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Protection Motivation Theory and Contingent Valuation: Perceived Realism, Threat and WTP Estimates for Biodiversity Protection

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Protection Motivation Theory and Contingent Valuation: Perceived Realism, Threat and WTP Estimates for Biodiversity Protection

Summary

We report on a discrete-choice CV study conducted in Germany to value the WTP for biodiversity protection in less developed countries. To systematically investigate survey realism and subjective threat assessment from the loss of biodiversity described in the scenario the study includes questions to uncover the constructs of Protection Motivation Theory, which is introduced to the CV literature. The patterns of responses to such questions are analysed using an Expectation-Maximization algorithm to derive class membership probabilities. These are found to match the predictions of Protection Motivation Theory and systematically improve the logistic analysis of the *WTP* responses.

Keywords: Biodiversity valuation, Protection motivation theory, Latent class analysis, Expectation-Maximization algorithm, Contingent valuation

JEL Classification: Q2, D6,C42, C25

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1. Introduction

The convention on biological diversity considers the transfer of resources from developed countries, with relatively low-biodiversity and high opportunity cost of conservation, to developing countries with relatively high-biodiversity and low opportunity cost of conservation (CBD, 1992; Perrings, 1995). Such measure ensures, amongst other things, that money be allocated in conservation activities in locations where the marginal returns are high. However, its implementation poses at least two challenging questions. First, what is the appropriate amount of money to be transferred for the purpose of biodiversity conservation? Such issue is addressed in this study where we report the results of a contingent valuation (CV) survey asking a random sample of German residents to state their willingness to pay (WTP) for such conservation initiatives.

The second challenge derives from the unique nature of biodiversity as a good of global public value and is linked to the perception of the consequences of its loss by respondents. In this paper we approach this second challenge in the context of the CV study and by drawing from a broad research program in social psychology: Protection Motivation Theory (henceforth PMT). Empirically, we explore

1) the potential that PMT affords in informing economic analysis of CV responses, and ultimately WTP estimates. In particular, we exploit it in a finite-mixing context, contrasting it with conventional analysis that would not rely on this set of psychological constructs and;
2) the relationship between PMT constructs as they cluster in each of the different classes we empirically identify and their underlying WTP distributions.

Earlier studies have assessed and emphasized the role of *familiarity* with the purchase of the good under valuation (Carson, 1998) and of the *perceived realism* of contingent valuation surveys (Cummings and Taylor, 1998; Powe and Bateman, 2004). These are now consensually accepted as necessary ingredients for a valid measurement of WTP via CV. While it is safe to assume that respondents would not be familiar with the notion of *"purchasing"* biodiversity protection in developing countries, during the focus group discussions conducted for the development of our survey instrument some doubts were expressed about the "*practical deliverability*" of biodiversity protection.

In the absence of familiarity respondents are known to resort to heuristics (Schkade and Payne, 1994; DuBourg *et al*., 1997) and in our case this frequently leads to an *assessment of the threats* implied by biodiversity loss. Threat evaluation also emerged as a dominating concern in the focus group discussions of this study. Threat and risk assessment are not uncommon contexts of study for CV, as its use as a valuation tool for goods that are implicitly requiring respondents to assess some kind of threat is rapidly expanding (Buzby, Ready, and Skees 1995; Henson, 1996 amongst others). In a stated preference exercise on biodiversity protection, dominated by low familiarity of the public good under valuation, one would generally expect respondents' statements not to be perfectly consistent with rational choice theory (Payne and Bettman, 1993; Spash and Hanley, 1995), and hence show some anomalies which might be explained by including in the analysis a select number of psychological constructs. In short, the aim of this paper is to explore and champion the use of PMT in such an empirical context.

In PMT <u>perceived realism</u> and <u>threat assessment</u> are the constructs that together constitute the main sources of intention analysis. Psychologists, however, have developed their own terminology for these constructs, and part of the objective of the paper is that of

reconciling the terminology used in economics with that employed in social psychology. What is important to our purposes is that the PMT research programme developed tight protocols to empirically measure these constructs. A major feature of PMT in our context of study is that it predicts the existence of interactions between the two main dimensions of "realism" and "threat" perceptions, which result in well-identifiable payment intentions. The basic question we ask is whether this framework effectively helps the econometric analysis of referendum CV responses by providing better grounds to explain differences, and perhaps some anomalies, in estimates of WTP distributions. In short: we try and identify the primary sources of preferences that lead to stated WTP by applying PMT constructs to the analysis of the observed responses. Although we use as background conventional logit analysis, this theory enables us to answer some remaining questions in the modelling of response heterogeneity via latent class analysis, as it provides underlying reasons for finite heterogeneity in preferences. This is useful step forward, especially because economic theory alone does not provide many indicators to check if an answer to a WTP question results from rationally well-behaved preferences, as analysts often assume that this is a fact. In this context, we find that supplementing conventional economic theory with theories from other social sciences is a fruitful avenue of investigation.

1.1 Background and previous empirical work

Theories from social psychology were applied to the analysis of CV responses and they were found to be important in explaining the rationale behind patterns of WTP answers. For example, the *theory of reasoned action* (TRA) (Ajzen and Fishbein, 1980) and its subsequent development *theory of planned behaviour* (TPB) (Ajzen, 1991) from social psychology have been used to explain CV responses (Ajzen and Driver, 1992; Barro, Manfredo, Brown, and Peterson, 1996; Kerr and Cullen, 1995).

In the context of information bias the theory has been used to investigate links between quality of arguments, personal relevance of the proposed public good and stated WTP (Ajzen, Brown, and Rosenthal, 1996). Pouta and Rekola (2001) used it to investigate attitudes, subjective norms, and perceived behavioral control in predicting behavioral intention. Ajzen, Rosenthal, and Brown (2000) used it to explore perceived fairness and WTP for public goods. After Bishop and Heberlein (1986) had suggested that the norm activations model would be a useful framework to analyse WTP-answers, this was used in a qualitative evaluation of a CVM study to show the influence of social norms in stated WTP responses (Blamey, 1998). This body of literature significantly adds to the early evidence reported by the influential study by Kahneman and Knetsch (1992) that theories provided by Psychology can enhance the interpretation of values compared to pure micro-economic explanations.

However, none of these studies directly addresses the issues of realism and threat assessment, which are two mental dimensions that loom important in biodiversity conservation.

The role of perceived realisms in CV survey design for public goods has been studied under two prevalent aspects. One aspect of realism is motivated by the need to generate in the respondent the perception that the results of the survey will effectively influence policy decisions, thereby inducing a high subjective probability that the respondent's answer will affect policy outcomes. This is what Green *et al.* (1998) call a "decisive implementation frame". However, the importance of this aspect of realism can be traced to the early work of Hoehn and Randall (1987), where the link to incentive compatibility and truthful revelation was first established. Cummings and Taylor (1998) provide evidence that this aspect of "realness" is much more powerful when it is extended to include the likelihood of payment[1].

Another aspect of realism that has received recent attention within the context of scope effects is that concerning the perceived realism of the proposed scenario (or scheme).

For example, in such context Powe and Bateman (2004) find a dummy variable representing "perceived realism" to be significant in explaining the probability of a "yes" response and draw the conclusion that "… tests for perceived realism should become a standard element of CV study design and analysis…"(page 259). Following this prescription we believe that the measurement of "perceived realism" can be improved by using psychological constructs. We therefore turned our attention to psychological theories addressing the role of such constructs in the context of motivating intentions and actions for the purpose of protection from some kind of loss, as we are interested in WTP for biodiversity loss.

1.2 This study in brief

When using stated preference methods to value global biodiversity we are faced with a challenging task, which is to elicit valid WTP responses for the reduction of its loss (Bishop, 2003). When validity is an issue, we are not interested only in the result of economic choice (WTP), but also in the motivations or sources behind these choices.

We have designed the CV survey instrument so as to include the individual measurements of constructs from Protection Motivation Theory (PMT). This theory was originally developed to gain understanding on processes of response formulation and reasons for choices when scenarios require respondents to assess threats and, in particular, the possibilities to cope with a potential threatening event (Rogers and Prentice-Dunn, 1997). This is the terminology with which psychologists in this field would use to indicate what economists in the CV literature named "perceived realism". In what follows we will use the term "coping" and "efficacy" as synonyms to indicate such specific forms of survey realism.

Originally, PMT was introduced by Rogers in 1975 and it has since been widely applied in psychology, mostly for predicting health-related (Milne, Sheeran, and Orbell, 2000) and environmental-related behaviour (Gardener and Stern 1996; Hass, Bagley, and Rogers, 1975; Martens & Rost 1998; Martens 1999). We are not aware of applications of such theory in the context of stated-preference studies; hence this paper would be novel in this respect.

We argue that if the decision context under investigation requires individual judgement on both perceptions of threat (which is loosely linked to uncertainty) and realism of the proposed protective action (in our case the proposed species conservation initiative), then PMT may offer useful insights on the sources of preference behind stated WTP (Menzel 2004).

A consequence of PMT is that the respondent's perceptions of the threat of biodiversity loss *jointly* with that of efficacy of the proposed protective action are intuitive evaluation criteria to turn to when considering a payment for biodiversity conservation.

Psychologists have long maintained that PMT is an adequate framework for the investigation of intentions and behaviour with regard to environmental and health risk. We maintain that PMT deserves closer attention from stated preference practitioners because it provides a framework for the understanding of choices when scenarios require respondents to assess threats and their associated ability to cope with such threats. On the other hand, economic theory remains quite uninformative in this respect. Particularly so in view of the fact that a number of recent CV studies have investigated issues associated with private and public risks of various nature, such as global warming (Layton and Brown, 2000), potential benefits from the Kyoto Protocol agreement (Berrens *et al.* 2004), the value of statistical life (Johannesson, Johansson, and O'Conor, 1996; Krupnick *et al.* 2002), of road safety (Garrod *et al.* 2002; Scarpa *et al.* 2001), and of food-safety issues (Buzby, Ready, and Skees 1995; Henson, 1996; Canavari *et al.* 2004).

More specifically, PMT might be of interest to applied economists because it can provide a framework for identification of preference groups in the treatment of heterogeneity.

The structure of the constructs underlying each preference group and the relative dimension of the WTP values across groups can be used as an additional argument to validate this valuation method. Recent efforts in the treatment of heterogeneity have focussed on finite rather than continuous mixing. Validation of non-market estimates based on latent class approaches (finite mixing) have attracted the economists' attention (Provencher *et al.* 2002; Boxall and Adamowicz, 2002; Scarpa *et al.* 2003; Shonkwiler and Shaw, 2003). However, economic theory is silent about the number, sources and sizes of different preference groups, as these issues are not addressed by economics. Latent-class analyses are normally conducted *in the absence* of both a theoretical prediction on the number and structure of classes and of statistical tests capable of discriminating across competing hypotheses. Only statistical *criteria* have been employed so far to get some guidance on this issue (Clogg and Goodman 1984; Wedel and Kamakura 1999), which are often found to be inconclusive in practice (cfr. Scarpa and Thiene 2004).

The advantage of PMT in this context is that not only does it propose a theory for the source of preference, but it also makes predictions on the structure of preference classes and it can be used to develop theoretical validity relations for the WTP values of each group. We hence find it convenient to employ latent class analysis centred on responses to carefully formulated PMT-based questions. The fact that PMT produces clear predictions about how perceptions of respondents should segregate into motivational classes provides analysts with expectations on the outcome of latent class analysis. The empirical analysis in our case supports the claim that such segregation produces a better statistical fit than that achieved by endogenous segregation in the presence or absence of conventional socio-economic covariates.

2 The original structure of PMT

As already mentioned, the appraisal of a threat and that of coping with such a threat (approximately *realism* in an economist's terms) are the main constructs of PMT to predict an intention or behaviour. Both constructs are composed of sub-constructs as illustrated in figure 1 and in what follows.

Threat Appraisal

The appraisal of a *perceived threat* is the result of the evaluation of sub-constructs. These include severity, vulnerability, fear, and the subjective probability of occurrence of the threatening event. In earlier applications of PMT these sub-constructs were combined in a multiplicative fashion (Beck *et al.* 1981). This assumption was later empirically rejected, so it is now often assumed that the relations between these sub-constructs are additive (Wolf, Gregory and Stephan 1986). However, our approach breaks away from this restrictive functional relationship, as we will describe in what follows.

Coping Appraisal

The appraisal of *coping*, instead, is the combined result of evaluating other two sub-constructs, in addition to the cost of the coping action. The first sub-construct is *response efficacy*, that is, the "belief that a recommended action is able to avert an undesirable threat" (Rogers, 1983). The second is *self-efficacy*, or the "beliefs about ability and effort required to carry out a recommended (health) behaviour" (Rogers and Prentice-Dunn, 1997, cited by Houlding and Davidson, 2003). If one cannot conduct the recommended protective action by

oneself and must instead rely on a public agency, then what becomes important is the perception of whether the agency is perceived as trustworthy and able to conduct the recommended action (Shelton and Rogers, 1981).

PMT predicts the following course of reasoning: If one is confronted with a potentially threatening event, first one conducts an individual appraisal of the threat. Then, the coping appraisal follows, focussing on whether the individual or the public agency can cope with it, how so and to which expenses. The combination of threat and coping appraisals leads to the individual choice of a *coping strategy*, which determines *intention* – in our case expressed in the reporting of a WTP in the interview – and ultimately in *action* (the payment of the WTP amount). As a basic principle it is assumed that perceived threat as well as a perceived ability to cope with such threat influence the probability of a given intention or action (Rogers and Prentice-Dunn, 1997).

For the purpose of illustration we consider an extreme example: protection against a potential earthquake. According to PMT one would first consider the severity of an earthquake (e.g. the dimension of damage at one's property and of personal injuries) and its likelihood (e.g. the probability that an earthquake occurs within, say, the next 2, 5, or 10 years). After considering whether there is a possibility to prevent damages and/or injuries from such earthquake, one will assess one's abilities to conduct the possible prevention activity, taking into account the costs of these actions. As a result, one will conduct possible actions to reduce or prevent the potential damaging event or decide to do nothing.

Many empirical studies have been conducted to explore the implications of this theory and results have shown it useful in predicting both intention and action (Beck and Frankel, 1981; Houlding and Davidson, 2003; McClendon and Prentice-Dunn, 2001; Martens, 1999). Further, recent meta-analyses of empirical studies based on PMT show that variables concerning constructs relating to coping appraisal display a relatively superior performance in predicting intention or action than those measuring threat appraisal (Floyd, Prentice-Dunn and Rogers, 2000; Milne, Sheeran, and Orbell, 2000).

Note, however, that PMT does not imply that a highly perceived threat always leads to a higher intention to act upon it. There are also significant interaction effects between threat and coping appraisals that need to be accounted for. These can enhance or detract from the overall outcome due to the single effects. For example, one may perceive the threat to be high, yet associate this with a low coping appraisal. PMT predicts this combination to lead to no action, the so-called "maladaptive behaviour" (Gardner and Stern, 1996; Rogers and Prentice-Dunn, 1997). This despite a perception of high threat alone would induce the expectation of some degree of action.

2.2 PMT coping strategies and expression of WTP

In the light of the above, what we hypothesise in our study is that in formulating the response to the WTP question respondents assess the utility of investing money for preserving biodiversity in developing countries by considering mostly two features:

1) An assessment of the perceived threat to oneself and others in terms of the potential welfare-loss due to the absence of the proposed biodiversity protection policy and
2) perceived coping[2] of the proposed policy to produce the desired level of protection of biodiversity.

Although each of these two constructs is multidimensional in nature, and is treated as such in this empirical study, one can simplify the postulated relationship in a reduced form as follows. Indicate the perceived threat assessment as a factor ranging in the population from a

minimum of $\underline{\theta}$ to a maximum of $\overline{\theta}$ and the assessed efficacy (perceived realism) of the agency as a factor ranging from $\underline{\lambda}$ to $\overline{\lambda}$.

Then, the respondent's subjective assessments of θ and λ jointly determines the coping strategy and, as a consequence, the underlying valuation driving the response to the *WTP* elicitation question. PMT predicts that the joint density values for θ and λ display multi-modality and cluster around focal values consistent with the four prevailing coping strategies.

More explicitly, the theory predicts the existence of four prevailing coping strategies, each accompanied by an established terminology in the literature (table 1).

1) When both values of θ and λ are below certain levels θ^* and λ^* we expect that the individual formulates a low expectation for the utility of the proposed biodiversity conservation policy, so as to express a low or zero valuation. Such group in the PMT literature is called "*no action*", because the perceived utility of the proposed scheme is so low that no action is taken to protect oneself.

2) Conversely, for those individuals who have both threat and efficacy assessments higher than θ^* and λ^*, and are hence focussed on the reduction of the threat, we expect that they formulate a high expectation for the utility of the proposed biodiversity conservation policy. Such group in the PMT literature is called "*problem focussed*", because the perceived utility of the proposed protection policy is at a sufficiently high level to justify a strong valuation.

The remaining two groups are made-up by individuals whose assessments are mixed: they have either $\theta < \theta^*$ and $\lambda > \lambda^*$ or vice-versa. In either case we expect a *WTP* not as high as in the problem-focussed group.

3) If threat is low and coping is high the person has no much motivation to act, or does so with a reduced effort. This coping strategy is termed "*just to be sure*".

4) If threat is assessed as high and at the same time perception of coping is low the person reacts "*maladaptively*". So, the discomfort of a high threat is matched by a feeling of disempowerment. As a consequence, the reaction to the appraisal of the threat is not focussed on its reduction, as this is perceived as not achievable. But it can be – for example – characterised by apparently irrational behaviours, such as trying to endure the threat, or to develop fatalistic attitudes, or to live with fears, anxieties or a feeling of helplessness (Gardener and Stern 1996).

The theory predicts that the intensity of intention (in our case stated *WTP*) leading to the action reducing the threat is higher for respondents adopting the "just to be sure" coping strategy than for those adopting the "maladaptive".

Of course, empirically speaking θ and λ are unobserved multidimensional factors, but they can be derived on the basis of responses to adequately formulated questions. We now illustrate how we have modified PMT survey techniques to this purpose.

2.3 Modification to the CV survey and application of the theory

2.3.1 Modification

For the purpose of this study we departed from the conventional application of PMT, and modified it in some minor points. First, following Martens (1999), *responsibility* was included as an additional construct. This seemed necessary, because PMT was originally developed for health psychology, and as a result it needed adjusting to the purpose of valuing a global public good. While it is quite self-evident that one feels responsible for its own health, in the case of biodiversity conservation it can be argued that the respondent can feel

responsible also for other "entities" beyond oneself – a form of pure altruism. We assume that the degree of responsibility for these additional entities has an impact on both intention and action. Evidence of the effect of responsibility towards others on *WTP* responses in CV was found before under various guises (Blamey 1995, Nyborg 2000, Shiell and Rush 2003). We defined *responsibility* as the extent the respondent feels the duty to contribute to the protection of species in developing countries. (See Appendix for exact wording).

Secondly, we looked at a special form of self-efficacy. This, in conventional applications of PMT, is the ability to act to prevent a threat. In our case we had rather looked at the *perceived result* of paying for the prevention of loss of biodiversity. In other words, *self-efficacy* concerns the respondent's opinion that the required amount the respondents is asked to contribute could have an influence on the protection of biodiversity, and is similar to the *decisiveness* concept that Green *et al.* (1998) find of high relevance in CV survey design.

Finally, *vulnerability*, which is part of the threat construct in PMT, although it was included in the study, resulted in responses that we eventually decided not to employ in the empirical analysis. This because a preliminary investigation persuaded us that respondents were not able to deal with probabilities of threat linked to the loss of biodiversity.

2.3.2 Application

It became apparent in the focus group discussions that loss of biological diversity is not perceived as a direct and current threat for German residents. Thus, the component of threat assessment dealing with *severity* (figure 1) was broadly defined. Current threat was limited to population of developing countries, while threat to the German respondent was investigated in terms of future effects. *Fear* was operationalized in terms of *uneasiness* at the thought of loss of biological diversity and loss of species in developing countries.

Response efficacy was operationalized as the *belief* that 1) species can be protected at all or 2) can be protected in the way proposed in the scenario, respectively. Any single respondent cannot implement a program to conserve species in developing countries. So an important component of realism, *trust in the implementing organisation*, was surveyed as part of the perceived coping. The *costs* result from monetary costs (bid level). For the relation between operationalized PMT constructs and survey questions see figure 2).

3. Latent Class Model of WTP

If PMT is informative in latent class analysis of *WTP* response distributions, then:

1. one should find classes with patterns of responses that could be recognised or reconciled with the PMT classes;
2. the membership probabilities to PMT-defined classes should significantly improve the fit of finite mixing specification of *WTP* distributions in discrete-choice CV responses.

In what follows we outline an econometric approach developed to evaluate such implications in our sample.

3.1 Endogenous WTP classes

The theory underlying the estimation of positive response probability to a given bid amount is well known (Hanemann and Kanninen, 1999; James and Cameron, 1987). Here we focus on the estimation of a finite mixing model of response probability.

In the context of a sample of discrete choice responses to a *WTP* question one can rely on endogenous segmentation techniques to identify homogeneous response classes. Assume there are C classes of responses, each respondents has a probability of membership $\Pr_i(c)$. Then, from the law of total probability, the *marginal* probability of observing a "yes"

response from respondent i at a given bid level t^* can be written as Pr (" *yes* " | $t_i = t^*$) = $\sum_{c \in C} \Pr(c) \Pr_i(\text{"}yes\text{"} \mid t_i = t^*)$. However, such a model is rarely employed in contingent valuation studies where it is more prevalent to assume that there is a unique, most often unimodal distribution of WTP values in the population, perhaps shifted by socio-economic factors or attitude scores. This is clearly quite restrictive, although justified by the low informational content of binary responses. However, discrete-choice studies that account for finite mixing distributions are increasing in other areas of non-market valuation. The consensus is that it may be an approach worth pursuing when – such as in this case – there are reasons to believe that preferences are clustered around focal values.

Probabilities of membership to groups can be specified either semi-parametrically (Hensher and Greene, 2003; Scarpa and Thiene, 2004), or conditionally on socio-economic covariates (Provencher *et al.* 2002; Scarpa *et al.* 2003; Scarpa *et al.* 2004) and simultaneously estimated with the underlying choice model using full information maximum likelihood. Although the above are the conventional ways to derive membership probabilities, in the approach we employed here they are estimated separately and based on our responses to questions designed to measure PMT constructs. In the empirical analysis we will then compare our approach with the above more conventional ones to validate the role of PMT in identifying *WTP* classes.

3.2 Deriving PMT-based class membership probabilities

In our application the constructs necessary to apply the PMT are probed by means of PMT questions, the answers to which are expressed in a Likert scale. We therefore use a latent-class modelling approach suitable to identify membership probabilities on the basis of such information. Although analyses of this type have a long history and wide scope of application in quantitative psychology (Henry, 1999), this approach is relatively uncommon in economics. Here we follow the approach used by Morey *et al.* (2004) and focus on preference heterogeneity linked to PMT constructs. The intent is first to endogenously identify classes with communalities in response patterns, and the individual membership probability of each respondent to each class. The assumption is that individuals belonging to the same PMT type are more likely to produce similar patterns of response than those belonging to different classes. Secondly, we aim to check whether the observed response patterns of each class are consistent with those predicted to be dominating by PMT. Finally, because class membership is probabilistic, we estimate a willingness to pay model for each of the identified classes, and examine the pattern of mean *WTP* estimates against the features that PMT emphasize being part of each class.

Define $\mathbf{y}_i$ as a $k \times 1$ vector with the observed pattern of responses to k attitudinal questions for individual i. Our objective is that of first estimating the *unconditional probability* of observing a given response to attitudinal question y_{ki}. For all questions we used a 1-5 Likert scale, ranging from expressions of "strong agreement" (score = 1) to "strong *dis*agreement" (score = 5), and a "do not know" response (score = 0), giving a total of six potential responses.

$$\Pr(y_{ki} = j),\ j = 0, 1, 2, 3, 4, 5 \qquad (1)$$

Then we are interested in the same type of probability, but *conditional* on the individual belonging to a given class c.

$$\Pr(y_{ki} = j|c),\ j = 0, 1, 2, 3, 4, 5;\ c = 1, 2, 3, \ldots, C \qquad (2)$$

Where the total number of classes C is to be established on the basis of the empirical outcomes, but it is suggested to have a structure that can be rationalised around four types by PMT. Given class membership the response sequence is assumed to be independent, so that the unconditional response pattern probability is:

$$\Pr(\mathbf{y}_i) = \sum_{c=1}^{C} \Pr(c)\Pr(\mathbf{y}_i \mid c) = \sum_{c=1}^{C} \Pr(c) \prod_{k=1}^{K} \prod_{j=1}^{J} \Pr(y_{ki} = j|c) \tag{3}$$

This approach can be extended to condition on socio-economic covariates (gender, education level, household size, etc.), so that the membership probability is also made conditional on socio-economic "types". However, when we used this approach our likelihood values did not substantially improve. So, for the sake of simplicity, and to maintain focus on the main research issue, which is the matching of PMT predicted and observed classes, we omit to discuss the treatment of covariates here.

The objective is to estimate the $(J \times K \times C) - K$ probability parameters that maximize the sample log-likelihood function:

$$\ln L = \sum_{i=1}^{N} \ln\left[\Pr(\mathbf{y}_i)\right] \tag{4}$$

constrained by the adding-up properties of response and class membership probabilities: $\sum_{c=1}^{C} \Pr(c) \le 1$ and $\sum_{j=1}^{J} \Pr(y_{ki} = j \mid c) \le 1$.

The constrained-maximizers of the above log-likelihood are:

$$\Pr(y_{ki} = j \mid c) = \frac{\sum_{i=1}^{N} \Pr(c \mid \mathbf{y}_i) 1(y_{ki} = j)}{\sum_{i=1}^{N} \Pr(c \mid \mathbf{y}_i)} \tag{5}$$

Notice that this is just an estimate of the proportion of responses in class c which took a j Likert value in question k.

The unknown components of the above formula are the class membership probabilities conditional on the pattern of response. These can be promptly derived by Bayes' Law:

$$\Pr(c \mid \mathbf{y}_i) = \frac{\Pr(c) \prod_{k=1}^{K} \prod_{j=1}^{J} \Pr(y_{ki} = j \mid c)}{\Pr(\mathbf{y}_i)} \tag{6}$$

This can be made a function of observables by substituting equation (3) into (6). As illustrated in Morey *et al.* (2004) the estimation can be conveniently achieved by means of the E-M algorithm. Although a number of commercial software packages are available to implement E-M algorithms for the purpose of latent-class analysis, we obtained our results by purpose coding the algorithm in Gauss (available from authors upon request). The first iteration of the E-M algorithm starts with some guess for the individual $\Pr(c|\mathbf{y}_i)$, which are then fed into equation (5). This, in turn, is used to compute the log-likelihood in (3) and (4). The next iteration starts with new updated values obtained using equation (6) and repeats the process. Convergence is achieved when the difference between the difference in the log-likelihood values of iteration T and T-1 is lower than a predetermined threshold (we used 10^{-6}). The process is completed many times (250 in our case) using each time random starting values and only the results associated with the highest log-likelihood are kept. This because the maximization problem is ill-behaved and may achieve only a local maximum, which is a frequent occurrence when the number of latent classes C is high (larger than 3). In our search we allowed up to 7 preference classes.

When the above latent-class estimation is completed, each individual will have an estimated membership probability conditional on her own specific pattern of response $\Pr(c|\mathbf{y}_i)$. We call these PMT-based membership probabilities. The model estimating the probability of a positive discrete response to the proposed bid amount in the contingent

valuation question is formulated as a simple logit random utility model, in which the marginal probability is weighted by the estimated membership probability:

$$\sum_{i=1}^{N} \ln\left[\sum_{c=1}^{C} \Pr(c|\mathbf{y}_i)\pi_i^{\text{yes}}(1\text{-}\pi_i)^{(1\text{-yes})}\right], \text{ where } \pi_i = \frac{\exp(\alpha_c + \beta_c A_i)}{1-\exp(\alpha_c + \beta_c A_i)}, \qquad (7)$$

and A_i is the bid amount offered in the CV question to respondent i and "yes" is an indicator function of a positive response to the bid amount. The estimate for mean/median WTP for class c is therefore $-\alpha_c/\beta_c$. Notice that each class is associated with a different marginal utility of income $-\beta_c$.

3.3 Criteria for model fit and number of classes

Although the total number of classes C with different response patterns to PMT questions is unknown, PMT predicts the presence of four prevalent patterns of responses. From the estimation viewpoint C is outside the space of the estimable parameters. Because the parameter values under the null are at the boundary of the parameter space the conventional specification tests used for maximum likelihood estimates (likelihood ratio, Lagrange multipliers and Wald tests) are not valid in this context. The regularity conditions for a limiting chi-square distribution under the null are not satisfied.

Wedel and Kamakura (1999, p. 91) discuss how resampling from the empirical distribution is feasible but very impractical because of the computational complexity it involves. As guidance practitioners have used a variety of information criteria $C = -2\ln L + J\kappa$ where $\ln L$ is the log-likelihood of the model at convergence, J is the number of estimated parameters in the model, and κ is a penalty constant. However, these criteria also fail some of the regularity conditions under the null for a valid test under the null (Leroux, 1992). We mention here only a selection. For $\kappa = 2$ we obtain the Akaike Information Criteria (AIC); for $\kappa = \ln(N+1)$ we obtain the *consistent* AIC (cnAIC); for $\kappa = \ln(N)$ we obtain the Bayesian Information Criteria (BIC), which by construction is very similar to the cnAIC. Finally, for $\kappa = 2(J+1)(J+2)/(N-J-2)$ we have the *corrected* AIC (crAIC) (Hurvich and Tsai, 1989), which increases the penalty for the number of extra parameters estimated.

The AIC is reported to over-estimate the number of groups, while the BIC does not do this, asymptotically, although in small sample sizes it tends to favour too few groups (McLachlan and Peel, 2000).

Finally, a criterion that we favour in this context is an entropy index suggested by Wedel and Kamakura:

$$En = 1 - \frac{\sum_{i=1}^{N}\sum_{c=1}^{C} -\Pr(c\,|\,\mathbf{y}_i)\ln\left[\Pr(c\,|\,\mathbf{y}_i)\right]}{N\ln(C)} \qquad (8)$$

The choice of number of classes that maximizes this criterion is associated with the best separation in terms of individual membership probabilities.

4. Empirical Study

4.1 Survey and data

The population of the survey consists of German residents (native and foreign) aged 18 or older[3]. Because of the large population of German residents (66.4 million) a minimum sample of 1,000 completed questionnaires was set as a target to ensure a sufficiently representative result. A telephone survey was selected as the interview technique, primarily because of limited financial resources. Telephone numbers were generated using the "random

digit dialling method". When contact was established and more than one individual was available at the telephone unit, then the person who most recently had his/her birthday was asked to participate.

In April and May 2001 a total of 12,000 random numbers were dialled. These resulted in 3,675 contacts with persons to whom the screening text was read, 58% of whom refused to participate in an interview. Out of the fraction who did engage in the phone interview only 1.5% dropped out during the administration of the survey. Eventually, a total of 1,017 respondents completed the interview (see table 2) each providing a complete set of the required responses.

Of these 54.7% were women, 45.3% were men. The age group in the sample ranging from 25 to 45 was over-represented and people older than 65 were under-represented with respect to the national proportions (see table 3). Households with three or more than three people were overrepresented whereas one-person-households were highly underrepresented (see table A in Appendix). The average length of the telephone conversation was 16 minutes.

The sample is more or less evenly distributed over different income categories and this seems comparable to the statistics from the last population census, however, as it is always the case, the evaluation of the overall representativeness of the sample is problematic (see table B in Appendix).

The formal education of the sample is hard to compare to the basic population. Data concerning the education of the population are only available for special age groups. According to the PISA-survey[4] 19% between 25 and 64 years hold a university degree. In the sample almost 26% in this age group held a university degree. A university-entrance diploma or an advanced technical college certificate are held by 40% of the population living in Germany.[5] Whereas 46% of the respondents (all older than 18 years old) had reached at least this level of qualification. The sample is hence under-representative of German residents with lower education, perhaps due to a higher rate of drop-off in the screening process.

4.2 Results from latent class analysis

Our intent goes beyond simply addressing the issue of the number of classes, their relative proportions in the population and their individual preference structure. We also wish to identify the extent of the correspondence between the groups predicted by PMT and those empirically identified in the analysis. Further, we wish to learn more about these groups and the features of the implied WTP distribution of each class.

4.3 Choice of questions for response patterns

The survey instrument included a total of 12 questions designed to elicit responses suitable to characterise PMT types. However, interpreting the 6^{12} combinations produced by 12 sets of 6 Likert scale responses is quite a complicated endeavour, even when limited to a number of only 4-6 latent classes. We hence reduced the number of variables by dropping in turn each set of responses to a given question and using as a criterion the impact of such exclusion on the log-likelihood at convergence. If dropping a given set produced a relatively small reduction of the log-likelihood in equation 4, compared to the effects of dropping others, then this was taken as an indication that the set of responses was relatively uninformative. As a consequence the responses to these questions were eliminated. At the end of this lengthy procedure (each convergence required about 7 hours of computing time with 500 random starting points) – whose results are reported in table 4a – we were left with response to questions x2, x4, x8, x9, x11, and x12. (For the values of the goodness of fit criteria for the model including the select group of responses and the model with all responses see table 4b and 4c).

Using these variables we maximize equation 4 varying the number of classes from 2 to 7. Over this range, using the criteria described above, we fail to identify evidence in support of any particular number of classes. The criteria, in fact, did not allow a clear-cut identification of the optimal number of classes.

Because we were primarily interested in informing the number of a finite points in a mixture of WTP distributions another objective was to find the number of PMT-based classes that best explains the *WTP* response model in (7), rather than the patterns of Likert scale responses in equation 4. So, the individual probabilities of class membership that are obtained in the maximizations of the latter were then used in the maximization of equation 7, which explains the distribution of *WTP* in each class. For this equation the average contribution to the sample log-likelihood associated with 5 classes is the highest in the range between 1 to 7 classes (table 5, Model 1).

We report here the mean log-likelihood values at convergence for estimates based on semi-parametric estimation, where only *C*-1 constants are estimated in the logit membership probabilities functions (Model 2); and based on logit membership probabilities conditional on various selections of socio-economic covariates (Models 3 to 5). In particular, we used average household income and age (Model 3), and then we added to these two variables, one dummy for "having visited developing countries" (Model 4) and the "number of children in the respondent's household" (Model 5).

We observe that PMT-based membership probabilities produce better mean log-likelihood values than those produced by other conventional latent class models with logit membership probabilities for classes 2 to 5 (we fail to achieve convergence for any number of classes larger than 5), both when these were specified semi-parametrically in Model 2 (constant only), and conditionally on select co-variates in Model 3 to 5.

Because of the different sample sizes due to missing data on socio-economic covariates it is not possible to formally test specifications, using, for example, the approach by Vuong (1989). However, since "the maximum likelihood of a model is a natural estimator of the distance between the model and the true distribution as measured by the Kullback-Leibler Information Criterion" (Vuong 1989, page 326), we conclude that, with the information in hand, the specification based on 5 PMT classes are best at informing the segmentation of *WTP* distributions in the sample in hand.

4.4 Identified classes and class characteristics

We point the reader to tables 7 and 8 for the predicted probabilities of response to each question in members of each class as predicted by the 5 class model. We therefore focus our attention on the structure of these five and proceed to check that the four classes predicted by PMT are recognizable.

Class A. It is the largest class (39% of the sample), and has the highest mean WTP (€ 36). This class shows a pattern of probability of response consistent with what PMT defines as *problem focused* coping strategy. The probabilities of observing responses in agreement with the perception of threat (X2 and X4), responsibility (X12) and efficacy of the policy (X8, X9, X11) are all high.

Class B. This class is the smallest (3% of the sample) and shows a pattern of response clearly consistent with what PMT defines as *no action* coping strategy, and an attendant estimate of mean WTP of € 3. Probabilities of low scores are high along all dimensions.

Class C. This is an intermediate size class (14% of the sample). The pattern of response probabilities to PMT questions is consistent with what PMT defines as *maladaptive* coping strategy, as members of this class have a very high probability of low scores in all variables, with the exclusion for the severity of threat, which shows a moderate score. The

estimated mean WTP for the class is negative (€ -16), a value consistent with the features of this class, as we will discuss below in more detail.

Class D. This class shows the second highest mean WTP (€ 28) and is the second largest class with (= 22% of the sample). The probabilities of low scores for perceived threat are high especially own-threat. Instead the probabilities of *high* scores on response with high efficacy are high, but those for trust in the implementing organisations and feeling of responsibility are low. The combination of low threat and high perceived coping is consistent with what PMT defines as *just to be sure*.

Class E. Like class D, this class represents 22% of the sample and has an estimated mean WTP of €22. But the pattern of probabilities is dominated by moderate probabilities in high scores of threat perception. Probabilities for high scores with perceived efficacy of the policy are high apart from those on trust on the implementing organisations. High to very high score probabilities are found for responses of high feeling of responsibility for the protection of species in developing countries. As coping and perceived threat are high the class can be labelled as *problem focussed*. However, since the values are not as high as in class A we label it as *moderate problem focussed*.

Table 6 gives an overview of the probabilities of response patterns for the five identified classes.

5. Discussion

5.1 Psychological versus economic rationality

Given the results obtained, what can we conclude with regards to the *behaviour* of the *WTP* distributions associated with each class? Do they reflect anomalous preferences? Let us examine each in turn.

Problem-focussed case

Respondents who behave "problem-focussed" and report high *WTP* values behave rationally from both PMT and economic viewpoints. They perceive a high threat from the loss of biodiversity, they believe that in general the loss of biodiversity can be reduced, and they believe their monetary contribution has a positive impact on the preservation of species. Thus, they are willing to pay a comparable high amount for biodiversity conservation in developing countries. Our data are consistent with such pattern in two of the separate classes we identified empirically: the "problem-focussed" and the one we termed *moderate* "problem-focussed".

No action case

Similarly, the distribution of reported WTP for "no action" respondents' can be considered to be rational in terms of both PMT and economic theory. These respondents do not feel strongly threatened by biodiversity loss and believe that not much can be done in practice to protect biodiversity. Accordingly, they report an average willing to pay amount that is comparatively low.

Just to be sure case

We find that the mean WTP for the distribution of respondents in the class "just to be sure" is lower than that for those in class "problem-focussed", yet higher than that in the "no action" class. This, again, is rational in both PMT and economic theory terms. People who act "just to be sure" although they feel the threat from the loss of biodiversity in developing countries to be low, they do not extend this perception or belief to the possibility of protecting it. They believe species protection in developing countries to be generally viable, especially in terms of effectiveness of their own contribution.

Maladaptive case

Perhaps the most interesting class in terms of interpretation of the associated WTP distribution is the maladaptive class. People of this class express a high perception of threat and a low perception of coping, and are associated with a negative mean WTP. The obvious contradiction of a moderate-to-high threat perception and a negative WTP could be interpreted as an anomaly. However, in our case we can explain it by the low perceived realism, which becomes apparent only because of using the PMT constructs. The surveyed information that these respondents do not believe in the implementation of biodiversity protection or in the power of their own payment provides us the opportunity to interpret the associated *WTP* as the outcome of a rational calculation.

With the identification of the maladaptive class we found evidence for alternative explanations of negative *WTP*. Those negative *WTP* for a public good such as biodiversity conservation would more likely be associated with strategic behaviour or protest responses. Identification and elimination of inconsistencies from the sample has been advocated in the past (e.g. Foster and Mourato, 2002), and would presumably be the conventional course of action. However, the additional articulated information PMT affords on perception of realism provides a plausible reason for such occurrence. Members of the class manifest high levels of scenario rejection due to perceived unrealism, or as psychologist would put it have a low to very low perceived "coping". Furthermore, the latent class approach does not require the always-undesirable elimination of any group of respondents, but it elegantly accommodated all groups in an overarching statistical model.

5.2 Realism

Although during the interview great care was taken to emphasize that money will only be used to fund biodiversity protection, a noticeable proportion of the members of the sample expressed their low realism: they could not be convinced of the possibilities to put the protection of biodiversity in developing countries into practice, did not believe in the credibility of the implementing organisations and/or did not believe their payment would make a contribution to the protection of species. By decomposing realism based on PMT in sub-constructs response-efficacy, trust in implementing organisations and belief in the power of the own payment we get deeper insights in the characteristics of realism. We could identify the *multidimensionality* of realism and the different important of aspects of realism for *WTP*. Surprisingly lack of trust in the implementing organisations did not result in low mean *WTP* in the "problem-focussed" or "just to be sure" classes.

The emphasis in realism research in CVM so far was placed on the respondents' belief in the possibilities to implement the proposed scenario. With our operationalisation of realism we could show the importance in the belief of the power of the own payment for expressed *WTP*, which seems to be kind of ignored in CVM research so far.

6. Conclusions

In this study we emphasised the importance of perceived realism *in combination with* perceived threat as sources of systematic differences across classes of respondents and their mean *WTP* estimates for biodiversity conservation. We were inspired in our investigation by protection motivation theory, a well-established and successful psychological theory. We believe that researchers interested in characterizing the sources of heterogeneity in respondent behaviour should make an effort to bring to bear psychological findings in their economic analysis. In particular, we feel that with so much of the CV literature currently exploring the value of private and public health issues, PMT could represent a promising avenue for insightful findings in rationalising some common CV anomalies.

The empirical evidence produced in our analysis is consistent with the predictions of PMT. The patterns of observed probability of responses associated with each class matches the expectations built on such theory, and so do the relative magnitudes of mean WTP for the value distribution in each class. There is much appeal in a theory that can predict the structure of a finite number of classes, especially in view of the poor guidance available from statistical criteria suitable to discriminate between competing hypotheses on class compositions in discrete choice models.

Looking at the characteristics of the identified classes and according to the PMT helped to understand reported WTP of class members. We can summarise that a very low perceived threat as well as low self-efficacy and responsibility resulted in a very low mean WTP – as predicted by PMT. Additionally, high scores for responsibility and self-efficacy are associated with high mean WTP.

Furthermore, the theory predicts that high threat in combination with low coping results in maladaptive behaviour. We could identify this effect very clearly with negative WTP for the class identified as "maladaptive".

Similarly, to other PMT applications (Milne *et al*. 2000) we have evidence that perceived coping (response efficacy & self-efficacy) is more influential than perceived threat (severity & fears). In fact, the level of reported WTP is lower when perceived coping is low than when our measure of perceived threat is low. The suggestion is that self-efficacy has a higher influence on WTP than fear.

In the case of payments for biodiversity protection the application of PMT made different forms of perceived realism apparent for stated *WTP*. Whether the respondents perceive the production of the good in question as plausible or not and whether the own payment is perceived as important for the production of the good in question plays a key role for stated *WTP*. In our case a class of people could be identified which did not believe in species protection in the described way or biodiversity protection in general as possible, or they did not believe in the power of their own payment. However, we can conclude that even the members of this group expressed well-behaved preferences in terms of their rationality.

Powe and Bateman (2004) have already emphasised perceived realism in the construction of CV surveys. We present further empirical evidence for the importance of realism and highlight its multidimensionality. Self-efficacy and response-efficacy, as components of realism, should be examined in the design phase of CV studies and the main survey. Using PMT enables researcher to find an appropriate wording for questions to measure the different aspects of realism. A good wording is found when respondents do not realise that it is intended to test whether they believe in the scenario or not. If reasons for low realism are detected in the design phase of CV studies, then this needs to be amended. Additionally, in the main survey respondents could be allowed to ask for extra information after the standard scenario presentation (see Fischer, 2004). Furthermore, respondents' belief in the effects of their payment contribution ought to be measured in early stages of the interview to possibly strengthen the trust of respondents in the power of their own actions.

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8. Appendix:

x1 = "The loss of biodiversity in developing countries will in the long run affect the living conditions of **people living in developing countries"**
x2 = inverted "The loss of biodiversity in developing countries will – if at all – derogate a few **people on earth."**
x3 = "The loss of biodiversity in developing countries will negatively affect the living conditions of **future generations."**
x4 = "The loss of biodiversity in developing countries will not derogate **me personally. "**
x5 = "The extinction of 50.000 animal and plant species does contribute to the danger/endangerment of the ecological equilibrium of the earth."
x6 = "I have a bad feeling, when I hear that animal and plant species are going to be extinct."
x7 = „It is a pity when 50.000 animal and plant species become extinct in developing countries."
x8 = "With advices and financial support from developed countries half of endangered plant and animal species can be protected. "
x9 = "The governmental and non-governmental organisations, who are trying to protect animal and plant species are confidential/trustable. "
x10 = "It is possible to reduce the extinction of species in developing countries. "
x11 = "Payer" (1) „Even my payment matters for the protection of species in developing countries "
"not payer" (2) „A payment from me would not matter for the protection of species in developing countries. "
x12 = "I am as well responsible for the protection of 50,000 endangered species in developing countries."

Appendix : Tables

Table A: Household size in sample und basic population

	Valid Percent (sample)	Percent (basic population)
1-personhouseholds	19.4	36.7
2-personshouseholds	31.2	33.7
3-personshouseholds	17.1	14.2
4-personshouseholds	20.3	11.1
5 and more personshouseholds	12	4.2

Sources: own survey and Federal Statistical Office Germany (available at http://www.destatis.de/basis/d/bevoe/bevoetab11.php)

Table B: Household income in sample und basic population

	Sample			**Basic population**	
Income categories (in €)	Frequency	Percent	Valid percent	Income categories (in €)	Percent
< 900 Euro	127	12	**16**	< 920	**16.7**
900 - 1.250 Euro	107	11	**13**	920-1534	**27.7**
1.251- 1.600 Euro	138	14	**17**		
1.601 – 2.000 Euro	124	12	**16**	1534-2556	**32.5**
2.001 – 2.500 Euro	107	11	**14**		
> 2.500 Euro	197	19	**25**	>2556	**22.9**
total	**800**	**77**	**100**		
Do not know/ no statement	217	21			

(*Sources: own survey and Federal Statistical Office Germany, Datenreport 2002, S. 212)*

Table 1: Coping strategies of PMT (source: Rogers and Prentice-Dunn 1997)

		Threat	
		high	low
Coping	high	Problem focused	Just to be sure
	low	Maladaptive	No action

Table 2: Sample report

	Cases	Percentages
Telephone-Number Total	12000	100.0%
neutral outfalls	5177	43.1%
No connection	4537	37.8%
wrong connection / number has changed	83	0.7%
business telephone number	557	4.6%
Revised Gross I	6823	100.0%
other outfalls	3148	46.1%
no connection tone, no contact	1701	24.9%
busy	86	1.3%
answering machine / mailbox	601	8.8%
fax machine/ modem (whistle)	541	7.9%
strong communication problems	219	3.2%
Revised Gross II	3675	100.0%
not neutral outfalls	2658	72.3%
cancelled appointments	41	1.1%
person not available in given time period (10 contact attempts)	427	11.6%
refusals	2135	58.1%
drop outs	55	1.5%
Realised Interviews	1017	27.7%

Source: own research and own calculations

Table 3: Percentages of people in age groups in sample and basic population

	Percent of sample	Percent of basic population
15(18)-25	15	13
25-45	45	36
45-65	29	31
65+	12	20

Source: own research and own calculations

Data for basic population: Federal Statistical Office (Germany), 2002.

Table 4a: log likelihood with and without dropping of each variable for the different class cases (variables in bold were kept in the final analysis)

	4 classes	**5 classes**	**6 classes**	**7 classes**
Complete set	*-13976.49*	*13890.72*	*13810.82*	*13747.32*
Omitting X1	-12997.30	-12917.50	-12848.51	-12795.75
Omitting X2	**-12614.87**	**-12543.84**	**-12482.92**	**-12422.75**
Omitting X3	-13132.33	-13041.83	-12983.47	-12983.47
Omitting X4	**-12455.97**	**-12378.39**	**-12303.14**	**-12303.14**
Omitting X5	-12779.93	-12709.15	-12643.22	-12643.22
Omitting X6	-13266.43	-13181.35	-13108.89	-13108.89
Omitting X7	-13493.21	-13412.92	-13339.38	-13339.38
Omitting X8	**-12634.70**	**-12562.50**	**-12499.20**	**-12499.20**
Omitting X9	**-12496.50**	**-12421.20**	**-12362.10**	**-12362.10**
Omitting X10	-12879.30	-12800.90	-12741.60	-12741.60
Omitting X11	**-12579.00**	**-12499.30**	**-12435.40**	**-12435.40**
Omitting X12	**-12750.20**	**-12673.50**	**-12602.30**	**-12602.30**

Table 4b: Goodness of fit criteria for model including the select group of Likert responses (x2, x4, x8, x9, x11, x12) for cases of 2-7 classes

Classes	log-lik.	AIC	CAIC_J	AIC_C	Entropy
2	-8764.63	17525.26	17543.11	17519.26	0.5597
3	-8644.10	17282.20	**17308.98**	**17274.20**	0.5959
4	-8595.06	17182.12	18713.75	17305.55	0.6526
5	-8552.59	17095.19	19009.73	17301.81	0.6738
6	-8517.47	17022.93	19320.38	17343.79	0.7214
7	**-8484.93**	**16955.85**	19636.21	17430.08	**0.7312**

Table 4c: Goodness of fit criteria for model with all variables

Classes	log-lik.	AIC	BIC	AIC_C	Entropy
2	-14306.28	28608.57	29443.52	28641.56	0.751
3	-14090.47	28174.94	**29427.37**	28253.84	0.7512
4	-13976.49	27944.99	29476.4	28068.41	0.7690
5	-13890.73	27771.45	29685.72	27978.08	0.7638
6	-13810.82	27609.63	29906.75	**27930.48**	0.7919
7	**-13747.32**	**27480.65**	30160.62	27954.87	**0.8037**

Table 5: Comparisons of mean log-likelihood values across latent class *WTP* logit models

		Model1	Model 2	Model 3	Model 4	Model 5
classes	PJ	PMT-based	Constant-only	HH_INC+AGE	+knowdev	+kids
2	5	-0.5844	-0.6216	-0.5896	-0.5872	-0.5767
3	8	-0.5224	-0.6215	-0.5838	-0.5773	-0.5742
4	11	-0.5451	-0.6213	-0.5812	-0.5741	-0.5622
5	14	-0.5183	-0.6207	-0.5799	-0.5537	-0.5279
6	17	-0.5293	n.a.	n.a.	n.a.	n.a.
7	20	-0.5345	n.a.	n.a.	n.a.	n.a.

Table 6: Table: Probabilities of “I completely agree” plus “I fairly agree” answers to PMT questions for members of the five classes

	A	**B**	**C**	**D**	**E**
N	392	35	142	221	227
%	39	3	14	22	22
WTP	36	3	-16	28	21
Threat					
Severity – others	0.8	0.54	0.54	0.51	0.77
Severity – self	0.76	0.22	0.38	0.27	0.6
Coping					
response efficacy	0.81	0.47	0.26	0.7	0.73
Trust in organisations	0.45	0.2	0.2	0.3	0.36
Self efficacy	0.83	0.23	0.22	0.73	0.65
Responsability	0.91	0.48	0.33	0.59	0.8
PMT group	Problem focussed	No action	Maladaptive	Just to be sure	Moderate problem focussed

Legend:

> 0.75	0.6 – 0.76	0.45-0,59	0.3-0.44	< 0.29

Figure 1: Structure of PMT including choice of coping strategy (adapted from Gardener and Stern, 1996)

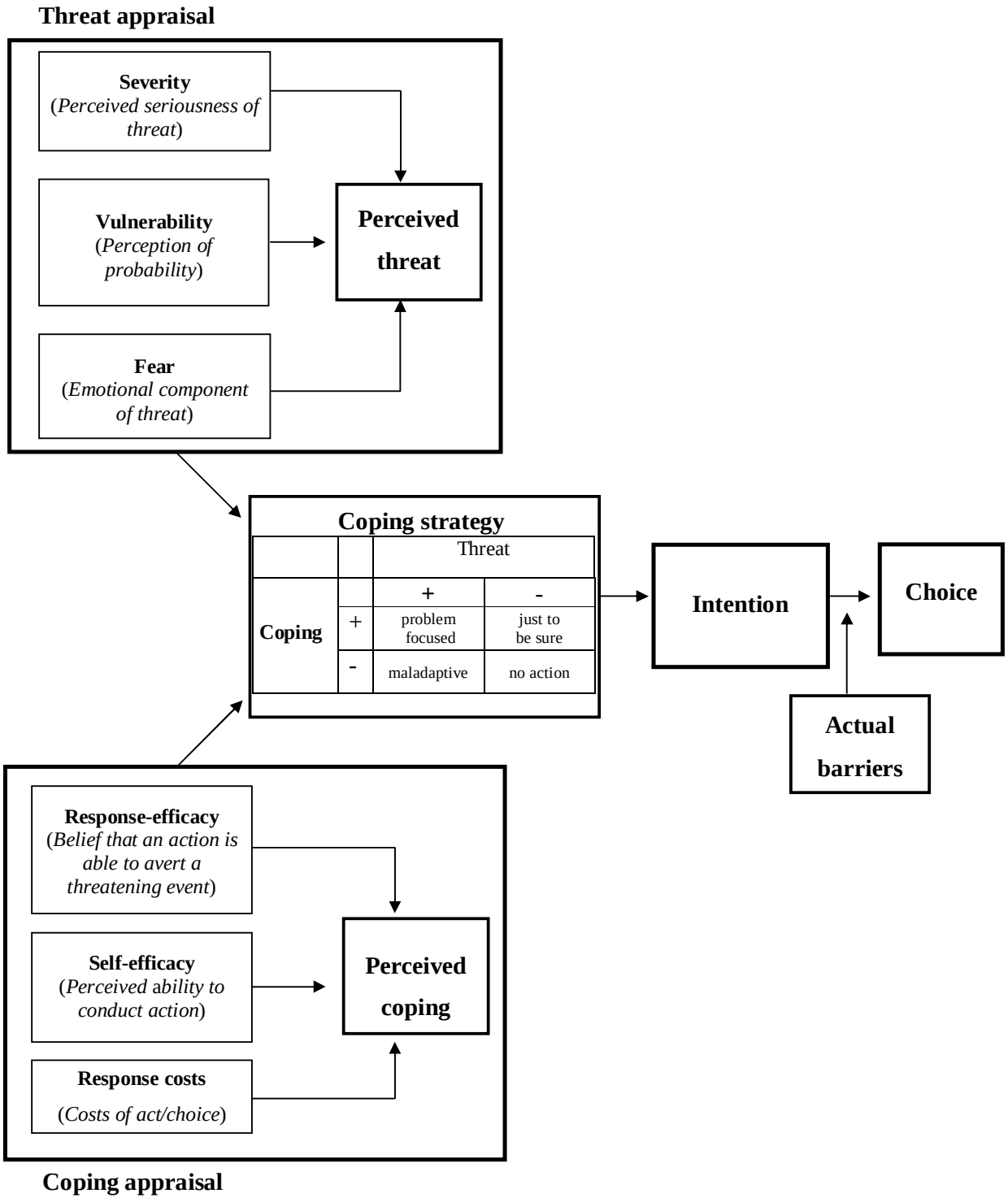
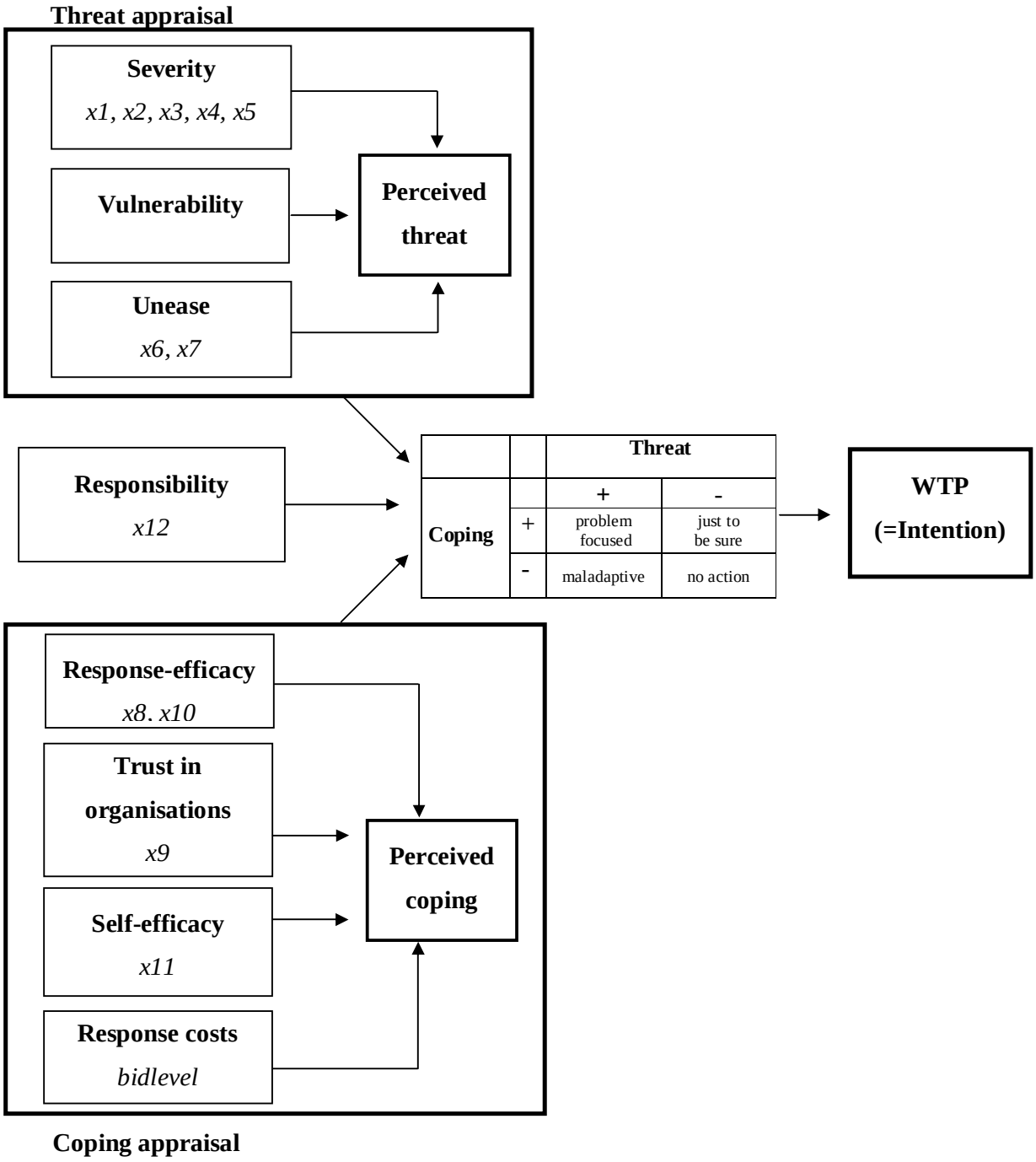


Figure 2: Theory's constructs and variables of survey



[1] Although for incentive-compatibility Green et al. (1998) note that the payment vehicle must be decoupled, that is, "if a good is provided, then its cost will be distributed across all consumers by a formula (such as an income tax) surcharge that does not depend on the subject's CV response." (page 88).

[2] Short of cost considerations this maps into "perceived realism" in an economist's terms.

[3] One part of the basic population is its eligible voters. In Germany people are eligible to vote when they turn 18. 1998: 60.8 million (1998). (Federal Statistical Office, Bundeswahlleiter). The other part of the basic population are the foreigners, who are 5.775 million (2001), 5.561million (1998) people aged 18 and older (Federal Statistical Office)

[4] OECD: http://www.oecd.org/pdf/M00036000/M00036064.pdf

[5] Federal Statistical Office http://www.destatis.de/basis/d/biwiku/bildab1.htm

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