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ORIGINAL ARTICLE

Accounting for environmental attitude to explain variations in willingness to pay for forest ecosystem services using the new environmental paradigm

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ABSTRACT

In the environmental psychology literature, the new environmental paradigm (NEP) scale has been used to measure environmental attitude as a multidimensional concept. This study is conducted based on this multidimensionality concept to analyse willingness to pay for forest management targeting non-use value ecosystem services. In most previous studies, the NEP scale has been considered as a unidimensional measure and directly incorporated into the modelling. Here, we outline the relevance of considering such multidimensionality of the NEP scale using a different modelling procedure. This is performed following two modelling approaches (1) a random parameters logit model where the NEP score is incorporated directly and (2) a hybrid choice model in which latent variables identified from the NEP scale are incorporated in simultaneous equations setup. In both models, the environmental attitude influences preferences and willingness to pay estimates, but the first one ignoring the multidimensionality tends to exaggerate its impact. The hybrid choice model shows slightly lower statistical performance. However, in this model, the use of two latent variables reveal a non-uniform effect and thereby clearly shows the relevance of considering a multidimensional NEP scale for a better understanding of variations.

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1. Introduction

The NOAA panel (Arrow et al. 1993) has recommended consideration of environmental attitude in contingent valuation studies to interpret the responses, and this recommendation is recently supported by Johnston et al. (2017). Following this, some contingent valuation studies have shown the importance of introducing such a variable used to explain willingness to pay (WTP) estimates (e.g. Kotchen and Reiling 2000; Meyerhoff 2006). Valuation studies that applied discrete choice modelling have also included variables reflecting attitude to show the association with WTP estimates (Choi and Fielding 2013; Bartczak 2015). The other justification is based on the proposition that WTP expresses behavioural intention (Heberlein and Bishop 1986; Barro et al. 1996; Choi and Fielding 2013), and with that understanding, it seems obvious to explicitly incorporate environmental attitude in estimating WTP for quality improvements of

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environmental goods. Moreover, consideration of such a variable helps to explain unobserved heterogeneity in preferences (Aldrich et al. 2006).

Attitude can be defined as a person's evaluation of an entity in question (Ajzen and Fishbein 1977; Meyerhoff 2006); and specifically, environmental attitude as a psychological tendency to be expressed by evaluating the natural environment with some degree of favour or disfavour (Hawcroft and Milfont 2010; Bartczak 2015). According to Meyerhoff (2006), the concept of attitude can be defined in three ways: general environmental attitude, attitude towards a public good to be valued, and attitude towards the behaviour of paying money. In our case, we refer to the general environmental attitude in which individuals express their worldviews on human-nature interactions; measured by the 'New Environmental Paradigm' (NEP) scale (Dunlap and Van Liere 1978; Dunlap et al. 2000, 2008).

The intention with the NEP scale is to measure environmental attitude along several dimensions, which are not necessarily reflected in simple sums or average scores of the scale. Yet, most studies analysing its relationship with WTP elicitation uses the average score on the NEP items. For instance, Bartczak (2015) considered the average score of 12 NEP items and indicated the impact on WTP estimates using interaction effects. Aldrich et al. (2006) and Choi and Fielding (2013) have used the total score of the NEP scale to examine WTP differences of individuals with different levels of environmental attitude; and Kotchen and Reiling (2000) used the total score as an explanatory variable to the bid function in a contingent valuation.

In our study, we want to evaluate the differences in willingness to pay estimates considering the NEP scale as multidimensional (through latent constructs) rather than as a unidimensional averaged score. The basis for our more detailed approach is a principal component analysis (PCA) in which groups (latent constructs) of the NEP questions reflecting different dimensions are identified. It turns out that two groups are separable – reflecting 'ecocentric' and 'anthropocentric' attitudes.

Hence, comparison of estimation results is done following three[1] modelling approaches. The first model is a base model for our comparisons and does not incorporate environmental attitude indicators (NEP scale). In the second model, the average NEP score is directly incorporated in the utility function, as commonly done in previous studies. The average score of the NEP items are incorporated in the utility function as interaction terms in random parameters logit (RPL) modelling. In the third model, we use a hybrid choice model (HCM) where the two components (latent variables) are determined using structural equations; and their effect on preferences and NEP responses are estimated simultaneously. By this, it can avoid the potential endogeneity problem that could arise from including the indicators directly in to the choice model (Hess and Beharry-Borg 2011). It can also help to explain unobserved preference heterogeneity in WTP, which could not be explained by other means – like interacting with sociodemographic variables alone (see Aldrich et al. 2006; Choi and Fielding 2013). More importantly, incorporating latent variables in the HCM can provide a richer explanation of behaviour associated with sociodemographic variables (Walker and Ben-Akiva 2002).

Our case relies on a study which investigates the general public's preferences for forest ecosystem services in Denmark.[2] These services include both use and non-use value attributes. We want to examine to what extent people's attitudes affect preferences for different forest management initiatives. In particular, we expect the relation between non-use value attributes and environmental attitude to be more pronounced, as justified by Choi and Fielding (2013), and hence consider the interaction with those variables.

In summary, our aim is to address the following main research questions: (1) does environmental attitude, measured through the NEP scale, influence WTP for forest management initiatives that could improve provision of forest ecosystem services? (2) As a measure of environmental attitude, how should the NEP scale be treated in the choice model? (3) Which modelling approaches can be employed to take account of the multidimensionality of the NEP scale?

2. Literature review

2.1. Environmental attitude in environmental valuation studies

Of the large number of studies conducted to value environmental goods and services, only a few consider environmental attitude—commonly measured through the NEP scale (e.g. Kotchen and Reiling 2000; Aldrich et al. 2006; Meyerhoff 2006; Milon and Scrogin 2006; Choi and Fielding 2013; Bartczak 2015) or the 'awareness of consequences' (AC) scale (see Spash 2006; Ojea and Loureiro 2007; Hoyos, Mariel, and Hess 2012). In these studies, environmental attitude has been considered in valuation of various environmental goods and services such as protection of endangered species, protection of ecosystem services, and land use changes for sustainable environmental management.

The NEP scale, originally consisting of 12 items of questions, was developed to assess an individual's endorsement of environmental attitude (Dunlap and Van Liere 1978; Dunlap et al. 2000). Later, it has gone through revisions with more items of questions, updated wording of some items, and increasing the number of underlined dimensions (conceptual components) (Grendstad 1999; Dunlap et al. 2000; Lalonde and Jackson 2002; Dunlap 2008; Amburgey and Thoman 2011). The revised NEP scale consists of 15 items of questions with five dimensions (see Dunlap et al. 2000; Dunlap 2008; Amburgey and Thoman 2011).

2.2. Empirical overview

Most of the studies have shown the positive impact of pro-environmental attitude on the value of environmental goods and services. For instance, using the NEP items in a contingent valuation study, Aldrich et al. (2006) found stronger pro-environmental attitude to increase estimates of mean WTP for the species recovery efforts. In a case study about protection of endangered species, Choi and Fielding (2013) also showed WTP for endangered species being mainly influenced by an individual's environmental attitude. The same conclusion has been drawn from a similar study conducted by Kotchen and Reiling (2000) where individuals with strong pro-environmental attitude tend to be less likely to give protest responses.

Meyerhoff (2006) has shown the effect of environmental attitude on willingness to pay for management actions targeting protection of riparian ecosystems of a river in Germany. He argued that intentions to perform the behaviour are strong predictors of the stated preferences. Similarly, Milon and Scrogin (2006) incorporated the NEP items in a choice experiment application to evaluate wetland ecosystem restorations. They used a latent class model to examine preference heterogeneity and concluded that introducing attitudes can provide richer understanding of the source of heterogeneity.

In a choice experiment study, Bartczak (2015) has introduced 'environmental attitude' to examine WTP for management of the Białowieża Forest, Poland. The focus was to study preferences over management plans that could maintain naturalness of the forest. She has indicated the significant impact of environmental attitude in estimating WTP and found individuals with strong environmental attitude willing to pay higher for improvements in the naturalness of the forest. Those individuals were also found less opposing to restriction on number of forest visitors as one of the measures proposed for better forest management.

Given that environmental attitude can play a role to determine WTP for improvements in environmental goods, the methodological approach to incorporate such a variable has to be clearly justified. Attitude is a cognitive construct which should be treated as a latent variable (Ben-Akiva, Joan Walker, et al. 1999; Ben-Akiva et al. 2002; Hess and Beharry-Borg 2011). In most of the previous studies, responses to the NEP items are directly incorporated as explanatory variables of WTP estimates. These variables are considered to explain bid function (in CVM) or latent classes identifiers to examine heterogeneities in discrete choice analysis (see Aldrich et al. 2006; Milon and Scrogin 2006). Since indicators are usually measured using Likert scale, measurement errors could lead to endogeneity problem (Louviere et al. 2005; Hess and Beharry-Borg 2011). In addition, the latent

variables that are incorporated as determinants of WTP are presupposed to be influenced by sociodemographic variables (Ojea and Loureiro 2007). Therefore, the choice modelling procedure has to take account of these variables with a simultaneous equation set up. In this regard, we found the study by Hoyos, Mariel, and Hess (2015) that looked into these issues applying a hybrid choice model. Moreover, in most of the previous studies, an average score of the NEP scale is used to be directly incorporated representing as single 'indicator' of environmental attitude of a person. However, the NEP scale is defined to consist of several conceptual components to be considered in the modelling process for better understanding of the impact.

The current study contributes to the literature in several ways. First, it elaborates on the importance of considering the multidimensionality of the NEP scale by using two latent variables in contrast to an average score. Second, it compares different modelling approaches to treat the NEP scale in discrete choice modelling. Third, it adds to the empirical evidence on the effect of general environmental attitude (measured through the NEP scale) in estimating WTP for ecosystem services and evaluating variation among groups of individuals.

3. Materials and method

3.1. Data collection

Data comes from a questionnaire designed to assess the public's attitudes towards nature and value of environmental goods in Denmark (see Campbell et al. 2013 for details). The questionnaire consists of four main sections. The first part includes information and questions regarding the case study area, motivation and attitudes of individuals towards forest use and their environmental values. The second section presents the choice experiment with descriptions of attributes as well as follow-up questions. The third deals with household consumption patterns and attitudes to environmental subsidy schemes while the last section consists of socioeconomic and demographic questions. The survey was administered online, from August to September 2011. Before the final survey, the questionnaire was tested in focus groups and pilot sample which led to a redesign of some attributes and questions.

3.2. Choice set design

The choice experiment questions are presented with choice sets consisting of four main attributes that were identified to be aligned with ongoing policy initiatives for implementation of NATURA2000 and some certification schemes, along with the payment attribute. The four main attributes are:

(1) *Recreational access*: Danes have access to recreate in public forests day and night, also outside paths and roads. In private forests, they are restricted from recreating outside walking paths and during nights. Therefore, the proposed alternative scenarios show possibilities of increased recreational access in forests outside walking paths. In Denmark, public forest makes up 25% of the total forest area, which defines the current status quo of access everywhere in the forest on 25% of the total forest area.
(2) *Protection of endangered species*: Currently, 25% of animal and plant species in forests are endangered. It is, therefore, vital to manage forests and make targeted efforts to protect the species (e.g. by providing nesting boxes, fencing critical areas, devising mechanisms for dispersion of species, and so on). In this choice experiment, alternative

scenarios were proposed to protect the endangered species – by securing survival of a fixed number of species.

(3) *Opportunity for natural processes:* Animals and plants in forests depend on presence of large, old, and dead trees. That means forests have to be managed properly to maintain their biodiversity functions. The alternative scenarios were to either keep a few old trees for natural decay, or to set aside part of the forest area as untouched forest reserve, or to do both.

(4) *Groundwater:* Drinking water in Denmark comes from groundwater. For the last 20 years, many groundwater wells have become contaminated, often from agricultural activities. Groundwater discharged under forests is clean, in general, and the amount of recharge depend on the forest management. The proposed improvement scenarios are to increase the amount of groundwater obtained from forests through changes in forest management practices (e.g. planting more broadleaved trees or letting forests regenerate naturally).

In the choice experiment, each respondent was provided with six consecutive choice sets. Attribute levels and payment vehicle were described in detail, illustrated with diagrams (see Figure 1). Respondents had to make their choices out of three provided alternatives, i.e. labelled as 'initiative one' or 'initiative two' with forest management changes, or the status quo option stated as 'existing forest management continues'. Along with each choice set, a web link was added to enable respondents to access a webpage repeating the attribute level description (see Campbell et al. 2013 for details on the choice set design).

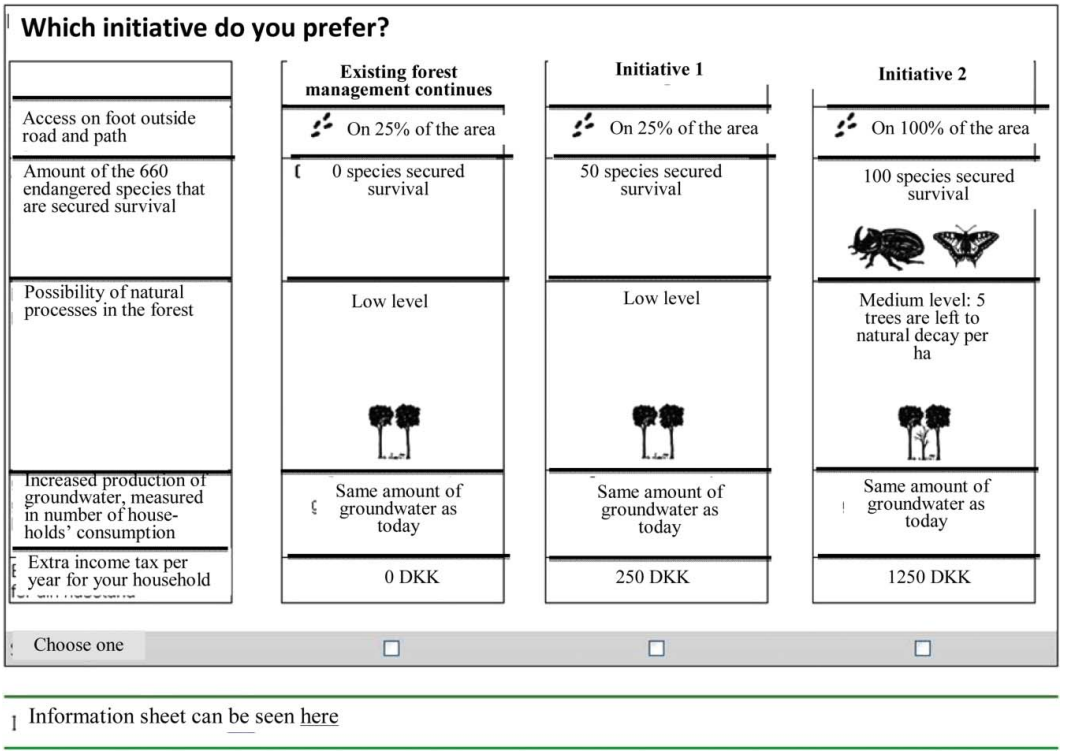

Figure 1. Sample choice set.

3.3. The NEP scale

Items of the NEP scale are descriptions on worldviews towards human influence on the natural environment. The respondents were asked to indicate their 'level' of agreement or disagreement with nine (of the fifteen) items. These items were meant to address three components of the NEP scale; i.e. 'anthropocentrism' (items 1, 4, and 7), 'ecological crises' (items 2, 5, and 8), and 'balance of nature' (items 3, 6, and 9) (see Amburgey and Thoman 2011). The remaining NEP items, related to 'limits of growth' and 'exemptionalism' dimensions were not considered of importance in this case.

3.4. Econometric modelling

3.4.1. Choice modelling framework

The standard approach in discrete choice analysis is the random utility maximisation (RUM) framework consisting of the deterministic and random components (McFadden 1974). Estimation of the utility maximisation is done through the deterministic component and with distributional assumptions of the random part. The deterministic utility is formulated to be explained by observable characteristics of the good/service.

One way of handling preference heterogeneity is to apply a random-parameters logit (RPL) model, in which individual differences can vary with a given distribution of parameters. Another way involves use of sociodemographic variables as interaction terms to explain part of the observable heterogeneity. However, the unobserved taste variation among individuals would still prevail and one of the options to address such heterogeneity is through incorporating latent variables (Aldrich et al. 2006; Hoyos 2010; Hoyos, Mariel, and Hess 2012; Choi and Fielding 2013). These may include variables, such as attitudes and perceptions that can be incorporated into the modelling to explain the deterministic utility (Ben-Akiva, McFadden, et al. 1999; Hoyos, Mariel, and Hess 2012, 2015).

A more rigorous way of dealing with the issue of heterogeneity in hybrid choice modelling can be justified from the understanding of the choice making process. Choice making is performed after mental processes influenced by interconnected psychological factors, like attitudes and perceptions (Ben-Akiva et al. 2002; Hoyos, Mariel, and Hess 2012). An illustrative description of the choice making process is shown in the following diagram (Figure 2).

In this case, the choice modelling procedure requires expanding the RUM formulation through introducing a behavioural framework explicitly – using psychological factors identified from some indicators (Ben-Akiva, McFadden, et al. 1999; Ben-Akiva et al. 2002). The approach is to construct latent variables based on the information obtained from indicators, e.g. through items of questions included in a survey (Bahamonde-Birke et al. 2015). The association between the latent variables and indicators can be treated in a multiple indicator multi-cause (MIMC) modelling. In MIMC modelling, latent variables are set to explain a number of indicators and in

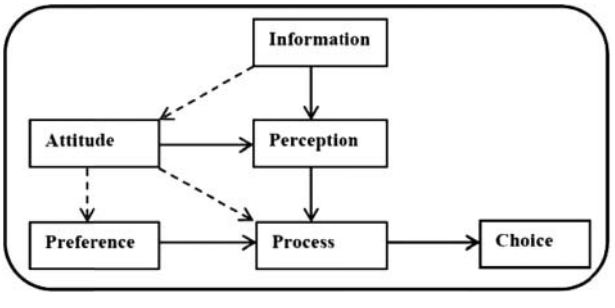

Figure 2. Choice making process (slightly modified as presented in McFadden 2001; Ben-Akiva et al. 2002).

turn be explained by individual's characteristics (Bahamonde-Birke and Ortúzar 2013; Bahamonde-Birke et al. 2015).

3.4.2. Model specification

As mentioned before, we follow three modelling procedures to outline the variations in WTP estimates. The first model is a RPL model where estimation is made using the main attributes alone and is considered as reference for the comparison. Model 2, which has been used in most previous studies, accounts for the NEP score by interacting it with the attributes. In model 3, we consider NEP scale in its multidimensionality. We do so by running a principal component analysis to identify how many dimensions to include. This results in two factors which form the basis for identifying two latent variables. The three modelling approaches are similar regarding specification of the choice model, relying on the RUM framework.

Model 1 (RPL)

In this model, the utility function is specified as a function of the attributes alone. It is customary to present the unobserved utility function to be the sum of an indirect utility (the deterministic part) and stochastic random term as follows:

$$\mathrm{U}_{in} = \mathrm{V}(\mathrm{X}_{in}; \beta_n) + \varepsilon_{in} \;\; \varepsilon \sim \mathrm{D}\left(0, \sum\nolimits_{\varepsilon}\right) \tag{1}$$

$\mathrm{U_{in}}$ represents the unobserved utility of individual n choosing alternative i. V is the deterministic utility that is linear in parameters; X is vector of attributes; β represents a vector of parameters of the attributes assumed to follow normal distributions except for the payment attribute (which is kept fixed); and ε is a random disturbance in our case assumed to be independently and identically distributed with mean zero and Σ variance-covariance matrix.

With an IID assumption of the error term and a sequence of choice sets T, the probability of choosing a given alternative conditional on β_n in the logit formulation becomes

$$\mathrm{P}(\mathrm{y}_{in} = 1 \mid \; X_{in}, \beta_n) = \prod\nolimits_{\mathrm{t}}^{\mathrm{T}} \frac{\exp(\beta_n \cdot \mathrm{X_{in}})}{\sum \exp\left(\beta_n \cdot \mathrm{X_{jn}}\right)}; \mathrm{i}, \mathrm{j} \in \mathrm{T} \text{ and } \mathrm{i} \neq \mathrm{j} \tag{2}$$

The probability is evaluated through the maximum likelihood estimation by taking the integral over the distribution of β. Given its density function $f(\beta|\theta)$ where θ represents the distribution parameter, the choice probability can be rewritten as:

$$\mathrm{P}_{in} = \int P(y_{in} \mid \; X_{in}, \; \beta_n) \cdot f(\beta \mid \theta) d\beta \tag{3}$$

In our case, the deterministic utility function in this modelling procedure is specified as follows:

$$\begin{aligned} \mathrm{V_{in}} = \mathrm{ASC} + \beta_{\mathrm{payment}} \cdot \mathrm{Payment_{in}} + \\ \beta_{\mathrm{access}} \cdot \mathrm{access_{in}} + \\ \beta_{\mathrm{species50}} \cdot \mathrm{SP\_50_{in}} + \\ \beta_{\mathrm{species100}} \cdot \mathrm{SP\_100_{in}} + \\ \beta_{\mathrm{naturalprocess1}} \cdot \mathrm{NP1_{in}} + \\ \beta_{\mathrm{naturalprocess2}} \cdot \mathrm{NP2_{in}} + \\ \beta_{\mathrm{naturalprocess3}} \cdot \mathrm{NP3_{in}} + \\ \beta_{\mathrm{groundwater}} \cdot \mathrm{groundwater_{in}} \end{aligned} \tag{4}$$

Where the variable names refer to the names given in Table 1.

Table 1. Description of attribute levels.

Attribute	Levels
(1) Increase access outside of the paths and roads in the forest (Access)	• Access outside road and path on 25% of the area (status quo) • Access outside road and path on 50% of the area • Access outside road and path on 100% of the area
(2) Protection of endangered species (SP_50, SP_100)	• 660 endangered species (status quo) • 50 species can be secured survival through a special initiative • 100 species can be secured survival through a special initiative
(3) Opportunity for natural processes in the forest (NP1, NP2, NP3)	• Dead trees left only occasionally and 0.01% of forest area set aside as untouched forest reserves (status quo) • 5 trees per ha left to natural decay and 0.01% of forest area set aside as untouched forest reserves (medium level) • 7% of broadleaved forest area set aside as untouched forest reserves (high level) • 5 trees per ha left to natural decay and 7% of broadleaved forest area set aside as untouched forest reserves (very high level)
(4) Increase recharge of groundwater (Groundwater)	• Same as now (status quo) • Increase to 20 million m^3 (corresponds to 10% households in case study area) • Increase to 40 million m^3 (corresponds to 20% households in case study area)
(5) Extra annual income tax per household (Payment)	• 0 DKK (status quo) • 250 DKK, 500 DKK, 750 DKK, 1000 DKK, or 1250 DKK

Model 2 (NEP score in RPL)

In this modelling, we incorporate environmental attitude into the choice model. It is a RPL model and hence follow the same functional forms as in model 1. But additional to the parameters in Equation (4), it contains interaction terms between the individual's average NEP score and the parameters for natural processes, species conservation and the alternative specific constant (ASC). The attributes related to groundwater and access were not interacted with the NEP question.

Model 3 (HCM)

The HCM is structured in three sets of equations: a choice model, structural equations, and measurement equations. In our case, the latent variables are defined as 'ecocentrism' and 'anthropocentrism', and the indicators of the latent variables are items of the NEP scale. The explicit modelling specification can be written as follows: (details about the structure of HCM can be seen in Ben-Akiva, Joan Walker, et al. 1999; Ben-Akiva, McFadden, 1999; Ben-Akiva et al. 2002; Walker and Ben-Akiva 2002; Daly et al. 2012; Bahamonde-Birke and Ortúzar 2013; Hoyos, Mariel, and Hess 2015).

(1) *The choice model:*

The choice model is an extended version of RUM which includes latent variables in the deterministic part. Hence, the utility function can be written as

$$\mathrm{U}_{in} = \mathrm{V}(\mathrm{X}_{in}, \mathrm{LV}_{in}; \beta, \gamma) + \varepsilon_{in} \;\; \varepsilon \sim \mathrm{D}\left(0, \sum\nolimits_{\varepsilon}\right) \tag{5}$$

Therefore, Equation (2) can be rewritten as

$$\mathrm{P}\;(\mathrm{y}_{in} = 1 \;\mid\; X_{in}, LV_{in}; \beta, \gamma) = \prod\nolimits_{\mathrm{t}}^{\mathrm{T}} \frac{\exp(\beta \cdot \mathrm{X}_{\mathrm{in}} + \gamma \cdot \mathrm{X}_{\mathrm{in}} \cdot LV_{in})}{\sum \exp\left(\beta \cdot \mathrm{X}_{\mathrm{jn}} + \gamma \cdot \mathrm{X}_{\mathrm{jn}} \cdot LV_{jn}\right)}; \mathrm{i}, \mathrm{j} \in \mathrm{T} \text{ and } \mathrm{i} \neq \mathrm{j} \tag{6}$$

LV is a vector of latent variables; β and γ represent vectors of parameters linked to the attributes and interaction terms– and in this case, maintained to be fixed among individuals; ε is again assumed with an IID distribution of mean zero and Σ variance-covariance matrix. Specific to this

modelling, the deterministic utility becomes:

$$\begin{aligned} V_{in} = ASC + \beta_{payment} \cdot Payment_{in} + \\ \beta_{access} \cdot access_{in} + \\ \beta_{species50} \cdot species50_{in} + \\ \beta_{species100} \cdot species100_{in} + \\ \beta_{naturalprocess1} \cdot NP1_{in} + \\ \beta_{naturalprocess2} \cdot NP2_{in} + \\ \beta_{naturalprocess3} \cdot NP3_{in} + \\ \beta_{groundwater} \cdot groundwater_{in} + \\ \gamma_{ecocentric\_interaction} \cdot ecocentric\_interaction_{in} + \\ \gamma_{anthropocentric\_interaction} \cdot anthropocentric\_interaction_{in} \end{aligned} \tag{7}$$

(2) *Structural equations:*

This is a representation of set of equations where the latent variables are considered as functions of sociodemographic variables. In our case, the two latent variables, which we name 'ecocentrism' and 'anthropocentrism' are set as functions of gender, age, education, and being member of the Danish nature protection organisation:

$$LV_{ln} = \vartheta_{lr} \cdot S_{ln} + \eta_{ln} \tag{8}$$

Where LV represents latent variables with subscript l – 'ecocentrism' or 'anthropocentrism'; *S* represents sociodemographic and other variables; ϑ is the vector of corresponding parameters to be estimated, and η, the error term, assumed to be with a standard normal distribution and independent of the error term of the choice model. This equation does not include a constant term for normalisation. The latent variables are given as function of the sociodemographic variables being linear in parameters as

$$\begin{aligned} LV_{ln} &= h(age,\ gender,\ education,\ org\_prot) \\ LV_{ln} &= \vartheta_{age} \cdot age_{ln} + \vartheta_{female} \cdot female_{ln} + \vartheta_{educ} \cdot educ_{ln} + \vartheta_{org_{prot}} \cdot org\_prot_{ln} \end{aligned} \tag{9}$$

(3) *Measurement equations:*

The measurement equation allows each of the NEP items to be explained by the latent variables. Based on the factor loadings from a principal component analysis (see Section 4.1.2); items 2, 3, 8, and 9 are specified to be explained by a latent variable we call 'ecocentrism' and items 1 and 7 by another which we call 'anthropocentrism' to reflect the content of the items (see Table 2):

$$\begin{aligned} Q_{qn} &= \tau_q + \alpha_{lq} \cdot LV_{lqn} + \nu_{qn} \\ Items_{1-6} &= g(\text{'ecocentrism'},\ \text{'anthropocentrism'}) \end{aligned} \tag{10}$$

Table 2. The NEP items used: evaluated on a Likert scale from completely agree (1) to completely disagree (5).

	NEP statements
1	Humans have the right to modify the natural environment to suit their needs
2	When humans interfere with nature it often produces disastrous consequences
3	Mankind is severely abusing the environment
4	Plants and animals have as much right as humans to exist
5	The balance of nature is strong enough to cope with the impacts of modern industrial nations
6	The so-called 'ecological crisis' facing humankind has been greatly exaggerated
7	Humans were meant to rule over the rest of nature
8	The balance of nature is very delicate and easily upset
9	If things continue on their present course, we will soon experience a major ecological catastrophe

Here, Q is a vector of indicators with an index q for the six NEP items; α the associated parameters to be estimated, τ is a threshold level of indicators (constant), and ν a random disturbance term.

Since the NEP questions are presented in a five point Likert scale, it could have been modelled using ordered choice models consistently with how they are measured (Daly et al. 2012). However, in our case, a single latent variable was set to explain many indicators and treating all these indicators with an ordered choice model resulted in non-convergent estimation which would have made it more difficult to satisfy a set of simultaneous equations. Hence, we do not employ this modelling, and instead recode the six items as dummy variables so that indicators are modelled in a binary logit function (taking a value of 1 for an agreement to the NEP items):

$$P(Q_{qn} = 1) = \frac{1}{1 + \exp(LV_{lqn})} \tag{11}$$

Based on the above set of equations, the joint likelihood is estimated from the joint probability of choosing a given alternative in the choice model and the probability to 'agree' to the NEP items; conditional on the exogenous variables, X and the parameters. Therefore, given f_{LV} to be the probability density of the latent variables and f_Q the probability density of the indicators, the loglikelihood becomes

$$LL(y, Q \mid X; \alpha, \beta, \gamma, \vartheta) = \sum_{n}^{N} \int \int P(y \mid X, LV; \beta, \gamma) f_Q(Q \mid X; \alpha) f_{LV}(LV \mid X; \vartheta) d(Q) d(LV) \tag{12}$$

Technically, estimation of the HCM can be done either sequentially or simultaneously with simulated maximum likelihood by taking random draws of the latent variables to depict their probability distribution (Ben-Akiva, Joan Walker, et al. 1999; Ben-Akiva et al. 2002; Bahamonde-Birke et al. 2015). In our case, we carry out the estimation simultaneously using R-programming. Initially, we run the HCM estimation with 500 Halton draws. At this stage, the priors in the choice model are taken from the basic RPL model estimated with only the attributes; priors in the structural model are taken from simple linear regression; and priors for the indicator and interaction terms of the latent variables are '0'. The final estimation is performed based on 500 draws.

Notice that the latent variables are considered through an interaction with an 'alternative specific constant' (ASC) and non-use value attribute levels; 'SP_50', 'SP_100', 'NP1', 'NP2', and 'NP3'. The interaction with the ASC can show the effect of latent variables on WTP for changes in forest management altogether while the interaction with specific attribute levels can disclose preference heterogeneities between the specific attributes. This resembles the interactions in model 2, where the average NEP score was used.

4. Results

4.1. Descriptive statistics

The total number of individuals who responded to the web-based survey was 811, with a response rate of 29%. Out of those who completed the questionnaire, 16 respondents were identified as protesters for objections regarding payment vehicle or lack of trust in the scenarios (see Campbell et al. 2013). In addition, 73 individuals did not fully respond to the NEP questions and are excluded. Therefore, a total of 722 individuals are found eligible to be included in this analysis.

The respondents were aged between 18 and 70 (mean age 48) and 47% were female. Most of the respondents have completed high school education. About 87% of them have personal income below the mid income category, and 65% reported their total monthly income to be between

Table 3. Sociodemographic variables.

Variable	Per cent
Gender	
Male	52.8
Female	47.2
Age category	
Below 35 years	17.6
Between 35 and 50 years	34.8
Above 50 years	47.5
Level of education	
Secondary	25.6
Tertiary	46.3
Above tertiary	28.1
Personal monthly income before tax	
Below 25,000 DKK	71.8
25,000–50,000 DKK	16.3
Above 50, 000 DKK	11.8

8000 – 25000 DKK. Our sample is overrepresented by people older than 50 years, and low-income groups (see Table 3).

In addition, 84% participate in nature experiences (such as picnics); 18% participate in consumptive activities like hunting, collecting berries, or fishing in forests; and 22% of the respondents indicated that they are members of at least one nature protection organisation.

The main attributes except 'payment' and 'groundwater' are coded as dummy variables. Also notice that age of the respondent and education are considered as continues variables in the latent variable structural equations of the HCM. The rest of the variables used in the structural equation are also coded as dummies.

4.1.1. Answers to NEP questions

As noted above, in this study, nine of the fifteen items of the standard NEP scale (Dunlap 2008) were incorporated in the questionnaire. Respondents were asked to indicate their level of agreement using the Likert scale. For the purpose of consistent description of a pro-environmental attitude and grouping, we reversed the scale of items 1, 5, 6, and 7 (1 to 5; 2–4) (see also Choi and Fielding 2013; Bartczak 2015); which were phrased in negative connotations to such an attitude. As shown in Figure 3, more than 60% of the respondents have agreed to the pro-environmental descriptions of the NEP.

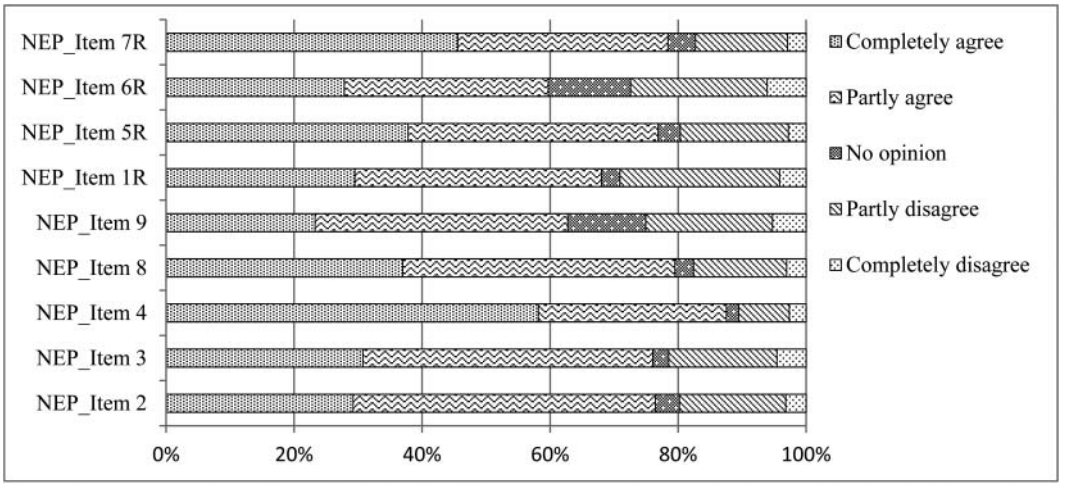

Figure 3. Responses to NEP items.

4.1.2. Principal component analysis

Principal component analysis (PCA) is used as a factor reduction method to identify latent variables from the nine items. Doing PCA, we end up with two components, with the criteria of Eigen values greater than 1. The first component explains 29.2% of the total variation with an Eigen value of 2.6 and the second explains 21.6% of the total variation with an Eigen value of 1.9. The Cronbach's alpha as test of internal consistency is 0.79 – which can be regarded as satisfactory (Gliem and Gliem 2003). The total mean score on the NEP scale is 19.38. Results from the PCA can be seen in the Appendix.

As shown in the 'Rotated Component Matrix', six items contribute uniquely to the factor loadings to one of the components. The other three items which load (more or less) equally to both components are not included in the choice model. That means, only the six items are considered in our modelling to determine the average NEP score of model 2, or the indicator equations of model 3. The two components are considered as representations of the latent variables – 'ecocentrism' and 'anthropocentrism'. The first component (ecocentrism) has loadings from four items (2, 3, 8, and 9) and can thus be taken to represent 'ecological crisis' and 'balance of nature' dimensions of the original NEP scale while the second component (anthropocentrism) has loadings from only two items (1 and 7) (see Amburgey and Thoman 2011). That means, in model 3, we estimate two latent variables which can affect the answers to the NEP questions. Therefore, items 2, 3, 8, and 9 are presented as functions of the latent variable 'ecocentrism' while items 1 and 7 are set to be explained by the latent variable 'anthropocentrism'.

If we look at the distribution of the 'anthropocentric' and 'ecocentric' individuals according to their answers to the NEP questions, we see (in Table 4) that 5% could be regarded as both 'ecocentric' and 'anthropocentric' while 39% could be neither. Therefore, proper analysis of responses can be made by considering the NEP as multidimensional measure. Modelling with NEP scale as unidimensional measure will lead to force the 45% to be counted in one of the two dimensions.

4.2. Choice modelling results

In this section, we present the results from the three modelling procedures (see Table 5). The first two columns show the parameter estimates and standard errors from the basic model (model 1). In the third column, we have the RPL estimation results of model 2 where the average NEP score is directly interacted with the ASC and non-use value attributes (SP_50, SP_100, NP1, NP2, NP3). Similarly, the fifth column shows the estimation results from the HCM (model 3) where the two latent variables, 'ecocentrism' and 'anthropocentrism' are interacted with those variables.

The main effect attributes except recreational access are significant with expected signs in all the three models. In the second model, all the interaction terms, except the interaction between NEP-score and 'NP3', are significant with expected negative signs. Note that the NEP items are scaled from 'higher' to 'lower' level of agreement (i.e. lowest score corresponds to a 'completely agree' level). Notice that the scales to items 1 and 7 are also reversed to make consistent description of a pro-environmental attitude. So, the negative coefficients of these interaction terms imply that people with less pro-environmental attitude (highest average NEP score) tend to be less likely to pay for improvements in those variables.

Table 4. Individuals with ecocentric vs anthropocentric attitudes.[a]

		Anthropocentric		
		0	1	Sum
Ecocentric	0	39%	7%	46%
	1	49%	5%	54%
	Sum	88%	12%	100%

[a] Note that the mean score of items 2, 3, 8, and 9 were taken to determine 'level' of 'ecocentrism' while the mean score of items 1 and 7 determine the 'level' of 'anthropocentrism'. Then a dummy variable was created taking the value 1, if the score was below 2; and 0 otherwise - to make it close to the labelling of items in indicator equations of model 3.

Table 5. Estimation results based on the three modelling procedures.

	Model 1 (basic model)		Model 2: RPL (NEP score)		Model 3: HCM	
Variable	Est.	SE	Est.	SE	Est.	SE
ASC_alt1	−2.04***	0.26	−3.17***	0.63	−1.76***	0.50
Payment	−0.003***	0.0002	−0.003***	0.0002	−0.002***	0.0001
Access	−0.20	0.13	−0.12	0.13	0.06	0.08
SP_50	1.94***	0.14	3.23***	0.39	1.38***	0.20
SP_100	3.05***	0.22	6.23***	0.57	2.11***	0.56
NP1	1.06***	0.11	1.66***	0.33	0.73***	0.13
NP2	1.50***	0.14	2.74***	0.41	0.91***	0.24
NP3	1.43***	0.17	1.31***	0.48	0.72***	0.13
Groundwater	0.28***	0.04	0.31***	0.04	0.32***	0.03
Standard deviations						
Std_ASC_alt1	3.56***	0.27	1.80***	0.39		
Std_Access	1.61***	0.17	−1.54***	0.17		
Std_SP_50	0.45	0.46	−0.66***	0.30		
Std_SP_100	−2.52***	0.21	−2.52***	0.22		
Std_NP1	−0.04	0.20	0.08	0.19		
Std_NP2	−1.09***	0.20	1.05***	0.21		
Std_NP3	1.61***	0.19	−1.64***	0.24		
Std_Groundwater	0.56***	0.05	0.59***	0.05		
Interactions						
NEP score*ASC_alt23			−0.56**	0.27		
NEP score*SP_50			−0.55***	0.16		
NEP score*SP_100			−1.40***	0.22		
NEP score*NP1			−0.28*	0.15		
NEP score*NP2			−0.57***	0.18		
NEP score*NP3			0.07	0.20		
NEP score*ASC_alt23_std			−1.16***	0.14		
NEP score*SP_50_std			−0.21	0.14		
NEP score*SP_100_std			−0.11	0.17		
NEP score*NP1_std			0.02	0.09		
NEP score*NP2_std			−0.02	0.17		
NEP score*NP3_std			0.23	0.18		
Ecocentric*ASC_alt23					0.73***	0.19
Anthropocentric*ASC_alt23					−2.13***	0.21
Ecocentric*SP_50					0.46***	0.11
Anthropocentric*SP_50					−0.71***	0.12
Ecocentric*SP_100					0.92***	0.18
Anthropocentric*SP_100					−2.43***	0.20
Ecocentric*NP1					0.16	0.11
Anthropocentric*NP1					−0.33***	0.13
Ecocentric*NP2					0.45***	0.13
Anthropocentric*NP2					−0.86***	0.14
Ecocentric*NP3					−0.03	0.13
Anthropocentric*NP3					0.12	0.14
Final Log Likelihood	−3319.58		−3257.23		−3312.20 [−3269.12][a]	
AIC	6673.17		6572.46		11035.34 [6592.24]	
BIC	6781.52		6757.30		11296.67 [6764.33]	
No of parameters	17		29		41	

[a] Values in closed brackets are from the reduced HCM.
***, **, and * are level of significances at 1%, 5%, and 10%, respectively.

In model 3 (HCM), the interaction of the ASC with 'ecocentrism' is positive while the interaction with 'anthropocentrism' is negative. This implies that the likelihood of choosing a scenario over the status quo is higher for individuals with ecocentric attitude and lower for those with anthropocentric attitude. It is also evident that the interactions between 'ecocentrism' and the levels of 'protection of endangered species' are significant and positive which imply that highly ecocentric individuals would like to choose scenarios with improvements in these variables. From the magnitude of the coefficients, we can see that the higher the number of species protected, the higher would be the willingness to pay of 'ecocentric' individuals. In contrast, the interaction between 'anthropocentrism' and the levels of 'protection of endangered species' are significant and negative indicating that highly

Table 6. Estimation results of the structural and indicator function from the HCM model.

Variables in the structural equations	Est.	SE
Ecocentric Female	0.30***	0.10
Anthropocentric Female	0.13	0.09
Ecocentric Age	0.008**	0.004
Anthropocentric Age	0.002	0.003
Ecocentric Education	−0.02	0.025
Anthropocentric Education	−0.001	0.02
Ecocentric member of nature org.	0.58***	0.18
Anthropocentric member of nature org.	−0.52***	0.16
Variables in the indicator equations		
NEP item2 (α_2)	2.90***	0.49
NEP item3 (α_3)	1.75***	0.23
NEP item8 (α_8)	1.71***	0.22
NEP item9 (α_9)	1.80***	0.24
NEP item1 (α_1)	0.21**	0.10
NEP item7 (α_7)	0.13	0.12
NEP item2 (τ_2)	1.12	0.72
NEP item3 (τ_3)	0.93**	0.44
NEP item8 (τ_8)	1.22***	0.43
NEP item9 (τ_9)	−0.04	0.45
NEP item1 (τ_1)	−0.92***	0.10
NEP item7 (τ_7)	−1.58***	0.10

***, **, and * are level of significances at 1%, 5%, and 10%, respectively.

anthropocentric people are less likely to choose forest management initiatives that may secure the survival of endangered species. Similarly, the interactions of the latent variables and the levels of 'opportunity of natural process' – 'NP1' and 'NP2' are significant with the expected signs. However, 'ecocentrism' matters only for 'NP2' while 'anthropocentrism' influences both 'NP1' and 'NP2'.

From the estimation of structural equations of latent variables (Table 6), we can see that gender and age can explain an ecocentric attitude positively. Older people and female are more ecocentric than their counterparts. On the other hand, anthropocentric attitude is not found to be explained by any of the included demographic variables. In addition, being member of nature protection organisation can explain 'ecocentrism' positively and 'anthropocentrism' negatively.

In the indicator equations, we found all except item 7 to be significantly positively explained by the identified latent variables. That means, on average, ecocentric individuals have 'agreed' to the description of items 2, 3, 8, and 9; while anthropocentric individual 'agreed' only to item 1. This indicates that 'ecocentrism' is a stronger predictor than 'anthropocentrism'. Jointly, we can say that the attitude of ecocentrism is the one which loads the most into the NEP questions and the one that affects WTP the most.

In general, it seems that the second model performs better based on the final log-likelihood values and information criteria. Yet, it cannot be compared directly with the third model as attitude is measured differently. For some insights into the model comparisons, we can estimate a reduced form of the HCM. The reduced form of HCM is a model without indicator equations. Even though the latent variables cannot be treated exactly as in the longer form, it enables us to examine the relative model performance compared to the second model. However, it should be noticed that the estimates in the reduced model are different from that of the longer form, since the latent variables cannot be explicitly identified through NEP items. As can be seen in Table 4, the log likelihood and the information criteria of the reduced form show that the HCM performance is very close to, but not better than, model 2. At this point we would like to stress that the nature of the two models are different – in the treatment of the NEP items and distributional assumption of the parameters.

4.3. Estimation of WTP

The WTP of a person with average answers to the NEP questions (hereafter called 'mean value' attitude) for non-use value attributes are calculated based on parameter estimates from the three modelling approaches. In model 1, WTP is estimated taking the ratio of the coefficients of the main attributes to the coefficient of the payment variable. Notice that in this modelling, environmental attitudinal variables are not incorporated into the utility functions. In the following models, it is again the ratio between the coefficients for the main attributes and the price that forms the WTP, but additional to the coefficients for the main attributes the interactions with the NEP questions have to be added. In the second model, we take the mean value attitude of 2.2 (calculated using the six items of the NEP scale). In this case, the mean score indicates an average person with an 'average' attitude of the unidimensional pro-environmental proposition. In model 3, the mean value attitudes of 0.47 and 0.10 were calculated for the variables entering the 'ecocentric' and 'anthropocentric' attitudes respectively. These values are calculated by multiplying the coefficients and levels of the explanatory variables of the structural equations. Therefore, an 'average – ecocentric' individual is represented by considering the proportion of female (48%), 48 years of age, medium category of education (4.7), and proportion of being member of nature protection organisation (10%). For all models, WTP is estimated using the Krinsky and Robb Method taking 1000 draws (Greene 2012).

As shown in Figure 4, the average WTP of the 'mean value' attitudinal indicators based on estimates from the two different models is not significantly different, nor are they different from the WTP calculated using a basic RPL model that does not account for NEP. Model 3 shows slightly lower average WTP for all attributes (but not significant). Thus, the different modelling approaches do not affect the mean. This may be due to the fact that opposite effects of the latent variables are being concealed.

To investigate the differences in WTP for the extreme levels of the two attitudinal variables and performances of the two models, we consider the most extreme attitude measures, i.e. the most ecocentric and the most anthropocentric scores. In model 2, the 'most ecocentric' individual can take a NEP score of 1 while the 'most anthropocentric' can take NEP score of 5. In model 3, we again follow the approach of calculating the extremes from the latent variable from the structural equation.

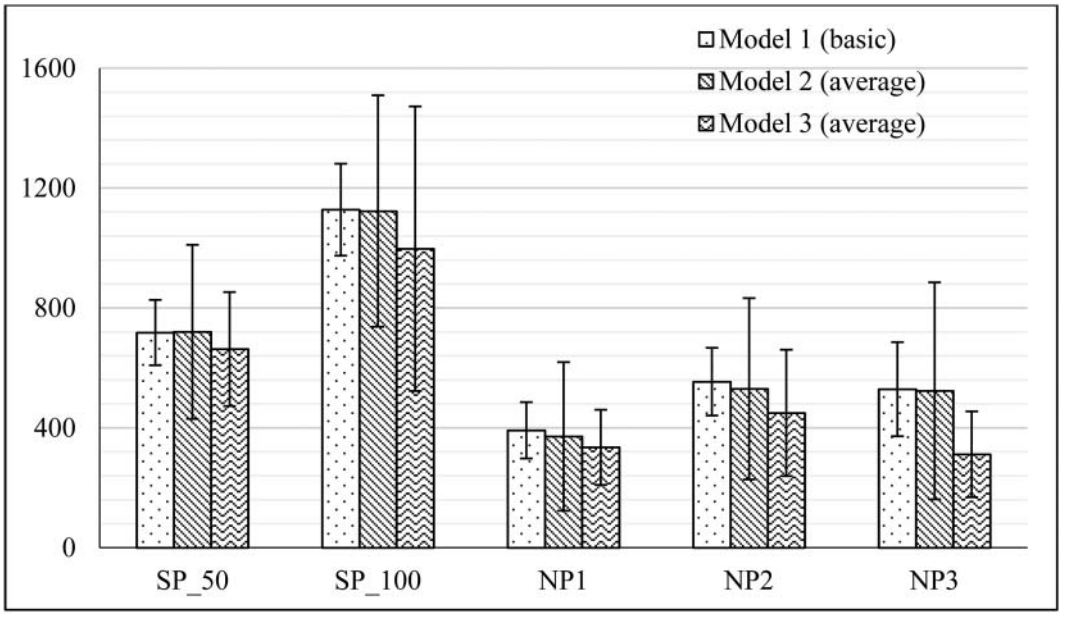

Figure 4. Average WTP (DKK/person/year) based on estimates of a 'mean' value attitude person.

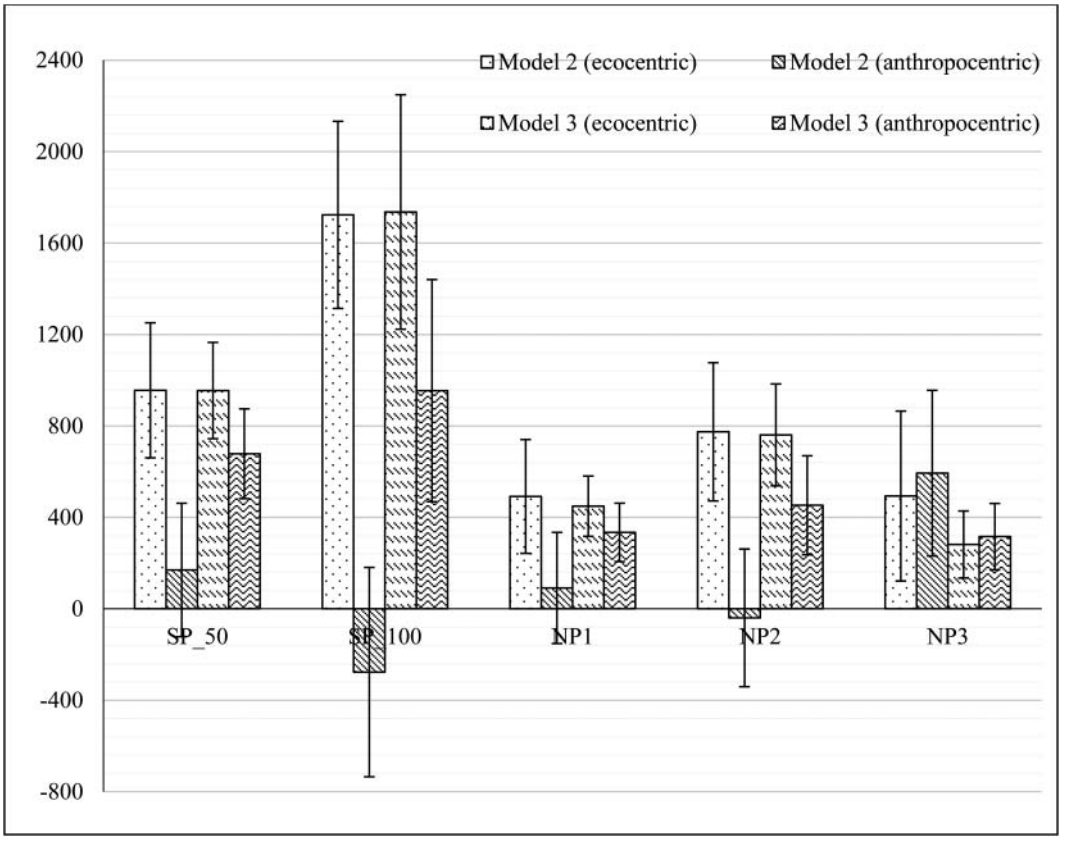

Figure 5. Average WTP (DKK/person/year) based on estimates of the 'most ecocentric' vs 'most anthropocentric' person.

Since its value is estimated from the socio-demographic variables, the extremes here are gender (0,1), age (18,70) and education (level 8 and 1). Figure 5 shows the WTP that each model could predict for an individual with the extreme levels of the two attitudinal variables.

It is evident that WTP estimates computed for the 'most anthropocentric' persons are significantly lower than the WTP computed for the 'most ecocentric' persons in both models. The only exception is for the variable defined as 'NP3' in which the interaction terms are insignificant. Model 2 shows the lowest WTP for the 'most anthropocentric' persons, which become even negative in two of the attribute levels. It can be argued that this model overestimates the impact of attitude as it measures the NEP on a linear scale, which our principal component results have shown not to be consistent. Model 3 provides a more consistent evaluation of the multidimensionality of the NEP scale and the variations in WTP estimates, yet with statistically insignificant differences.

5. Discussion

There are several arguments for incorporating individual's environmental attitude in understanding their willingness to pay for environmental goods and services. First, based on the attitude-behaviour relationship, environmental attitude is presumed to impact behavioural intentions of individuals and hence their WTP for environmental goods and services (Ajzen and Fishbein 1977; Meyerhoff 2006). Second, attitude is considered as one factor that can influence the choice making process in preference analysis (Ben-Akiva, Joan Walker, et al. 1999; Ben-Akiva, McFadden, et al. 1999; Ben-Akiva et al. 2002). Third, various studies have recommended to include such a variable to address unobserved preference heterogeneity (see, e.g. Aldrich et al. 2006; Choi and Fielding 2013).

Our findings also support the proposition that environmental attitude should be considered to explain variations in WTP for forest management initiatives focusing on provision of ecosystem services. The attitudes of people towards human-nature interaction have important implications on their willingness to pay for conservation measures. For instance, with an anthropocentric attitude, humans are viewed as being separated and insusceptible to nature; and nature as instrumental for the benefit of humans (Stokols 1990; Grendstad 1999). With such an attitude, it would become difficult to implement proposed conservation measures (Thompson and Barton 1994). Therefore, consideration of environmental attitudes in the valuation of environmental goods and services is relevant to make an informative outline of management decisions. We elaborate the role of environmental attitude through incorporating the NEP scale – using two modelling approaches that are compared to a basic model that does not include such an indicator. First and foremost, we do not find a difference in average WTP between the two modelling approaches. Looking into understanding the extremes, we analysed the WTP for the most extreme ecocentric and anthropocentric in the two modelling approaches. For the first of these, Model 2, a RPL model with interactions between the main attributes and the NEP score, showed that 'ecocentric' individuals are likely to pay more to forest management initiatives with higher provision of ecosystems services than more anthropocentrically oriented people. This supports the hypothesis that strong pro-environmental attitude can positively impact WTP. In this modelling approach the NEP scale is unidimensional and hence an individual would be classified to have either an ecocentric or anthropocentric attitude. Our results clearly showed that people may possess both attitudes. While the NEP scale includes 5 dimensions, we used a reduced form to fit the current context, and further, we were only able to identify 2 dimensions – ecocentric and anthropocentric. We found that people may have both sets of attitudes simultaneous. Therefore, taking the extreme levels of these attitudinal variables, the model may overestimate the difference – e.g. anthroponotic individuals having negative WTP for SP_100 and NP2. In contrast, our other model, Model 3 the HCM, evaluates the effect of environmental attitude through incorporating NEP scale and using two latent variables, one for each of the identified dimensions. In other words, this modelling allows taking account of the multidimensionality of the NEP scale. Another difference here is that the extreme values are identified through a structural equation consisting of sociodemographic variables rather than on the attitudes per se. The results show that even though this model also predicts that people with ecocentric attitudes will pay more than people with anthropocentric attitudes, the differences are not significant. As this model is more consistent with the multidimensionality of the NEP-scale, we argue that using the average NEP score as done in Model 2, and as most frequently applied in the literature may exaggerate the differences – as people may hold both ecocentric and anthropocentric attitudes at the same time.

Looking at statistical model performance, we do however notice that Model 3 performs slightly lower than the Model 2. Recently, Vij and Walker (2016) argued that the HCM could not have better performance than a reduced version. In our case, the focus is to elaborate on the variations in WTP estimates through better understanding of the underlying latent constructs of the NEP scale. Therefore, we see the HCM as a better modelling procedure in this case with only minor losses in modelling performance.

Through the application of HCM, the link between sociodemographic variables and WTP can be well explained from explicit modelling of latent variables. For instance, we found women and the elders to be more ecocentric compared to their counter parts. That means female and older people are willing to pay more for forest management targeting ecosystem services. Such explicit explanation would not be evident from the other modelling approach.

It is worth mentioning another point often used as an argument for choosing a HCM, namely handling the endogeneity problem which could arise from incorporating environmental attitude into choice modelling. Endogeneity can arise from measurement of indicators with a Likert scale (Hess and Beharry-Borg 2011). It can also be linked to the causality of attitude – behaviour relationships (see Levine and Langenau 1979; Tarrant and Green 2009). However, it should also be noticed that HCM is by others criticised for the possibility of rather inducing endogeneity than avoiding it,

and for its weakness for valid policy implications (see Chorus and Kroesen 2014; Vij and Walker 2016). Yet, again, because in our case it is more consistent with the underlying assumptions of the variables in the measurement equations, it is appropriate.

Previously, Bartczak (2015) has indicated that environmental attitudes can have an impact on the amount people are willing to pay for changes in forest management. People with strong pro-environmental attitude tend to choose a forest management which maintains the naturalness of the forest and restrictions in the number of forest recreationists. On the one hand, this explanation is in line with our finding that people with 'ecocentric' attitude are more committed to support policies with environmental conservation. On the other hand, her study could not explicitly show how individuals with an 'anthropocentric' attitude would react to such measures. Therefore, treating the NEP scale as unidimensional as in Model 2 is less preferable to represent attitude towards the environment. In a confirmatory factor analysis using all fifteen items, Amburgey and Thoman (2011) have shown that the NEP can be best described as a multidimensional scale. They indicated that the fifteen NEP items represent five interrelated components. That means, incorporating environmental attitude distinctly by 'ecocentrism' and 'anthropocentrism' dimensions would provide better assessment than with single average or aggregate score.

Beyond the dimensionality, we want to mention the limitation of the NEP scale in terms of the effectiveness of the items to reflect on attitude as a determinant of WTP for forest ecosystem services. The NEP scale considered in this study is used to measure general environmental attitude, and on purpose, not modified in wording to be particularly linked with the advantages of forest management for ecosystem services. It is possible that a scale linked more directly to the topic would provide different results (see Notaro, Grilli, and Campbell 2017). Moreover, the ordering of the NEP questions and choice experiment in the questionnaire might be of critical importance. Presenting the NEP scale questions before the choice experiment might potentially have created psychological awareness, which could have influenced responses in the choice experiment.

6. Conclusion

In this study, the impact of incorporating environmental attitude on WTP estimates of protection of endangered species and natural processes in forests has been outlined. We have done so by using the NEP scale. The NEP scale is by construction multidimensional – based on attitudes measured among 5 dimensions. Yet, most studies using it in relation to WTP estimates do so by looking at average scores. By a principal component analysis of 9 of the 15 items analysed in this study, we find that two factors can capture the heterogeneity – reflecting anthropocentrism and ecocentrism. We also find that respondents can be both ecocentric and anthropocentric at the same time – as it is measured along two different dimensions. This leads to the main part of the paper. The relation between answers to the NEP questions and WTP have been estimated in two different models: (1) an aggregated score of the NEP questions interacted with non-use attributes using RPL modelling (the most frequently used approach); (2) a HCM model, where answers to the NEP questions are assumed to be affected by two different latent variables. The second approach allows for a more nuanced view of the heterogeneity than the first as it allows for the fact that we find that people may possess both attitudes. We find that the RPL model that incorporates the NEP score may exaggerate the effect of attitudes by ignoring the multidimensionality of the NEP scale.

We show that for both modelling approaches 'ecocentric' people, in contrast to those having 'anthropocentric' attitude, are in favour of forest management initiatives for improvements in ecosystem services, but the differences are not significant for the HCM model. Thereby, we illustrate the relevance of taking account of multidimensionality of the NEP scale in measuring environmental attitude. We also show the performance of different modelling approaches, incorporating latent variables in discrete choice models.

Consideration of environmental attitude in distinct concepts of 'ecocentrism' and 'anthropocentrism' can help to understand the different motivations of payments for forest management

initiatives. It can be argued that if the majority of people justify forest management initiatives from an ecocentric attitude, the implementation of proposed scenarios taking this into account will get better public acceptance. However, the fact that people may possess both sets of attitudes simultaneously indicates that preferences modelled based on attitudes may not be either or.

Notes

1. It is a RPL model where the choice model is set as a function of attributes alone.
2. This data has also been used in Campbell et al. (2013) to investigate heterogeneity in WTP for public recreational access

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix. Results of the PCA

Table A1. Total variance explained (%)

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
Component	Total	Var.	Cum.	Total	Var.	Cum.	Total	Var.	Cum.
1	3.37	37.43	37.43	3.37	37.43	37.43	2.63	29.22	29.22
2	1.20	13.37	50.80	1.20	13.37	50.80	1.94	21.58	50.80
3	0.97	10.80	61.60						
4	0.73	8.09	69.68						
5	0.66	7.26	76.94						
6	0.56	6.39	83.33						
7	0.55	6.16	89.49						
8	0.51	5.71	95.20						
9	0.43	4.80	10.00						

Note: Extraction method: principal component analysis.

Table A2. Rotated component matrix[a]

	Component	
	1	2
NEP1r		0.79
NEP5r	0.48	0.51
NEP6r	0.39	0.39
NEP7r		0.81
NEP2	0.72	
NEP3	0.75	
NEP4	0.39	0.41
NEP8	0.67	
NEP9	0.74	

Note: Extraction method: principal component analysis.
Rotation method: Varimax with Kaiser normalisation[a]

Table A3. Reliability statistics

Cronbach's alpha	Cronbach's alpha based on standardised Items	*N* of Items
0.79	0.79	9