. 35,000 individuals. For each version of the questionnaire, responses from approx. 350 respondents were received. It is considered here that internet presentation of information is less cognitive demanding than a mailed questionnaire as the questions and the choice sets are presented one by one and, furthermore, the possibility of presenting information, including photos, is good. Also, especially in relation to inclusion of the follow-up questions concerning respondents' perception of scope, it was imperative to ensure that respondents could not browse back to the choice sets.

### *3.2 The nature restoration project in Great Aamose*

The Great Aamose area is situated in the Western part of the island Zealand in Denmark and was originally one of the largest wet moorland areas in the eastern part of Denmark. The area has been cultivated over the past 250 years, the latest and most dominating changes having been implemented in the 1950s and 1960s, when the stream was converted to a channel and the area was heavily drained. Today a large part of the area is in agricultural use, even if most is not under intensive cultivation.

The proposed nature protection project would create a large and coherent nature area, enhance biological diversity and recreational opportunities, as well as preserve cultural heritage and archeological artefacts buried in the topsoil and threatened by the continued agricultural production in the area. Wetland restoration will protect these cultural assets for future generations.

### *3.3 The national parks*

In order to improve nature protection in Denmark seven pilot projects have been nominated as potential national park candidates. A number of them are going to be realised and a law has been prepared to underpin their administration. It is, however, not yet decided how many national parks will be implemented in the short run. Just as for Great Aamose, the aim of the projects is to create large coherent nature areas of a natural or semi-natural character to secure nature preservation, improve possibilities for recreation and to an extent also protect cultural heritage. Obviously, the projects can be regarded as substitutes for the area Great Aamose.

### 3.4. *The design of the questionnaire, including the design of the scope test*

We have used a split-sample approach where each of three splits was treated with a questionnaire<sup>2</sup> that differed *only* in the following aspects. In two of the splits the respondents were informed that recently it had been politically decided to establish large nature areas in Denmark, including 2 or 7 national parks. It was specified that these were to be established prior to the possible restoration of Great Aamose with which the choice sets were solely concerned. As an introduction to the nature protection area in Great Aamose the respondents were informed about nature protection and the effects of the proposed project. The respondents were informed that the new nature areas, including the forthcoming national parks, will establish large coherent nature areas and landscapes to enhance the biological diversity by improving the living conditions for rare as well as more common species. Cultural values and artefacts will be protected by the nature restoration, because many of these areas are historically and culturally rich areas, and access to the areas will be enhanced.

After this introduction the nature restoration project in Great Aamose was presented to the respondents. To encourage the respondents in those splits where they were also informed about the national parks to think of these areas as substitutes, they were requested to choose three of the potential national park projects as their most preferred. To induce them to reflect on payment and its dependence on scale, the respondents were furthermore informed that the forthcoming national parks will be financed by income tax, and that this also will be the case for Great Aamose. The respondents were informed that the costs of implementing the policy alternatives are to be assumed to be covered by Danish consumers and that all consumers will contribute to implementation of the alternatives. Moreover, it is emphasised that the stated amounts (WTP) represent sums over and above the consumers' present tax payments. This text is intended to induce respondents to provide

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<sup>2</sup> For a full questionnaire please contact the corresponding author

as valid and reliable responses as possible and to discourage the exhibition of strategic behaviour. Highlighting that all consumers must contribute, and that they must do so equally, is intended to discourage respondents from free-riding. Likewise, stipulating that the stated amounts are additional to current tax payments is considered relevant as it may serve to remind respondents that the amount they are asked to pay in the present survey represents, in fact, only one payment among many expenses that they have to consider against the constraints of their budgets. In addition to the above, a so-called ‘cheap talk’ is also included.

The choice of payment vehicle forms a substantive part of any survey design and should have a plausible connection with the good it is being used to value (Bateman et al., 2002). An entrance payment could have been used as payment vehicle in this study but would have delimited the analysis to use values, and according to the results of the focus group tests the annual tax was found to be a reliable payment vehicle.

In each of the splits a total of 9 choice sets were presented to each respondent. The choice sets were similar across splits to avoid variation from this feature. The alternatives were described by 5 attributes which are presented in Table 1.

Table 1. The attributes used in the CE

ATTRIBUTE	LEVELS
The acreage of the protected area in hectare	6 levels between 230 and 1,750 hectares
Biodiversity	<p><b>Small diversity:</b> A large number of animals, but distributed among a smaller number of ordinary species. Vulnerable and rare species are threatened by distinction because of dry conditions and cultivation.</p> <p><b>Some diversity:</b> Many animals distributed among a larger number of ordinary species, including small birds. Vulnerable and rare plants are only threatened by distinction few places.</p> <p><b>Large diversity:</b> Many ordinary and rare animal species, especially bird species. Rare species are protected against dry conditions and cultivation.</p>
Protection of the ancient artefacts	<p><b>Continued devastation:</b> Important artefacts, including internationally unique sacrificial and places of residence will be demolished within in a number of years.</p> <p><b>Reduced devastation:</b> The tempo of the devastation is reduced significantly for some of the most important artefacts, but the devastation is not brought to an end.</p> <p><b>Protection now and in the future:</b> The artefacts will be protected within the soil now and in the future so that they can be removed from the soil and presented in the future</p>
Public access	<p><b>Restricted access</b> by a few tracks and paths</p> <p><b>Extended access</b> to a larger part of the area by a larger system of paths and tracks</p>
Extra payment in annual tax (household level)	6 levels of 0, 10, 34, 61, 115 and 203 EUR

The combination of the alternatives into choice sets was performed using a fractional factorial design containing 36 alternatives, corresponding to 18 choice sets, which subsequently were blocked into 2 blocks of 9 choice sets.

Each respondent was then presented with one block To avoid forcing respondents to choose alternatives which they did not identify with (cf. Bateman et al, 2002), a status-quo alternative describing the baseline situation that would prevail if no further action is taken was added to the choice set, and thus each choice set contained three alternatives. The status quo implies continued loss of artefacts, and maintenance of the current level of biodiversity and current level of accessibility to the area.

In addition, a number of debriefing questions were asked to identify protest behaviour and to follow up on the scope test. The debriefing questions can be seen in Figure 1 below.

Figure 1. Debriefing questions concerning the scope context. The question is related to Split 2 where respondents were informed about 2 national park projects. In Split 3 the number of national parks was raised to 7.

***The previous questions, where you had to choose between alternatives, concerned payment for nature restoration. Which of the following statements are correct?***

*(mark one)*

The payment only concerned the restoration of Great Aamose .....

The payment concerned 2 national parks .....

The payment concerned 2 national parks and Great Aamose .....

The payment concerned nature in general .....

I don't know.....

Prior to the launch of the survey three focus groups were used to test the questionnaire. One of the main foci of these was participants' perception of the scope tests, including information on the potential implementation of substitute projects in the form of the 2 and 7 national parks located in

various places in Denmark. The questionnaire was revised following each of these focus group interviews.

#### **4. Results**

Respondents were invited to answer the questionnaire in December 2006 and the survey continued until the required number of responses had been returned. The three samples are somewhat underrepresented in terms of respondents in the group above 60 years of age and, thereby, somewhat underrepresented in the low income group compared with the population in Denmark. This may partly be due to the choice of an internet-based survey mode. However, it is our experience that the survey mode seems to be as representative as other survey modes (Hasler et al., 2005; Olsen and Lundhede 2005). In relation to the findings of this paper, though, it is important to note that there is no difference in age, gender and income between the three sample splits.

The data are analysed using the mixed logit approach where, for selected attributes, preference heterogeneity is allowed for. The tax payment and the alternative specific constant are held fixed in the estimations, whereas all other coefficients are assumed to be normally distributed around the sample mean. The estimations are based on simulations with 1,000 random draws, and in order to reduce estimation time the cost variable (Tax) has been divided by 100.

Table 2. Sample size reduction

	Split 1 Only Great Aamose	Split 2 Great Aamose and 2 additional nature areas	Split 3 Great Aamose and 7 additional nature areas
<b>Initial number of respondents</b>	<b>360</b>	<b>355</b>	<b>359</b>
- Protesters (I don't want to pay more tax, I don't know why I chose the status quo in all 9 choice situations)	-16 4.4%	-11 3.1%	-18 5.1%
- Mental account (My payment concerned nature in general)	-36 10.0%	-27 7.6%	-21 5.8%
<b>Sample left for initial estimation</b>	<b>308</b>	<b>317</b>	<b>320</b>
- The payment concerned 2(7) national parks	n/a	-24 6.8%	-19 5.3
- The payment concerned 2(7) national parks and Great Aamose	n/a	-43 12.1%	-49 13.6%
- Don't know (what the payment concerned)	-34 9.4%	-39 11.0%	-29 8.1%
<b>Reduced sample</b>	<b>274</b>	<b>211</b>	<b>223</b>

The data are analysed in two steps. First, respondents who chose the status quo alternative in all 9 choice sets and explained this with 'I don't want to pay more tax' (protest) or 'I don't know why' were removed from the data sample (See Table 2). In the same step respondents who stated 'My payment concerned nature in general' were also removed from the sample; the reason being that they are considered not to have related to the issue at hand, and that rather their answers are likely to reflect what is known as 'mental account dumping'. The resulting sample we call Reduced Sample 1.

Looking at Table 2, it is evident that in Split Samples 2 and 3 a total of almost 20 percent of the respondents have carried out the valuation task with an 'incorrect' good in mind, or in other words have valued a different scope. Furthermore, between 8 and 11 percent were not able to single out the scope of the valuation study at all, by answering 'I don't know'. We exclude these groups in a second reduction of the sample resulting in Reduced Sample 2.

Estimations based on the resulting reduced sample, called Reduced Sample 1, are presented in Table 3.

Table 3. Results of mixed logit estimation using Reduced Sample 1.

Name	Base case Only Great Aamose		Great Aamose and 2 additional nature areas		Great Aamose and 7 additional nature areas	
	Parameter estimate	t-test	Parameter estimate	t-test	Parameter estimate	t-test
Area (per 100 hectare) ( $\mu$ )	0.04 *	2.46	0.04 *	2.76	0.04 **	3.37
Area (per 100 hectare) ( $\sigma$ )	0.07	1.03	-0.02	0.26	0.00	0.01
Alternative Specific Const.	-0.45 *	-2.17	0.14	0.66	-0.44 *	-2.91
High Biodiversity ( $\mu$ )	1.31 ***	5.27	1.09 **	4.09	0.92 ***	5.44
High Biodiversity ( $\sigma$ )	1.60 *	2.47	2.47 *	2.94	1.14	1.90
Some Biodiversity ( $\mu$ )	0.70 **	3.85	0.64 **	3.30	0.47 **	3.43
Some Biodiversity ( $\sigma$ )	0.13	0.25	0.56	0.72	0.07	0.14
Extended Access ( $\mu$ )	-0.22	-1.71	0.09	0.72	0.04	0.47
Extended Access ( $\sigma$ )	1.29 *	2.42	1.46 *	2.31	0.04	0.06
Preservation of artefacts ( $\mu$ )	1.55 ***	5.68	2.09 ***	4.73	1.43 ***	7.17
Preservation of artefacts ( $\sigma$ )	3.14 ***	4.77	3.85 **	4.19	2.76 ***	4.71
Reduced devastation ( $\mu$ )	1.17 ***	5.56	1.30 ***	4.85	0.77 ***	6.23
Reduced devastation ( $\sigma$ )	1.88 **	3.72	1.75 *	2.87	1.51 **	3.54
Annual tax payment	-0.23 ***	-6.92	-0.25 ***	-5.11	-0.19 ***	-8.05
N	2772		2853		2880	
LL-value	-2467.98		-2621.41		-2551.63	
$\chi^2$	1154.74		1025.87		1224.75	
Adjusted R <sup>2</sup>	0.18499		0.15918		0.18912	

Note: One asterisk indicates significance at the 95% level, two asterisks at 99% and three asterisks at the 99.9% level. Means are indicated by  $\mu$  and the corresponding standard error by  $\sigma$ .

Except for the parameter for the mean of Extended Access, all the mean parameters are significantly different from zero. As we would expect the parameter estimate for ‘High Biodiversity’ is larger than the estimate for ‘Some Biodiversity’ in the models of all three splits. Also, the estimates for ‘Preservation of artefacts’ are larger than those for ‘Reduced devastation of artefacts’. Furthermore, the ‘Area’ attribute is significant and has the expected sign. The respondents thus pass the internal test of scope in regard to these three attributes. To compare the estimations across the three splits we look at WTP, thus bypassing the complex of potential scale parameters. The WTP shown in Table 4 are calculated as rates of substitution between an attribute and the ‘Tax’ variable.

**Table 4.** WTP estimates in EUR corresponding to the model in Table 3 and hence based on Reduced Sample 1

	WTP Base case Only Great Aamose	WTP Great Aamose and 2 additional nature areas	WTP Great Aamose and 7 additional nature areas
Area (per 100 hectare)	2.07 (0.57– 3.57)	2.16 (0.8– 3.52)	2.54 (1.09– 3.99)
Alternative Specific Const.	-26.09 (-49.88– -2.28)	7.08 (-13.51– 27.67)	-31.00 (-52.74– -9.25)
High Biodiversity	76.20 (58.94– 93.45)	57.07 (40.56– 73.57)	65.87 (49.09– 82.64)
Some Biodiversity	40.90 (24.91– 56.89)	33.67 (18.22– 49.11)	33.27 (17.98– 48.56)
Extended Access	-12.94 (-26.91– 1.03)	4.85 (-8.37– 18.07)	2.76 (-8.54– 14.06)
Preservation of artefacts	90.66 (71.17– 110.13)	108.94 (88.67– 129.21)	101.95 (83.37– 120.52)
Reduced devastation of artefacts	68.17 (52.28– 84.05)	67.88 (52.07– 83.68)	55.09 (40.16– 70.01)

*Note:* The 95% confidence intervals in parentheses are approximated using the Delta method (Greene, 2000) and refer to the estimation uncertainty of the sample estimates of the mean, and not the distribution of the mean in the population. WTP are converted from DKK to EUR by a rate of 758.

For most attributes with mean WTP significantly different from zero, there is a tendency for reduced WTP as substitutes are introduced. However, the overall impression is not clear-cut as especially the pattern of decrease does not carry as well from 2 to 7 substitutes as from 0 to 2. One remarkable exception, though, is the WTP for ‘Preservation of artefacts’ which shows no tendency to fall in value as more national park areas are pointed out for respondents. Rather, the tendency, even if not significant, is an increase.

From Table 2 we know that the Split Samples 2 and 3 still include quite a number of respondents who are apparently not fully aware of the scale context in which they made their choices. Table 5 shows the result of an estimation based on Reduced Sample 2, excluding all respondents who did not answer the debriefing questions ‘correctly’.

Table 5. Results of mixed logit estimation using Reduced Sample 2.

Name	Base case Only Great Aamose		Great Aamose and 2 additional nature areas		Great Aamose and 7 additional nature areas	
	Parameter estimate	t-test	Parameter estimate	t-test	Parameter estimate	t-test
Area (per 100 hectare) ( $\mu$ )	0.04 *	2.71	0.05 *	2.59	0.04 **	3.36
Area (per 100 hectare) ( $\sigma$ )	0.05	0.78	0.05	0.58	0.02	0.23
Alternative Specific Const.	-0.41	-2.11	0.01	0.04	-0.47 *	-2.45
High Biodiversity ( $\mu$ )	1.30 ***	4.91	1.16 **	3.44	1.00 ***	4.36
High Biodiversity ( $\sigma$ )	1.44 *	2.16	2.47 *	2.49	1.25	1.96
Some Biodiversity ( $\mu$ )	0.78 **	4.04	0.77 **	3.15	0.58 **	3.17
Some Biodiversity ( $\sigma$ )	0.07	0.14	0.64	0.54	0.19	0.36
Extended Access ( $\mu$ )	-0.15	-1.42	0.20	1.38	0.01	0.10
Extended Access ( $\sigma$ )	0.83	1.48	0.98	1.31	0.24	0.33
Preservation of artefacts ( $\mu$ )	1.34 ***	5.31	2.05 **	3.86	1.49 ***	5.65
Preservation of artefacts ( $\sigma$ )	2.78 ***	4.35	3.55 **	3.61	2.56 **	3.65
Reduced devastation ( $\mu$ )	1.03 ***	5.25	1.37 **	3.95	0.71 ***	4.85
Reduced devastation ( $\sigma$ )	1.57 **	3.17	1.56 *	2.24	1.10	1.96
Annual tax payment	-0.22 ***	-6.37	-0.28 **	-4.11	-0.19 ***	-6.23
N	2466		1899		2007	
LL-value	-2147.07		-2086.26		-1719.75	
$\chi^2$	1124.22		854.54		970.332	
Adjusted R <sup>2</sup>	0.202317		0.198091		0.213689	

Note: One asterisk indicates significance at the 95% level, two asterisks at 99% and three asterisks at the 99.9% level. Means are indicated by  $\mu$  and the corresponding standard error by  $\sigma$ .

The first thing to notice from Table 5 compared with Table 3 is that, as a result of the sample reduction, the overall Log-Likelihood has improved and the Adjusted R<sup>2</sup> has improved by more than 10%. Apart from this, the number of significant sample means remains more or less the same as in Table 3. The signs and the relative sizes of related attributes also in these reduced samples correspond to those expected under internal scope consistency.

Table 6. WTP estimates in EUR based on Reduced Sample 2.

	WTP Base case Only Great Aamose	WTP Great Aamose and 2 additional nature areas	WTP Great Aamose and 7 additional nature areas
Area (per 100 hectare)	2.28 (0.83– 3.72)	2.47 (0.94– 3.99)	3.08 (1.39– 4.76)
Alternative Specific Const.	-24.18 (-47.52– -0.82)	0.49 (-23.5– 24.48)	-32.33 (-60.04– -4.62)
High Biodiversity	76.37 (59.47– 93.26)	55.40 (37.59– 73.21)	69.25 (49.36– 89.14)
Some Biodiversity	45.91 (30.91– 60.9)	36.85 (19.98– 53.71)	40.06 (22.13– 57.99)
Extended Access	-9.07 (-21.03– 2.88)	9.71 (-3.39– 22.8)	0.64 (-12.3– 13.58)
Preservation of artefacts	78.62 (60.79– 96.44)	97.65 (77.06– 118.22)	103.05 (81.71– 124.38)
Reduced devastation of artefacts	60.75 (46.17– 75.32)	65.13 (48.78– 81.48)	49.07 (31.86– 66.27)

*Note:* The 95% confidence intervals in parentheses are approximated using the Delta method (Greene, 2000) and refer to the estimation uncertainty of the sample estimates of the mean, and not the distribution of the mean in the population. WTP are converted from DKK to EUR by a rate of 758.

Even if these reduced samples include only respondents who apparently understood the scope context correctly, cf. Table 2, they are unfortunately not able clearly to signal WTP estimates that reflect this. In Table 6, we see a similar tendency towards smaller WTP for at least the biodiversity related attributes, whereas some of the other attributes again remain either rather constant (like Area) or show a tendency to increase (Preservation of artefacts).

The first focus group interviews confirmed that the scope aspect of the questionnaire could be a difficult one to understand in the manner intended, and to ease the task it was explained explicitly that they should only consider Great Aamose in their choices and imagine that they had already paid for the national parks. This information was repeated before each choice set, and in the last focus group interview the respondents were happy with this text. From Table 2 we can see that even after

these reminders the scope test has been difficult to understand, and hence the debriefing questions are valuable as they enable us to identify these responses and remove them from the sample. Furthermore, one could argue that because of the general level of the scope effects considered here, the additional step in scale from 2 to 7 substitutes for the Great Aamose may be less clear than the difference between only Great Aamose and then the presence of substitutes. For these reasons, in Table 7 we present an estimation where the samples of Split 2 and 3 have been merged.

Table 7. Estimation results of mixed logit, Reduced Sample 2

Name	Base case Only Great Aamose		Great Aamose and additional nature areas ( 2 and 7)	
	Parameter estimate	t-test	Parameter estimate	t-test
Area (per 100 hectare) ( $\mu$ )	0.04 *	2.71	0.04 ***	4.48
Area (per 100 hectare) ( $\sigma$ )	0.05	0.78	-0.00	0.01
Alternative Specific Const.	-0.41	-2.11	-0.26	-1.88
High Biodiversity ( $\mu$ )	1.30 ***	4.91	1.01 ***	6.04
High Biodiversity ( $\sigma$ )	1.44 *	2.16	1.56 **	3.47
Some Biodiversity ( $\mu$ )	0.78 **	4.04	0.64 ***	4.82
Some Biodiversity ( $\sigma$ )	0.07	0.14	0.06	0.12
Extended Access ( $\mu$ )	-0.15	-1.42	0.09	1.25
Extended Access ( $\sigma$ )	0.83	1.48	0.32	0.49
Preservation of artefacts ( $\mu$ )	1.34 ***	5.31	1.61 ***	8.03
Preservation of artefacts ( $\sigma$ )	2.78 ***	4.35	2.86 ***	5.83
Reduced devastation ( $\mu$ )	1.03 ***	5.25	0.92 ***	7.41
Reduced devastation ( $\sigma$ )	1.57 **	3.17	1.17 **	3.18
Annual tax payment	-0.22 ***	-6.37	-0.21 ***	-9.02
N	2466		3906	
LL-value	-2147.07		-3390.36	
$\chi^2$	1124.22		1801.63	
Adjusted R <sup>2</sup>	0.20231		0.20666	

Note: One asterisk indicates significance at the 95% level, two asterisks at 99% and three asterisks at the 99.9% level. Means are indicated by  $\mu$  and the corresponding standard error by  $\sigma$ .

The resulting WTP estimates for mean parameters and confidence intervals are presented in Table 8. Here there is a strong tendency for decreasing WTP for the biodiversity attributes, and an almost identical tendency for the ‘Reduced devastation of artefacts’ attribute. There is a small but insignificant increase in the ‘Area’ attribute, whereas the ASC and the ‘Extended Access’ are

insignificant altogether. Again, a rather strong tendency for ‘Preservation of artefacts’ to increase is seen.

**Table 8.** WTP estimates in EUR, Reduced Sample 2

	WTP Base case Only Great Aamose	WTP Great Aamose and additional nature areas (2 and 7)
Area (per 100 hectare)	2.28 (0.83– 3.72)	2.67 (1.55– 3.78)
Alternative Specific Const.	-24.18 (-47.52– -0.82)	-16.03 (-33.33– 1.27)
High Biodiversity	76.37 (59.47– 93.26)	62.74 (49.46– 76.01)
Some Biodiversity	45.91 (30.91– 60.9)	39.65 (28.09– 51.2)
Extended Access	-9.07 (-21.03– 2.88)	5.70 (-3.19– 14.58)
Preservation of artefacts	78.62 (60.79– 96.44)	100.14 (85.41– 114.86)
Reduced devastation of artefacts	60.75 (46.17– 75.32)	57.52 (45.76– 69.26)

*Note:* The 95% confidence intervals in parentheses are approximated using the Delta method (Greene, 2000). WTP are converted from DKK to EUR by a rate of 758.

## 5. Discussion

The careful split-sample approach in this CE study allows us to evaluate issues of embedding, not only within each split sample (internal scope) but also between them (external scope), and to evaluate how careful design of follow-up questions may be used in the test of external scope effects.

### 5.1 Internal scope

Our results clearly demonstrate that respondents, through their choices, can relate to the level of attributes. We find that the parameter estimates of attributes for improved protection of biodiversity as well as the cultural heritage have the expected signs, and that parameter estimates of high level

attributes are always higher – often significantly higher – than the low level estimates. The ‘Area’ attribute is also significant and has the expected sign. Thus, within each split the CE study passes the ‘weak internal scope test’ in the sense of e.g. Corso et al. (2001) and Giraud et al. (1999). WTP for reduced access is seen not to be significant.

The strong evidence of internal scope sensitivity is of course found in a setting where each respondent is faced with a number of different choice sets. The question arises if attribute-oriented design of the CE method causes respondents to become aware of their true preferences and trade-offs among attributes. Or the question arises if the structure instead inspires them to construct and state preferences which they realise fit the form of the questionnaire, but which they do not truly hold (see Braga and Starmer (2005) for a general discussion in stated preference questions). The latter would be an argument along the lines of Arrow et al. (1993) who point out the potential weakness of internal scope-sensitivity tests. However, the complexity facing the respondent in a CE like the present survey differs greatly from that in the typical CV questions behind many embedding analyses. Typical examples are those of Heberlein et al. (2005) as well as Veisten et al. (2004), where respondents in a CV survey are presented with two or three questions concerning part of or the whole good, e.g. one or two species, or the entire biodiversity of a particular habitat. This design should make it quite easy for the respondents to consider the consistency of their answers across questions. In CE respondents are not presented first with a full good, and then a part. Rather, people are asked to respond to often quite complex choice sets, where the levels of several attributes vary across alternatives. This makes it much more difficult for the respondents to check their internal consistency in choices, especially in an internet based survey like the present one, where respondents cannot easily check their answers across choice sets. Therefore, we argue that internal evidence of scope sensitivity represents a stronger test here than in CV.

## 5.2 External scope

The results from the external scope test are not as clear as for the internal. This could simply be due to poor design of the external scope test, but we do not believe this to be the case. It is therefore worth looking for reasons for the lack of scope sensitivity.

With reference to the results for the biodiversity attribute, a weak tendency to reduced WTP for the splits referring to national parks is found. However, we do not see the expected difference between the WTP estimates derived from the samples concerning establishment of 2 and 7 parks, respectively. As mentioned in the introduction, it was anticipated that the potential national parks represented good substitutes for Great Aamose in the test for external scope. However, the respondents may not have perceived the national parks as being as good substitutes for Great Aamose as we expected. If respondents state a WTP for Great Aamose due to a general awareness of nature preservation we would expect sensitivity to scope, as establishment of national parks is just another way of providing the same preservation<sup>3</sup>. This may be the case for the attribute biodiversity where we see the best reaction to scope. When the scope effect is not as clear it may be because Great Aamose is seen as a unique area which cannot be substituted with others.

The most remarkable lack of scope effect is seen in the attribute for preservation of artefacts. As respondents were told at the beginning of the questionnaire that Great Aamose is a unique area for preservation of artefacts from the Stone Age they would not be expected to react to external scope, as the focus in most of the proposed national parks is more on biodiversity and recreation – although protection of historic cultural values does also feature in the national parks. From a WTP

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<sup>3</sup> Here we assume that biodiversity is what is valued by respondents, and not specific species or habitats.

study of the potential national parks, we are aware that protection of biodiversity is what people value most in the parks (Jacobsen et al., 2006). This external scope is not found in the present study, most likely due to the fact that it is difficult to find substitutes for cultural values which may be considered as unique. That the cultural heritage in Aamose is indeed of great value can be seen from the relative size of the attributes – the WTP is approximately the same as for biodiversity. For the attribute ‘Reduced devastation of artefacts’, an external scope effect from the base case to that with 7 national parks is found but not from the base case to 2 parks. This may be caused by the degree of uncertainty inherent in this attribute – reduced devastation does not preserve the artefacts it only delays the decay. Therefore there is a large degree of uncertainty with regard to future preservation status.

Another possible explanation for the lack of external scope effect could be that the task with which respondents were faced was too cognitively demanding. Thus, apart from the fact that 7 obviously implies ‘more’ than 2 when evaluated in a joint context, it does not appear unlikely that respondents faced with either 2 or 7 national parks have found it quite difficult to translate the number of parks into a specific amount of environmental/nature goods. Consequently, respondents may have used the information on establishment of national parks – ignoring the specific number of national parks – as a reassurance that some nature would be preserved no matter what; i.e. the question may as well have said ‘a number of national parks’ instead of specifying a specific number. If this is the best interpretation, then the merged results for 2 and 7 national parks are most trustworthy.

Seen from this perspective the inclusion of the scope reminder prior to each choice set may primarily have served to ‘talk down’ respondents WTP through the mentioning of alternatives, rather than induce respondents to consider scope as such. If this is the case, it is not surprising that

sensitivity to external scope cannot be established; however, it raises some important questions with regard to peoples' ability to grasp scope issues once the context is extended beyond the single project level.

Yet another reason for the failure to establish sensitivity to external scope could be that the scenario dealing with 7 national parks is considered unreasonable or unrealistic by the respondents, and that this has caused them to be inattentive in their answering of the choice questions. However, the political focus in recent years on establishing between 1 and 7 national parks in Denmark leads us to believe that the scenario is in fact realistic. Also, the findings from the focus group interviews do not give any reasons to consider the scenario as unrealistic. In terms of peoples' ability to distinguish between the scenarios with 2 and 7 national parks, it may be added that focus group participants found it demanded attention to understand the constructed scenarios properly, but that they were able to distinguish between 2 and 7 national parks. That the respondents in the survey nevertheless appear to have found this difficult may be explained by the fact that they, in contrast to the focus group participants, were presented only with one of the two options.

## **6. Conclusion**

This paper focussed on the issue of scope in a CE study. In addition to measuring the relationship between WTP and the scope of the valued good, the reaction of WTP to the introduction of substitute goods was measured.

It was found that the estimated WTP of a particular project may decrease if similar projects are implemented more or less simultaneous. This was to varying degrees true for the attributes valued

in the project that were easily substituted in other projects, such as biodiversity; whereas WTP for attributes of a more unique character were almost unaffected by scope. This indicates that WTP in many cases is not only affected by the scope of the project being valued itself but the scope of similar projects as well.

In this paper scope was also addressed scope by the use of debriefing questions. This showed that in the present case up to 20 percent of the sample valued a scope other than that associated with the good in question. Besides raising the explanatory power of our models, removal of respondents with an interpretation of scope that does not correspond to expectations did not cause any major changes to WTP in our samples. However, it is still suggested that the use of debriefing questions in a scope context might have great potential for the estimation of unbiased welfare estimates.

## **7. References**

- Adamowicz, W., J. Louviere and J. Swait (1998). 'Introduction to Attribute-Based Stated Choice Methods'. *Resource Valuation Branch Damage Assessment Center NOAA*, US Department of Commerce. 47 pp.
- Arrow, K., R. Solow, P.R. Portney, E.E. Leamer, R. Roy and H. Schuman (1993). *Report of the NOAA Panel on Contingent valuation*. <http://www.darp.noaa.gov>
- Bateman, I.J., Carson, R.T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Özdemiroglu, E., Pearce, D.W., Sugden, R. and Swanson, J., (2002). *Economic Valuation with Stated Preference Techniques. A Manual*, Edward Elgar Publishing, Cheltenham.

- Bateman, I. J., M. Cole, P. Cooper, S. Georgiou, D. Hadley and G. L. Poe, (2004). 'On visible choice sets and scope sensitivity', *Journal of Environmental Economics and Management* 47, 71-93
- Berrens, R. P., A. K. Bohara, C. L. Silva, D. Brookshire and M. Mckee (2000). 'Contingent values for New Mexico instream flows: With tests of scope, group-size reminder and temporal reliability', *Journal of Environmental Management* 58, 73-90
- Boxall, P. C., Adamowicz, W. L., Swait, J., Williams, M. and Louviere, J., (1996). A comparison of stated preference methods for environmental valuation. *Ecological Economics* 18, 243-253.
- Braga, J. and C. Starmer, (2005). 'Preference Anomalies, Preference Elicitation and the Discovered Preference Hypothesis', *Environmental & Resource Economics* 32, 55-89
- Carson, R. T. and R. C. Mitchell, (1995). 'Sequencing and Nesting in Contingent Valuation Surveys', *Journal of Environmental Economics and Management*, 28, 155-173.
- Corso, P. S., J. K. Hammit, and J. D. Graham, (2001). 'Valuing Mortality-Risk Reduction: Using Visual Aids to Improve the Validity of Contingent Valuation', *Journal of Risk and Uncertainty*, 23, 165-184.
- Foster V. and S. Mourato (2003), 'Elicitation Format and Sensitivity to Scope'. *Environmental and Resource Economics* 24, 141-160
- Greene, W. (2000). *Econometric Analysis*. Prentice-Hall, New Jersey.
- Giraud, K. L., J.B. Loomis and R.L. Johnson, (1999) 'Internal and external scope in willingness-to-pay estimates for threatened and endangered wildlife', *Journal of Environmental Management* 56, 221-229.

- Hanley, N., Wright, R. E. and Adamowicz, V. ,(1998). 'Using Choice Experiments to Value the Environment', *Environmental and Resource Economics* 11, 413-428.
- Hasler, B., T. Lundhede, L. Martinsen, S. Neye and J.S. Schou. (2005). *Valuation of groundwater protection versus water treatment in Denmark by Choice experiments and Contingent Valuation*, NERI Technical Report no. 543.
- Heberlein, T. A., M.A. Wilson, R. C. Bishop and N. C. Schaeffer, (2005). 'Rethinking the scope test as a criterion for validity in contingent valuation', *Journal of Environmental Economics and Management* 50, 1-22.
- Jacobsen, J.B., J.H. Boiesen, B.J. Thorsen and N. Strange (2007). 'What's in a name? The use of Quantitative Measures vs. 'Iconised' Species when Valuing Biodiversity', forthcoming in *Environmental and Resource Economics*, 38 pp.
- Jacobsen, J.B., Thorsen, B.J., Boiesen, J.H., Anthon, S., Tranberg, J., (2006). Værdisætning af syv mulige nationalparker i Danmark [Valuation of seven potential national parks in Denmark]. Arbejdsrapport 28, Skov og Landskab, KVL, Frederiksberg. 63 pp.
- Jakobsson, K. M. and A. K. Dragun, (2001). 'The Worth of a Possum: Valuing Species with the Contingent Valuation Method', *Environmental and Resource Economics* 19, 211-227.
- Jorgensen, B. S., M. A. Wilson, T. A. Heberlein, (2001). 'Fairness in the contingent valuation of environmental public goods: attitude toward paying for environmental improvements at two levels of scope', *Ecological Economics* 36, 133-148
- Kahnemann, D. and J. L. Knetsch (1992). 'Valuing Public Goods: The Purchase of Moral Satisfaction', *Journal of Environmental Economics and Management* 22, 57-70.

- Lehtonen, E., J. Kuuluvainen, E. Pouta, M. Rekola and L. Chuan-Zhong, (2003): 'Non-market benefits of forest conservation in southern Finland', *Environmental Science & Policy* 6, 195-204.
- Loomis, J. B. and D. S. White, (1996): 'Economic benefits of rare and endangered species: summary and meta-analysis', *Ecological Economics* 18, 197-206.
- McFadden, D., (1974). 'Conditional Logit Analysis of Qualitative Choice Behavior' In: Zarembka (ed). *Frontiers in Econometrics*, Academic Press, New York, pp. 105-142
- Olsen , S. B. and Lundhede, T., (2005): Rekreative værdier ved konvertering til naturnær skovdrift. En værdisætningsundersøgelse udført vha. metoden Discrete Choice Experiments [Recreational values in near-natural silviculture – an economic valuation of forest characteristics using choice experiment]. Specialerapport, akf-forlaget, Copenhagen.
- Smith, V. K. (1992). 'Arbitrary Values, Good Causes, and Premature Verdicts', *Journal of Environmental Economics and Management* 22, 71-89.
- Smith, V. K., and L. L. Osborne (1996). 'Do Contingent Valuation Estimates Pass a "Scope" test?', *Journal of Environmental Economics and Management* 31, 287-301
- Train, K.E (2003). *Discrete Choice Methods with Simulation*. Cambridge University Press. Cambridge.
- Veisten, K., H. F. Hoen, S. Navrud and J. Strand (2004). 'Scope insensitivity in contingent valuation of complex environmental amenities', *Journal of Environmental Management* 73, 317-331.

White, P. C. L., K. W. Gregory, P. J. Lindley and G. Richards (1997). 'Economic values of threatened mammals in Britain: A case study of the otter *Lutra lutra* and the water vole *Arvicola terrestris*', *Biological Conservation* 82, 345-354.