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STATED PREFERENCES FOR CONSERVATION POLICIES UNDER UNCERTAINTY: INSIGHTS ON INDIVIDUALS' RISK ATTITUDES IN THE ENVIRONMENTAL DOMAIN

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**Stated Preferences for Conservation Policies under Uncertainty:
Insights on Individuals' Risk Attitudes in the Environmental Domain**

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Abstract

The outcome of a conservation policy is often subject to uncertainty. In stated preference valuation, there is increasing recognition that uncertainty affects preferences for environmental policies. However, there is also poor understanding regarding people's perception of uncertainty per se and risk attitude. To shed more light on this, we designed a discrete choice experiment and compared preferences for environmental outcomes under climate change across two split samples, each confronted with a scenario where environmental outcomes are presented as either certain or uncertain (i.e. probabilistically) but displaying the same expected results. We find that, for an equal expected outcome, preferences vary between the certain and the uncertain treatment. These results indicate that risk attitudes impact stated preferences for conservation policies under uncertainty and reinforce the idea that uncertainty should be included in stated preference studies to provide more accurate and policy relevant results. Interestingly, we additionally find that risk attitudes appear to be both context- and individual- specific – the effect of uncertainty depends on the magnitude and direction of change of the environmental good and on individual's socio-demographic characteristics.

Keywords:

Stated preference valuation; uncertainty; risk attitude; climate change; conservation

JEL:

D6, D81, Q20, Q51, Q54

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1. Introduction

Risk and uncertainty are gaining increasing attention in the analysis of the social benefits of environmental policies. This is especially true within the stated preference (SP) valuation literature, which often deals with decisions under risk and uncertainty (e.g., preferences over environmental conservation). Several recent studies have shown that an incomplete understanding of factors such as policy's technical performance and uncertainty around the social, economic and environmental contexts, which jointly make the results of environmental policies uncertain, significantly affect social preferences (e.g., Glenk and Colombo 2011). The consideration of uncertainty rather than certainty is therefore increasingly recommended in SP methods because assuming certainty could lead to wrong conclusions about the true policy's social benefits (Pindyck 2007). However, despite the advances in this literature, researchers generally agree that the effect of risk and uncertainty needs to be better understood to provide more robust information to policy-makers (Rolfe and Windle 2015).

To explore the role of uncertainty, previous SP literature has compared preferences of individuals for given scenarios displayed either as certain or uncertain (Roberts et al. 2008; Wielgus et al. 2009; Glenk and Colombo 2011; Lundhede et al. 2015; Torres et al. 2017). However, it is not yet clear to what extent individuals' choices are driven only by risk preferences or also by the perception that an uncertain policy has lower expected results. In fact, the possibility that a policy may not achieve a given outcome might indicate that it is less worthwhile. To make robust conclusions on the role of risk, it is therefore important to compare preferences under both certainty and uncertainty, while keeping expected outcomes equal in both scenarios. This allows to isolate the effect of uncertainty and to shed more light on individuals' risk attitudes.¹

Very few SP studies have explored risk attitudes and the effect of uncertainty *per se* on individuals' willingness-to-pay (WTP) (Johansson 1989; Macmillan et al. 1996; Koundouri et al. 2014). Most of the SP literature dealing with risk and uncertainty has usually assumed that individuals are risk averse because, based on monetary lottery experiments, risk aversion is the standard result in economics (e.g., Holt and Laury, 2005; Charness et al. 2013). However, there is a growing body of evidence that peoples' risk attitudes depend on individuals' socio-demographic characteristics and are domain-specific (Weber et al. 2002), i.e. their attitude towards risk depends on whether it is a decision regarding health, finance, recreation, social life, ethical or environmental issues, the nature of the specific good being involved, and the possible magnitude and direction of the change (i.e. whether it is a gain or loss) (Blais and Weber 2006; Pannenberg 2007; Dohmen et al. 2011; Figner and Weber 2011; Riddel 2012; Nguyen and Noussair 2014). This is something that has not been investigated in the SP literature so far. Given that people's attitudes to risk is expected to affect preferences and behaviour, gaining a better understanding of the role of risk attitude and of the underlying factors driving it within the SP literature is crucial to better inform public decision-makers about a policy's social return (Glenk and Colombo 2011).

In this paper, we apply a discrete choice experiment (DCE; Carson and Czajkowski 2014) to explore social risk attitudes regarding environmental outcomes in a context of climate change (CC). The environmental outcome chosen concerns a potential decrease in biodiversity in terms of the loss of bird species in a particular locality. This setting is ideal for studying preferences towards environmental risks given that CC is associated with large uncertainties (Heal and Millner 2014). In particular, we use split-sample treatments to compare social preferences in a certain and an uncertain environmental scenario. Both treatments display the same expected outcomes in terms of anticipated species' losses resulting from no extra policy effort under CC and in terms of

¹ How people perceive risk *per se* and react to it (Ananda and Herath 2005; Andersson and Gong 2010; Caliendo et al. 2010) allows to classify them as risk averse, risk seekers or risk neutral (Schonberg et al. 2011; Riddel 2012). Individuals are risk averse if they display higher preferences for the certain rather than the uncertain case, despite expected outcomes are held constant. They are risk seekers if their preferences are higher for the uncertain prospect over the certain case or, in other words, if they appreciate more uncertainty (or higher variance) around payoffs. Alternatively, they are risk neutral if they are indifferent between the certain and uncertain scenarios (Wärneryd 1996).

policy results to either maintain or increase current levels of species. The only difference is that one treatment shows outcomes in a probabilistic way and the other one displays outcomes with certainty. We compare preferences between the certain and uncertain scenarios to shed more light on the role of risk attitudes within a specific environmental context and in the case of a specific environmental good, while controlling for factors such as the magnitude and direction of change of the good and the respondents' socio-demographic characteristics.

We find that people react differently to the prospect of achieving given environmental outcomes with certainty or uncertainty, despite the expected outcomes presented in both cases being on average equal. This confirms that risk attitudes play an important role in decision-making under risk. Overall, our findings reinforce those of previous literature and show that uncertainty should be directly included in SP studies to provide more accurate and policy relevant results. However, with respect to previous literature, we provide additional insights regarding the understanding of the effect of uncertainty on SPs. Contrary to most empirical results in the financial domain, we find only limited support for the hypothesis of risk aversion for environmental gains. In the context of our analysis, individuals' behaviour implies that their risk attitudes depend on the specific environmental change considered and, to some extent, on socio-demographic characteristics.

The rest of the paper is organized as follows. The next section provides an overview of the existing studies examining the main drivers of risk attitudes and past attempts to study the effect of uncertainty within the SP valuation literature, while highlighting the limitations of some of the earlier approaches. Section 3 describes the case study and the methodology employed for the analysis. Results are reported in section 4, followed by a discussion and conclusions section that ends the paper.

2. Literature review

2.1. Determinants of risk attitudes

The economic literature provides ample evidence that individuals' attitudes to risk depend on a variety of factors. One of the most significant sources of observed heterogeneity of risk preferences is related to individuals' socio-demographic characteristics: women are generally found to be more risk-averse than men (Griffin et al. 1999; Eckel and Grossman 2008; Charness and Gneezy 2012); older people tend to be more risk-averse than younger ones (Nicholson et al. 2005; Mata et al. 2011); people with lower levels of education tend to be more risk-averse (de Jonge et al. 2007); individuals with lower wealth or with lower per-person/family income levels are generally more risk-averse (Ding et al. 2010; Gong and Yang 2012); previous experience (Barnett and Breakwell 2001; de Jonge et al. 2007), as well as emotional attachment to the good (Figner and Weber 2011) can both affect individuals' risk attitudes; being out of the labour force (Dohmen et al. 2011) and being an employee, rather than self-employed (Hartog et al. 2002), are usually associated with more risk-aversion; married individuals are generally more risk-averse (Guiso and Paiella 2004); people with children in the household sometimes are more risk-averse (Dohmen et al. 2011) and sometimes less risk-averse (Ekelund et al. 2005).

Individuals also tend to display different risk attitudes depending on the direction and magnitude of change of the good affected by risk. People are generally more willing to take risks over lotteries implying possible losses rather than gains (Kahneman and Tversky 1979), but the possibility of high perceived negative impacts could also trigger risk aversion. They could be risk-averse over gambles displaying large changes in a given good, but risk-neutral over gambles displaying small variations in the good (Nicholson and Snyder 2015).

Perhaps the most important for environmental economics, however, is the growing evidence that risk attitudes are domain-specific and vary depending on whether risks affect individuals in the health, financial, recreational, social, ethical or environmental domain (Weber et al. 2002; Riddel 2012). In this sense, given that

most of the evidence available on risk attitudes relies on monetary lotteries, inferring risk attitudes over financial gambles to draw conclusions regarding the effect of risk attitudes on preferences for environmental goods can be inappropriate (Blais and Weber 2006; Figner and Weber 2011). These findings have profound consequences for non-market valuation of environmental goods because environmental scenarios are usually associated with different risks and uncertainties with respect to financial scenarios.

2.2. Risk attitudes and non-market valuation of environmental goods

Within the SP literature focusing on social preferences for environmental policies, there are only a few attempts to investigate the link between respondents' risk attitudes and their preferences or WTP. Some studies use subjectively reported qualitative indicators to gauge individuals' aversion to risks (Fu et al. 1999; Isik 2006; Botzen and van den Bergh 2012; Hunter et al. 2012) or elicit respondents' propensity to buy insurance policies (Botzen and van den Bergh 2012). Subsequently, such indicators of risk attitudes have been included as explanatory variables of individuals' WTP.

Glenk and Colombo (2011) and Bartczak et al. (2015) relied on monetary lotteries to infer information about individuals' attitudes to risk. After classifying individuals as risk averse, neutral or seekers, they used this information to explain respondents' preferences. Veronesi et al. (2014) were the first to use non-financial domain indicators of risk attitudes. Their study explores risk attitudes by using lotteries over environmental outcomes (i.e. the number of flood events). They have employed this information in a DCE model to explain respondents' WTP to reduce environmental and health risks related to flood events.

Arguably the biggest contribution within the SP literature to the understanding of the role of risk on preferences comes from a few studies, which have compared individuals' WTP for given environmental outcomes presented either as certain and/or uncertain. Roberts et al. (2008) and Wielgus et al. (2009) have explored preferences for environmental improvements by assuming certainty of policy success in one split sample, while introducing information about the uncertainty around policy effectiveness in other split samples. Torres et al. (2017) have explored the effect on preferences of including information about the probability of impact occurrence: they have compared WTP for given policy results to counteract CC induced negative environmental impacts across split samples – one assuming CC impact certainty and the other two assuming CC impact uncertainty. Glenk and Colombo (2011) and, similarly, Lundhede et al. (2015) have first presented to respondents some choice cards without mentioning uncertainty before displaying another sequence of choice cards including one additional attribute reflecting the risk of failure of the policy. Based on these studies, introducing uncertainty in the analysis triggers significantly different (i.e. generally lower) preferences with respect to the case when individuals are exposed to certainty. However, it is not clear to which extent differences in preferences are driven only by risk attitude or also by the fact that an uncertain policy leads to different (i.e. generally lower) expected outcomes. In fact, introducing uncertainty regarding the achievement of a given outcome can make the policy appear less worthwhile.

Only a few contingent valuation (CV) studies (Johansson, 1989; Macmillan et al., 1996; Koundouri et al., 2014) have managed to isolate the effect of uncertainty to draw conclusions on risk attitudes. By means of a split sample approach, they have compared respondents' WTP for environmental scenarios presenting results as either certain or as uncertain (i.e. occurring with 50% probability). In addition, in the certain and uncertain versions, they have displayed equal expected outcomes, either in terms of environmental improvements resulting from policy efforts or in terms of environmental damages that will take place without policy intervention. In no case did any of these studies simultaneously present both the outcomes of policy efforts and those of no policy intervention as subject to uncertainty. This might have distorted individuals' perception of the risky context given that, in the presence of uncertainty, especially regarding environmental processes,

both the results of improvement scenarios with policy and of environmental losses without policy are subject to an inherent and often uncontrollable uncertainty (Torres et al. 2017). Omitting this information when presenting the scenarios could have had major repercussions in terms of risk attitude analysis.

The studies reviewed in this section have sometimes shown that individuals are risk averse and tend to be willing to pay less for the scenario with uncertainty (Johansson 1989; Macmillan et al. 1996; Isik 2006) or they are risk neutral and display no significantly different preferences for the certain and uncertain scenarios (Fu et al. 1999; Glenk and Colombo 2011; Koundouri et al. 2014; Veronesi et al. 2014). One of the reasons for this inconsistency of the results might be linked to the fact that the effect of risk on social preferences can be different depending on a variety of factors, which have not been controlled for. These include the specific domain or scenario considered, the good, the direction of change over the good and the individuals' socio-demographic characteristics. By explicitly taking into account all those aspects, the present paper aims to better understand the effect of uncertainty on preferences for environmental conservation outcomes and gather additional insights into people's risk attitudes to better inform policy-makers and SP practitioners.

3. Methodology and data

To investigate the effects of describing policy outcomes as certain or uncertain and gain insight into whether respondents are risk averse, risk neutral or risk seekers with respect to gains or losses in an environmental domain we designed and conducted a non-market valuation study in the context of climate change. Specifically, we look at conservation policies in S'Albufera wetland in Mallorca (Spain), where climate change effects are likely to influence the number of 'specialist' and 'generalist' migratory bird species. We use split-sample treatments and describe the policy outcomes as either certain or uncertain, while holding the expected value outcomes constant. Importantly, in our experiment all the outcomes (including the business as usual case, with no additional policy efforts) were either described as certain or uncertain. This provides us with an opportunity to separately study the effects of risk attitudes for gains or losses with respect to the status quo.

3.1. Case study

S'Albufera wetland, located on the Mediterranean island of Mallorca (Spain), was considered as a case study for the analysis of the effect of risk on individuals' preferences for environmental policies. This wetland, being the largest freshwater humid area of the island and supporting diverse and abundant flora and fauna species of international importance (Sato and Riddiford 2008), is ideal to investigate this research question. This is because the wetland, which is a natural park, is expected to be exposed to considerable risks induced by climate change (CC), with potentially negative impacts on bird species, the site's main natural asset. On the one hand, CC is anticipated to increase water salinization problems and to lead to major alterations in the wetland's ecological conditions. These are expected to generate a decline in S'Albufera's 'specialist' bird species, which refer to those species that find their ideal habitat in this wetland. On the other hand, CC might also lead to alterations in migratory bird species' patterns, such that migratory birds, which visit the wetland for nesting and breeding, are predicted to arrive earlier to S'Albufera. If this was the case, migratory birds might not find optimal roosting conditions in the wetland and would be obliged to abandon the site or die. This would lead to a decrease especially in the number of S'Albufera's 'generalist' migratory bird species, referring to those species that only happen to occasionally move to this wetland and are not typically seen there. It is difficult, though, to predict the exact repercussions of climatic variations on the specialist and generalist migratory bird species because CC impacts on the environment are to a degree unknown.

In this framework, experts think that the implementation of additional management efforts in the wetland may mitigate the loss of many bird species, which would be beneficial for wetland's conservation and the

recreationists visiting S'Albufera for its environmental quality. On the one hand, it is believed that the decline in the number of specialist bird species may be halted by maintaining current freshwater conditions at the site through intensification of current water management efforts. On the other one, it is thought that the decline in the number of generalist migratory bird species might be counteracted by increasing efforts on policies to create optimal nesting and breeding conditions at the site. In any case, due to the uncertainty of CC impacts on the environment, the exact results of these policies should also be uncertain.

3.2. Choice experiment design

In order to examine how risk attitudes drive individuals' (i.e. recreationists') preferences for alternative conservation policies in an uncertain context, the discrete choice experiment (DCE) technique was considered to be the most suitable method. DCEs allow obtaining information about preferences for environmental policy outcomes by asking individuals in a survey to choose their most preferred alternatives among multiple sets of options, where each alternative is described by a different combination of environmental policy attributes. Additionally, DCEs allow exploring preferences in hypothetical and uncertain future scenarios, like in the case of CC, where information on people's preferences cannot be observed and is not available elsewhere. Indeed, the DCE method relies on the creation of controlled experiments, in which the effect on preferences of a specific treatment, the uncertainty of CC impacts in the present paper, can be isolated.

Two DCEs were designed to capture the effect of uncertainty on individuals' preferences for conservation policies. One DCE, used here as a control treatment and presented in Faccioli et al. (2015), illustrates a context in which CC impacts and the results of policies in S'Albufera are displayed as certain to respondents (certain treatment). In the second DCE, both CC impacts and the results of policies appear as being uncertain (uncertain treatment). Respondents were randomly assigned to one of the treatments. This random assignment allows us to study the effect of presenting the policy outcomes as uncertain versus certain and the results can be used for revealing the information about respondents' risk attitudes.

In both DCEs, the alternative scenarios for S'Albufera's future in 10 years' time were described using the same 5 attributes reflecting management efforts that are perceived to be relevant for visitors. Two are environmental attributes – the change in the number of specialist bird species and generalist migratory bird species present in the wetland, compared to nowadays – and three are non-environmental attributes – the waiting time for an observation cabin's seat, the number of benches throughout the park with respect to today's number, both being proxies for the amenities available in the wetland for visitors, and an entrance fee per adult visitor and day. For each non-monetary attribute, three levels are considered, which reflect the results of a no increase, moderate or high increase in management efforts with respect to current levels.

The only difference between the two DCEs lies in the way the specialist bird species attribute levels are presented. In one treatment, these were described as certain, whereas they were presented as uncertain in the other treatment. In this last treatment, the uncertainty is described as being associated with a limited knowledge concerning how CC events in the next 10 years will affect the specialist bird species.² More precisely, the uncertainty around CC effects is described as being associated with either the occurrence of a more severe impact scenario, expected to take place with a probability p_1 , or the occurrence of a less severe impact scenario, which should take place with a probability p_2 (where $p_2=1-p_1$). A probability of 50% was considered for both p_1 and p_2 , which represents the maximum level of uncertainty. It was assumed that

² Participants to focus group sessions believed that CC impacts on specialist bird species will be more uncertain than those on generalist migratory bird species. They perceived specialist species, which are heavily dependent on the ecological condition in S'Albufera, to be more exposed to the variability and uncertainty of CC effects on the wetland than generalist species, which are less dependent on changes in the local ecological condition. Thus, participants found it credible to present the impacts of CC on the number of specialist bird species as uncertain and CC impacts on the number of generalist migratory bird species as certain.

uncertainty will affect the number of specialist bird species resulting from both increased policy efforts and no increased policy efforts in the uncertain treatment.³

For a given management effort, it was also assumed that the same outcome, in expected value (EV) terms, would be achieved in both experiments.⁴ With this design, the comparison of respondents' behaviour under uncertainty and in the absence of uncertainty (i.e. in the control group) can provide useful information on risk attitudes. By definition, respondents can be classified as risk averse if they prefer a certain outcome to a lottery with the same expected outcome, risk neutral if they are indifferent between the two, or risk seeking if they prefer the lottery.

Table 1 presents the attributes employed in the certain and uncertain DCE together with the attributes' levels.

Table 1. Attributes description and their levels in the certain and uncertain treatments

Attribute	Description	Levels	
		Certain treatment	Uncertain treatment
Specialist bird species	Change in the number of species ^a	+5 0 ^d -10 ^c	+4 or +6, each with a 50% chance (EV= +5) -5 or +5, each with a 50% chance (EV = 0 ^d) -16 or -4, each with a 50% chance (EV = -10) ^c
Generalist migratory bird species	Change in the number of species ^a	+5 0 ^d -10 ^c	+5 0 ^d -10 ^c
Waiting time	Minutes waited for an observation cabin's seat	About 3 About 7 About 15 ^{c, d}	About 3 About 7 About 15 ^{c, d}
Rest-stop benches	Number of benches throughout the park ^b	Triple Double Equal ^c	Triple Double Equal ^c
Entrance fee	Entrance fee per adult visitor and trip (in euros)	4, 8, 12, 16, 20, 24	4, 8, 12, 16, 20, 24

^a Changes with respect to the current number of bird species.

^b Number measured with respect to the current level of rest-stop benches.

^c Level resulting from no additional policy effort over the next 10 years, being €0 for the Entrance fee attribute.

^d Present level

In both DCEs, alternatives were created by combining the different attributes' levels by means of a D-efficient Bayesian experimental design. The combinations were then grouped into choice sets, such that each choice set contained three alternatives. One fixed option, showing the 'no policy' situation (or business as usual, BAU), specifically what will occur in a time horizon of 10 years under current or no increased management efforts. This alternative presents a drop, on average, by 10 in the number of specialist and generalist migratory bird species, current level of waiting time and of rest-stop benches and no entrance fee. Then, in each choice card, two policy options are also considered, showing at least improvements in one or more attributes with respect to the BAU situation and being associated with the payment of an entrance fee. An example of choice card for each DCE is provided in Appendix 1. Individuals were requested to select their preferred alternative in each of 6 successive choice cards.

³ In the uncertain version of the choice experiment, information about uncertainty was provided both through the attribute levels' description and through a framing statement: "The evolution of the number of specialist bird species in 10 years' time is uncertain. To make a comparison, it is like in a lottery, results are subject to a probability. In this sense, experts think that if park managers' efforts on current management practices are not strengthened, the decrease in the number of specialist bird species will occur with a probability equal to 50%. Of course, the changes in the number of specialist bird species resulting from strengthening efforts will also be uncertain."

⁴ where the EV is calculated as the sum of the probability-weighted outcomes that could result from a given event.

3.3. The sample

Both DCEs were implemented simultaneously through on-site, face-to-face interviews conducted with S'Albufera visitors between April and June 2013. Overall 322 individuals were randomly sampled for the certain DCE and 318 for the uncertain one.

The main characteristics of the respondents confronted with both the certain and the uncertain treatments are summarized in Table 2. In both samples, individuals display the same profile based on selected variables. Most of the respondents are non-residents. They are primarily motivated to travel to Mallorca for nature enjoyment and they are interested in visiting S'Albufera to contemplate and enjoy nature or to carry out more specific activities like birdwatching. They show repeat visitation rates to the park and generally travel in small groups.

Table 2. Main characteristics of sampled respondents

	Certain treatment	Uncertain treatment
Place of residence***		
Resident (in Mallorca)	12.88%	7.72%
Non-resident	87.12%	92.28%
Main interest of the trip to Mallorca***c		
Nature enjoyment	45.31%	40.88%
Relax	30.08%	36.50%
Other ^a	24.61%	22.62%
Main reason for visiting S'Albufera***b		
Contemplation/enjoyment of nature	42.03%	46.64%
Birdwatching	30.51%	29.87%
Other	27.46%	23.49%
Repeat visitation to S'Albufera***		
Repeat visitation (residents)	63.16%	69.57%
Yearly visitation rate (median)	1	2
Repeat visitation (non-residents – over last 5 years)	40.46%	45.08%
Yearly visitation rate (median)	1	1
Travel parties***b		
Visiting the wetland with someone else	87.46%	82.88%
Average number of accompanying people	2.20	1.66

^a Other includes: sun and beach, sport, fun and entertainment, family and friends, culture (art, history, gastronomy), holidays in a second home.

^b Includes residents and non-residents.

^c Includes only non-residents.

***non-significant difference at 1% level between the certain and uncertain treatments.

Concerning the socio-demographic profile of respondents, summarized in Table 3, S'Albufera visitors tend to be on average middle aged, with slightly more males than females in the sample. Their education level is generally high (typically a university or post-graduate degree) and, in terms of occupation, more than half of respondents are employees. On average, the size of the respondents' households generally consists of two or three adults living together and no children below 16. Regarding income levels, visitors' monthly average net household income is between 3,000 and 4,000 euros.

Table 3. Socio-demographic profile of sampled respondents

	Certain treatment	Uncertain treatment
Age***		
Average respondent's age	53	54
Gender***		
Man	53.56%	57.05%
Woman	46.44%	42.95%
Education achieved***		
Tertiary education	50.51%	50.67%
Other ^a	49.49%	49.33%
Occupation***		
Employee (part- and full-time)	56.27%	53.69%
Self-employed (entrepreneur and freelancer)	5.76%	8.05%
Other ^b	37.97%	38.26%
Household members***		
Average number of people in the household	2.39	2.34
No child(ren) below 16	78.54%	83.59%
Net monthly household income***		
Average net monthly household income	3000-4000€	3000-4000€

^a Other includes: secondary education (46.44% in the certain treatment and 46.64% in the uncertain one) and primary education.

^b Other includes: own house-keeping, unemployed, (non-working) student and retired (31.86% in the certain treatment and 33.89% in the uncertain treatment).

***non-significant difference at 1% level between the certain and uncertain treatments.

Through the statistical analysis of respondents' choices, information could be obtained concerning individuals' preferences regarding the implementation of a conservation policy in the wetland. More precisely, and as described in the following section, we are interested in comparing the results obtained in the certain treatment with those in the uncertain treatment.

3.4. Statistical modelling

According to the random utility maximization theory, which represents the usual framework for modelling choice data, the utility respondent n obtains from a specific scenario j of conservation of the wetland relies on a deterministic term $\beta'_n X_{nj}$, which is a function of the k attributes of this scenario including cost, and a random term ε_{nj} :

$$U_{nj} = \beta'_n X_{nj} + \varepsilon_{nj} \quad (1)$$

where ε_{nj} follow a Gumbel distribution, X_{nj} is the vector of k attributes describing alternative j faced by respondent n and β_n is the vector of k preference parameters. We use a mixed logit (MXL) model, due to its numerous advantages over the conditional logit one (McFadden and Train 2000; Train 2009), including the possibility to estimate individual-specific parameters (β_n). We assumed that β_n follow a normal distribution across the population, with mean b and standard deviation σ , excepted for the entrance fee (cost) parameter which is assumed to be log-normally distributed to restrict the sign of this coefficient to be the same over all respondents. The parameters b and σ are to be estimated by simulation (Train 2009). Then, the probability that respondent n chooses alternative j in choice card J is:

$$P(j|J) = \frac{\exp(\beta'_n X_{jn})}{\sum_{k \in J} \exp(\beta'_n X_{kn})} \quad (2)$$

As two different samples have been surveyed, one for each treatment, one approach would be to estimate one model for each treatment group and then compare preferences. Though, in this case, differences in scale,

defined as differences in the degree of “randomness” of choices (Czajkowski, Giergiczny and Greene. 2014), might exist due to the fact that respondents were confronted with different information (treatments)⁵. As shown in the following equation, the scale parameter (α_n) is confounded with β_n and hence the interpretation of whether the observed differences are due to preferences or scale are problematic (Hess and Rose 2012).

$$U_{nj} = \alpha_n \beta_n X'_{nj} + \varepsilon_{nj} \quad (3)$$

For this reason, the common differences between the coefficients obtained for the uncertain treatment (relative to the control) group are collected as a single dummy-coded variable T_n , which is introduced as a covariate of scale and takes the value 1 when respondent n took part in the uncertain treatment, and 0 for the certain (control) treatment:

$$\alpha_n = \exp(\theta T_n) \quad (4)$$

where θ , representing the effect of treatment on scale, is estimated in the MXL estimation process along with β_n . A positive (respectively negative) value for θ would mean that respondents confronted to the uncertain treatment ($T_n=1$) tend to, overall, have less (respectively more) random choices than those in the control group, where the scale is normalized to one.

Firstly, this approach allows scale differences between the two groups to be taken into account, which will ensure that the difference between coefficients is due to a variation in preferences and it is not confounded with differences in scales. Secondly, despite pooling data together, this approach still allows the estimation of treatment-specific effects in the model. This is achieved by introducing the dummy variable T_n in the utility function as an interaction with the levels of the specialist birds' species attribute to differentiate the effect of a variation in the number of specialist species on preferences in the control and in the uncertain treatment. Based on the above, the utility specification used for estimation purposes is:

$$U_{nj} = \alpha_n (\beta_{0,n} \cdot ASC_{nj} + \beta_{1,1,n} \cdot X_{SPEC-10,nj} \cdot (1 - T_n) + \beta_{1,2,n} \cdot X_{SPEC-10,nj} \cdot T_n + \beta_{2,1,n} \cdot X_{SPEC+5,nj} \cdot (1 - T_n) + \beta_{2,2,n} \cdot X_{SPEC+5,nj} \cdot T_n + \beta_{3,n} \cdot X_{GEN-10} + \beta_{4,n} \cdot X_{GEN+5} + \beta_{5,n} \cdot X_{TIME_7,nj} + \beta_{6,n} \cdot X_{TIME_3,nj} + \beta_{7,n} \cdot X_{BENCHES_{double},nj} + \beta_{8,n} \cdot X_{BENCHES_{triple},nj} + \beta_{9,n} \cdot X_{COST}) + \varepsilon_{nj} \quad (5)$$

where ASC_{nj} is the Alternative Specific Constant for the BAU Alternative, which takes the value 1 for the BAU alternative; $X_{SPEC-10,nj}$ takes the value 1 when the specialist bird species' attribute decreases by an expected value of 10 with respect to current levels; $X_{SPEC+5,nj}$ takes the value 1 when the specialist bird species' attribute is increased with respect to current levels by an expected value of +5; X_{GEN-10} takes the value 1 when the generalist bird species' attribute decreases by 10 with respect to current levels; X_{GEN+5} takes the value 1 when the generalist bird species' attribute is increased by 5 with respect to current levels; $X_{TIME_7,nj}$ takes the value 1 when the waiting time is reduced to 7 minutes (from the current level of 15); $X_{TIME_3,nj}$ takes the value 1 when the waiting time is reduced to 3 minutes (from the current level of 15); $X_{BENCHES_{double},nj}$ takes the value 1 when the number of benches is doubled with respect to current levels; $X_{BENCHES_{triple},nj}$ takes the value 1 when the number of benches is tripled with respect to current levels; and X_{COST} is the value of the entrance fee.

It is expected that, if risk attitudes play a role in individuals' preferences for alternative policy options for the conservation of S'Albufera wetland, then presenting the specialist bird species attributes as certain or uncertain will affect the weight of this attribute in respondents' utility function. The objective of the analysis is

⁵ Sometimes scale differences also arise due to differences between samples, but this is not our case, as the comparison of samples' characteristics has shown that the two groups have the same profile. Hence, it is possible to attribute the difference in scale to the treatment only.

therefore to compare the mean value of $\beta_{1.1}$ to the mean value of $\beta_{1.2}$, and the mean value of $\beta_{2.1}$ to the mean value of $\beta_{2.2}$ in order to identify the effect of the treatment. Then, we test the following hypothesis $H_{0.1}: \beta_{1.1} = \beta_{1.2}$ and $H_{0.1}: \beta_{2.1} = \beta_{2.2}$ the alternative hypothesis being that, if the parameters obtained under certainty ($\beta_{1.1}, \beta_{2.1}$) are higher (*respectively lower*) than their counterparts obtained under uncertainty ($\beta_{1.2}, \beta_{2.2}$), then, respondents confronted by the certain treatment derive on average a higher (*respectively lower*) increase in utility from a given change in the number of specialist bird species than respondents confronted by the same expected variation under uncertainty. This would reflect risk averse (*respectively risk seeking*) attitudes. Finally, failing to reject the null hypothesis would reflect risk neutral attitudes of the surveyed visitors of the wetland.

In a second step we compare, under certainty and uncertainty, the willingness to pay (WTP) of respondents for both a decrease and an increase in the expected number of specialist bird species with respect to current levels. The WTP was computed as the ratio of the attribute parameters (β_n) described in the utility equation (5) for each change in the specialist bird species attribute and the cost parameter ($\beta_{9,n}$). For example, the WTP for increasing with certainty the number of specialist bird species with respect to their current level is calculated as:

$$wtp_n = \beta_{2.1,n} / \beta_{9,n} \quad (6)$$

To better understand how individuals react to information about uncertainty due to their attitude towards risk, socio-demographics were also included in the analysis. To this aim, the utility function presented in equation 5 was modified as shown in equation 7 to explore the extent to which preferences in the uncertain treatment diverge from those of risk neutral individuals and whether this divergence can be explained by the effect of selected socio-demographic variables (based on section 2.1). For each level of the specialist bird species attribute, the utility function included: one variable, capturing all respondents and assuming they do not differentiate between the certain and uncertain treatment, and another variable, separately capturing the uncertain treatment group. This latter variable was interacted with each socio-demographic variable.

$$U_{nj} = \alpha_n(\beta_{0,n} \cdot ASC_{nj} + \beta_{1.1,n} \cdot X_{SPEC-10,nj} + \beta_{1.2,n} \cdot X_{SPEC-10,nj} \cdot T_n + \beta_{2.1,n} \cdot X_{SPEC+5,nj} + \beta_{2.2,n} \cdot X_{SPEC+5,nj} \cdot T_n + \beta_{3,n} \cdot X_{GEN-10} + \beta_{4,n} \cdot X_{GEN+5} + \beta_{5,n} \cdot X_{TIME7,nj} + \beta_{6,n} \cdot X_{TIME3,nj} + \beta_{7,n} \cdot X_{BENCHES_{double},nj} + \beta_{8,n} \cdot X_{BENCHES_{triple},nj} + \beta_{9,n} \cdot X_{COST}) + \varepsilon_{nj} \quad (7)$$

4. Results

To model individuals' choices in the two treatments, invalid and protest responses were first removed from the data set.⁶ The final database included 295 individuals from the certain treatment and 298 from the uncertain treatment, providing a total of 3,558 observations, taking into account that each respondent chose over 6 choice cards. To explore if respondents react in a significantly different way between the certain and uncertain treatment, despite both showing equal expected results, two models were initially estimated, as shown in Table 4. The first model (Mixed Logit 1) is a pooled MXL model where no distinction is made between the certain and the uncertain treatment. It serves as a reference model. The second model (Mixed Logit 2), following equation 5, introduces two distinct variables – one for each treatment – for each of the levels of the specialist bird species attribute.

⁶ Surveys were considered to be invalid when missing responses were detected in the choice of the alternatives or in other variables relevant for the modelling. Protest respondents were identified as those choosing the BAU option for the following reasons: i) "I don't perceive any problem to justify extra efforts on current practices", ii) "I consider I am already paying for these services", iii) "Others should pay" and iv) "I don't trust the local authorities".

Table 4. The mixed logit model results representing preferences for changes in specific conservation attributes under certainty and uncertainty

	Mixed Logit 1		Mixed Logit 2	
	Mean (St.error)	St. deviation (St. error)	Mean (St.error)	St. deviation (St. error)
Business as usual - alternative specific constant	-3.6380*** (0.5021)	3.5975*** (0.5613)	-3.6933*** (0.4858)	3.4473*** (0.5285)
Specialist bird species: 0 -> -10	-3.6383*** (0.4445)	2.4135*** (0.3776)		
Specialist bird species: 0 -> -10 - certain			-3.2149*** (0.3965)	1.3942*** (0.3926)
Specialist bird species: 0 -> -10 - uncertain			-3.9295*** (0.5764)	3.1459*** (0.5009)
Specialist bird species: 0 -> +5	0.9808*** (0.2094)	0.1841 (0.9110)		
Specialist bird species: 0 -> +5 - certain			0.6580** (0.2566)	0.0438 (0.5918)
Specialist bird species: 0 -> +5 uncertain			1.5096*** (0.3603)	1.6837*** (0.6197)
Generalist migratory bird species: 0 -> -10	-2.3968*** (0.3276)	1.5151*** (0.3431)	-2.4989*** (0.3408)	1.4800*** (0.3443)
Generalist migratory bird species: 0 -> +5	0.2857 (0.1800)	0.5367 (0.7158)	0.2419 (0.1824)	0.5500 (0.6970)
Waiting time reduced: 15 -> 7	0.6605*** (0.1879)	0.3688 (0.5496)	0.6372*** (0.1903)	0.2610 (0.6264)
Waiting time reduced: 15 -> 3	0.3588** (0.1702)	0.7545* (0.3950)	0.3910** (0.1799)	0.8342** (0.3781)
Number of rest-stop benches: doubled	0.8031*** (0.1885)	0.6875 (0.4759)	0.7004*** (0.1893)	0.6762 (0.4621)
Number of rest-stop benches: tripled	-0.0882 (0.1975)	1.7348*** (0.3105)	-0.3069 (0.2181)	1.8593*** (0.3047)
- Cost (10 EUR)	1.7641*** (0.1116)	0.8167*** (0.0463)	1.7799*** (0.1079)	0.8048*** (0.0452)
Covariates of Scale				
Uncertain treatment	-0.4674*** (0.1239)		-0.4706*** (0.1346)	
Model diagnostics				
LL at convergence	-2,154.95		-2,145.20	
LL at constant(s) only	-3,907.27		-3,907.27	
McFadden's pseudo-R ²	0.4485		0.4510	
Ben-Akiva-Lerman's pseudo-R ²	0.5706		0.5726	
AIC/n	1.2231		1.2199	
BIC/n	1.2596		1.2633	
n (observations)	3,558		3,558	
r (respondents)	593		593	
k (parameters)	21		25	

Results in both models show that on average respondents dislike the BAU scenario and prefer one of the conservation policies. They care about the preservation of both specialist and generalist migratory bird species and overall they see a decrease in bird species' numbers as a loss and an increase in their number as a gain to their utility level – with changes in the specialist bird species numbers valued higher. Reduced waiting times are also perceived positively by respondents. Interestingly, while moderate increase in the number of benches

is seen as a benefit, tripling their number is not statistically different than keeping their number constant, suggesting a u-shaped relationship with an optimum closer to twice the current number. The (negative) cost parameter, modelled as log-normally distributed, is highly significant and of the expected sign (coefficients of the underlying normal distribution are provided). All these results are associated with considerable preference heterogeneity, as indicated by the relatively large standard deviations of the distributions describing individuals' preferences.

To first examine if individuals display different preferences overall between the two treatments, Mixed Logit 1 and 2 were compared by means of a log-likelihood ratio test. Results of this test (p-value of 0.0125) show that Mixed Logit 2 has a significantly better fit than the first model. This indicates that preferences are overall significantly different when the changes in specialist bird species numbers during the next 10 years are presented either as certain or uncertain, even after the scale differences between treatments are controlled. The error term variance associated with the uncertain treatment appears to be significantly higher than in the certain treatment, meaning that (from the modeller's perspective) respondents tend to make more random choices in the uncertain treatment than in the certain treatment. This is to be expected as the choice task in an uncertain framework could be perceived by respondents as more difficult (Czajkowski et al. 2016).

Focusing on the preferred model results (Mixed logit 2) to investigate the effects of presenting a policy as certain or uncertain, we find that respondents seem to react to uncertainty in different ways depending on whether a loss or a gain is considered. The coefficient of the mean utility associated with a reduction of the specialist bird species in the uncertain treatment is significantly lower than that in the certain treatment, based on the results of a Wald test (p-value=0.0733). This would mean that respondents perceive much more disutility from a given (expected) decrease in the specialist bird species when the same is presented as a range of possible losses rather than as a certain value. This behaviour is consistent with risk aversion. On the other hand, when respondents consider increases in the number of specialist bird species with respect to current levels, the uncertain treatment results in significantly higher estimates in utility changes than the certain treatment, based on the results of a Wald test (p-value 0.0240). In other words, despite both the certain and uncertain treatments displaying on average the same expected environmental gains, reporting a range of possible improvements in the specialist bird species (rather than just the expected value) is associated with higher benefits. This is consistent with risk seeking behaviour. We discuss this result in more detail in the discussion section.

As expected, these conclusions are confirmed also by the WTP results (Table 5), which provide a further illustration of respondents' preferences and summarize the benefits of specific attribute changes in terms of monetary values. Respondents' mean WTP, obtained through the simulation procedure presented in Czajkowski, Hanley and LaRiviere (2014)⁷, is more negative when the decrease in the number of specialist bird species is presented as uncertain rather than certain. In other words, respondents would demand a higher compensation for experiencing an uncertain rather than a certain decrease in the number of specialist bird species, despite in both cases the same expected environmental losses being displayed on average. This confirms individuals' dislike of uncertainty over environmental losses. On the other hand, respondents are willing to pay more when the same expected increase in the number of specialist bird species is achieved with uncertainty rather than certainty. This confirms that they like uncertainty more when environmental gains are concerned.

⁷ We used 10⁵ draws from the parameter estimates and the associated variance-covariance matrix to account for the uncertainty, each followed by 10⁵ draws from the implied distributions to simulate empirical distributions of marginal WTPs.

Table 5. WTP estimates (EUR) implied by the models

	WTP – Mixed Logit 1		WTP – Mixed Logit 2	
	Mean (95% c.i.)	St. dev. (95% c.i.)	Mean (95% c.i.)	St. dev. (95% c.i.)
Business as usual - alternative specific constant	-8.65*** (-10.82;-6.76)	14.62*** (10.97;19.26)	-8.57*** (-10.63;-6.77)	13.78*** (10.35;18.10)
Specialist bird species: 0 -> -10	-8.65*** (-10.18;-7.32)	11.62*** (9.10;14.87)		
Specialist bird species: 0 -> -10 - certain			-7.46*** (-9.09;-6.04)	8.44*** (6.16;11.34)
Specialist bird species: 0 -> -10 - uncertain			-9.11*** (-11.07;-7.23)	13.33*** (10.23;17.10)
Specialist bird species: 0 -> +5	2.33*** (1.47;3.23)	3.20** (1.72;7.58)		
Specialist bird species: 0 -> +5 - certain			1.53*** (0.39;2.64)	2.11** (0.80;4.73)
Specialist bird species: 0 -> +5 - uncertain			3.50*** (1.98;5.08)	6.41*** (3.32;10.23)
Generalist migratory bird species: 0 -> -10	-5.70*** (-6.90;-4.60)	7.51*** (5.62;9.87)	-5.80*** (-6.98;-4.69)	7.32*** (5.43;9.65)
Generalist migratory bird species: 0 -> +5	0.68 (-0.17;1.53)	2.27 (0.46;6.27)	0.56 (-0.28;1.41)	2.17 (0.38;6.03)
Waiting time reduced: 15 -> 7	1.57*** (0.74;2.43)	2.28** (1.03;5.04)	1.48*** (0.65;2.32)	2.15** (0.95;5.16)
Waiting time reduced: 15 -> 3	0.86** (0.06;1.67)	2.67** (0.82;4.96)	0.91** (0.09;1.73)	2.84*** (0.94;5.01)
Number of rest-stop benches: doubled	1.91*** (1.10;2.72)	3.00*** (1.46;5.83)	1.62*** (0.82;2.45)	2.73** (1.22;5.31)
Number of rest-stop benches: tripled	-0.21 (-1.19;0.71)	5.78*** (4.14;7.62)	-0.71 (-1.75;0.29)	6.01*** (4.44;7.82)

Finally, in order to deepen our understanding of how risk attitudes are linked with respondents' socio-demographic characteristics, we estimated an additional model, described in section 3.4 (equation 7), in which the deviation from the risk-neutral preferences for an increase or decrease in the number of specialist bird species was interacted with respondent's gender, age, household size, number of children, income, education level and occupational status. Perhaps due to a low sample size, significant effects could only be detected for age and income. We therefore only focus on the results of the model incorporating these two socio-demographic predictors (estimations are reported in Appendix 2). Findings show that older respondents tend to be closer to risk neutrality – their tendency to be risk averse for losses and risk seeking for gains is lower. Higher income, on the other hand, makes respondents more risk averse, irrespectively of whether gains or losses are concerned.

5. Discussion and conclusions

This paper has explored the role that uncertainty has on individuals' preferences for environmental policies. Expectations were that individuals' risk attitudes are important in determining the benefits that people desire from environmental conservation policies, which are designed and implemented in an uncertain context. To test this, we designed and conducted a DCE, in which the changes resulting from different environmental policy efforts were described, by means of two split sample treatments, as certain or uncertain. For each given policy effort, the same expected outcomes were considered in the certain and uncertain case. In our analysis, we focused on recreationists' preferences for policies to avoid a CC induced decrease in the number of specialist bird species in S'Albufera wetland in Mallorca (Spain).

We found that individuals' utility and WTP are significantly influenced by whether the outcomes of a policy are presented as certain or uncertain, even if their expected values are the same. This confirms, as widely recognized in economics (Holt and Laury 2005; Charness et al. 2013), that risk attitudes play an important role in individuals' choices under risk. Our results reiterate the message highlighted by Roberts et al. (2008), Lundhede et al. (2015) and others that in SP valuation the scenarios should be framed as uncertain. However, unlike these previous SP studies, which have explored the effect of uncertainty while allowing other factors (the possible expected outcomes) to simultaneously vary in the exercise, we have isolated just the effect of uncertainty to avoid any confounding effect. As a result, our approach allows linking changes in preferences only to the attitudes that individuals have towards risk and uncertainty per se. This allows us to draw more robust conclusions on the role of uncertainty in SP methods.

We also find that risk attitudes and their effect on preferences are not generalizable and need to be contextualized. The present study shows limited support for risk aversion, as we have found that individuals display different risk attitudes depending on the outcomes presented (i.e. whether gains or losses are concerned) and individual characteristics. Taking into account the specific context of the analysis, we find that respondents are risk averse for environmental losses (reductions with respect to the current levels of specialist bird species) and risk seeking with respect to environmental improvements. Asymmetry with respect to risk attitudes over gains and losses is commonly found in behavioural studies (e.g., Kahneman and Tversky 1979). However, our results are not fully consistent with the prospect theory because we find that individuals display risk aversion over losses and risk loving attitudes over gains. We interpret it as a yet another example that risk preferences can be domain-specific and what is observed in financial lottery experiments is not necessarily applicable to the environmental domain.

Another interesting result of our study is that socio-demographic characteristics play a minor role over respondents' perception of risk. Our findings identified age and income as relevant variables to explain the deviation in respondents' behaviour under uncertainty with respect to the risk neutrality assumption. Elderly people tend to be less risk averse over losses and less risk seekers over gains, while respondents with higher levels of income seem to have more pronounced risk aversion, both over environmental losses and gains. These results partly diverge from the findings in the economics literature, where higher age and lower income are usually recognized to trigger more risk aversion (Mata et al. 2011; Gong and Yang 2012). Once more, this highlights the specificity of individuals' perception of and attitude to risk. As a result, assuming a priori, as traditionally done in economics, that individuals are risk averse and prefer a certain to an uncertain situation, despite both providing the same expected results, could lead to wrong decisions in uncertain contexts.

Our results highlight, at least in the context of our analysis, the importance of exploring and testing, rather than assuming, risk attitudes in SP methods. Most studies in the SP literature do not explicitly include uncertainty and present outcomes as expected results to be achieved with certainty, therefore assuming that people are indifferent to risk. Despite an increasing number of SP researchers exploring this topic, in most of cases those studies have generally not investigated the attitude of individuals to risk and have widely assumed that respondents act as risk averse, following the results of monetary lottery experiments employed in economics. Even among the few attempts in the SP literature to examine how individuals perceive risk and choose in a risky context (Koundouri et al. 2014; Glenk and Colombo 2011; Johansson 1989; Macmillan et al. 1996), no attention has been given to the variability of risk attitudes depending on the domain (environmental vs. financial), the direction of change in the good and individuals' characteristics. The findings of our research highlight the importance of being 'specific' in the risk attitude analysis in SP methods and of considering context- and individual-specific risk attitudes. Overall, a better understanding of the way people perceive risk and behave under risk in different situations and contexts can be helpful to guide policy-makers. Given that environmental policies increasingly need to be implemented in a context of uncertainty, risk attitude

knowledge can provide insights about the degree of public support for environmental interventions and it can help to more efficiently target action. Failing to take into account uncertainty and risk attitudes might lead to biased estimates of individuals' preferences and willingness to pay to conserve the environment and therefore to erroneous decision-making regarding environmental policy options.

Despite the limited evidence in favour of risk aversion, discarding the hypothesis that individuals can act as risk averse in an environmental context seems to be too premature. We find that individuals particularly like uncertainty when there is little or nothing at stake. They seem to have a more favourable attitude towards uncertainty when it is over the increase in the number of bird species with respect to current level and there is lower variability in terms of the potential outcomes achieved. Based on our findings, respondents prefer the policy results aiming to increase the number of bird species with respect to current levels under uncertainty (50% probability of an increase by 4 and 50% probability of an increase by 6) rather than under certainty (100% probability of an increase by 5). On the other hand, they like uncertainty less when this is associated with possible losses with respect to current levels and such potential losses may even result in greater damage than when certainty is considered. Respondents find a certain decrease by 10 specialist bird species (with respect to current levels) as less harmful than a possible decrease by 16 or by 4. Our findings suggest that respondents appreciate uncertainty more when this does not put the environment at risk of degradation, while it is seen as less beneficial as soon as it is associated with some perceived threat.

Some limitations to our study also need to be acknowledged. First of all, despite presenting in both treatments the results of the policies as equal in terms of expected values, respondents could have perceived them differently and they could have anchored more to the best or the worst environmental outcomes. There is considerable evidence that individuals may have difficulties understanding probability or making consistent decisions in this context (Lipkus 2007). Secondly, our analysis followed the common practice in environmental economics of assuming that consumers are utility maximizers. Some evidence from transport economics indicates that in some cases individuals' behaviour is more in line with regret minimization, rather than utility maximization (van Cranenburgh et al. 2015). Finally, we note that our results are based on a single study. Although we designed and conducted a study in such a way that it provides useful insights into the social preferences for conservation policies under uncertainty, it remains to be confirmed by future studies, if our results can be generalized to other conservation policies and environmental goods in general and to other respondents' groups (non-recreationists).

To better inform policy makers regarding risk attitudes and preferences under uncertainty, more research is therefore recommended to understand the possible factors underlying individuals' responses to risk, including the choice of the attribute levels, of the spread around the expected values and of the specific case study. Other questions that are still open and deserve attention in future research include the sensitivity of individuals' choices and preferences under uncertainty across different domains and goods. We did not specifically investigate this question in our study given that there is already literature exploring this (Riddel 2012). However, gaining more insights into this issue within the SP literature would still be of interest. Another possible venue for future research might be to better understand the various psychological aspects underlying the perception of risk, as these factors are also expected to be important in determining individuals' risk attitude (Fookien and Schaffner 2016).

In conclusion, the fact that respondents' preferences for conservation policies are affected by their risk attitudes and the fact that people are not necessarily risk averse in the environmental domain (at least when it comes to environmental gains) indicates that uncertainty should be explicitly included in SP studies to provide more accurate and policy relevant results. Presenting the policy outcomes in terms of expected results which can be achieved with certainty or assuming that respondents are generally risk averse may both result in

preference and WTP estimates which are not consistent with the true public preferences for the policy options considered.

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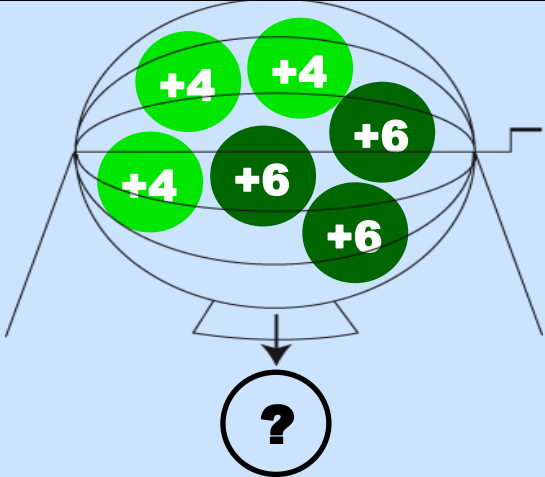
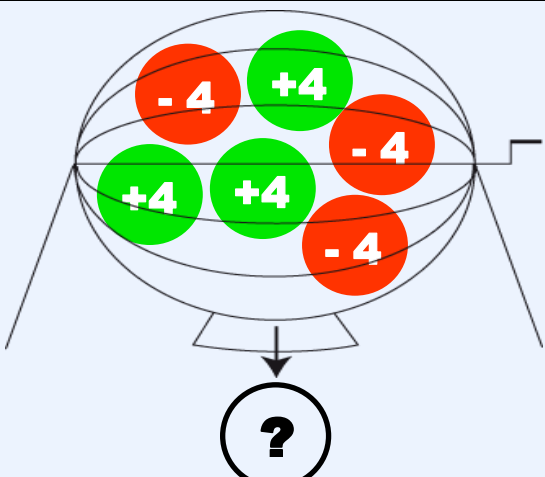
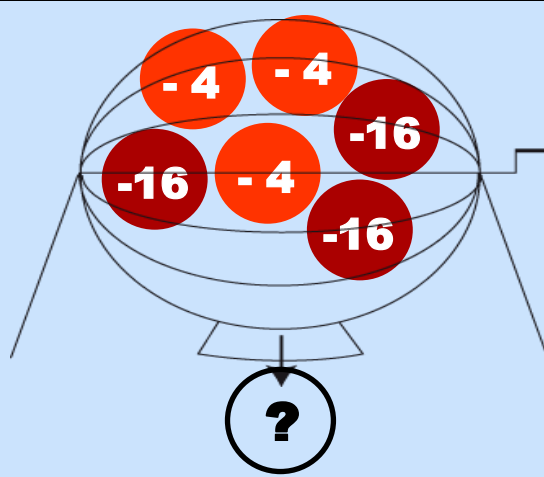
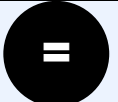
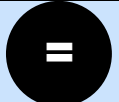
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Appendix 1: Sample choice card for certain and uncertain treatments

ATTRIBUTES	POLICY A	POLICY B	NO POLICY INTERVENTION (C)
SPECIALIST BIRD SPECIES	 Increase the current number by 5	 Keep the current number	 Decrease the current number by 10
GENERALIST MIGRATORY BIRD SPECIES	 Keep the current number	 Increase the current number by 5	 Decrease the current number by 10
WAITING TIME	 Wait about 7 minutes for a seat in observation cabins	 Wait about 3 minutes for a seat in observation cabins	 Wait about 15 minutes for a seat in observation cabins
REST-STOP BENCHES	 Double the current number throughout the park	 Triple the current number throughout the park	 Keep the current number
ENTRANCE FEE	12€	8€	0€

ATTRIBUTES	POLICY A	POLICY B	NO POLICY INTERVENTION (C)
SPECIALIST BIRD SPECIES	 50% chance, increase the current number by 4 50% chance, increase the current number by 6	 50% chance, decrease the current number by 4 50% chance, increase the current number by 4	 50% chance, decrease the current number by 16 50% chance, decrease the current number by 4
GENERALIST MIGRATORY BIRD SPECIES	 Increase the current number by 5	 Keep the current number	 Decrease the current number by 10
WAITING TIME	 Wait about 15 minutes for a seat in observation cabins	 Wait about 3 minutes for a seat in observation cabins	 Wait about 15 minutes for a seat in observation cabins
REST-STOP BENCHES	 Double the current number throughout the park	 Keep the current number	 Keep the current number
ENTRANCE FEE	20€	8€	0€

Appendix 2: the mixed logit model results including socio-demographic explanatory variables of deviations from risk-neutral behavior

	Main effects		Socio-demographic interactions	
	Mean (St.error)	St. deviation (St.error)	Age (norm.) (St.error)	Income (norm.) (St.error)
Business as usual - alternative specific constant	-3.6350*** (0.4687)	3.3767*** (0.4859)		
Specialist bird species: 0 -> -10	-3.2387*** (0.3859)	1.4089*** (0.3986)		
Specialist bird species: 0 -> -10 (deviation from risk-neutrality in the uncertain treatment)	-0.6408 (0.4669)	2.7516*** (0.5225)	0.1227 (0.3215)	-0.9753*** (0.3461)
Specialist bird species: 0 -> +5	0.6649** (0.2582)	0.0275 (0.5680)		
Specialist bird species: 0 -> +5 (deviation from risk-neutrality in the uncertain treatment)	0.8889** (0.4123)	1.5193** (0.6956)	-0.5807* (0.3220)	-0.5585* (0.3137)
Generalist migratory bird species: 0 -> -10	-2.5318*** (0.3398)	1.5762*** (0.3459)		
Generalist migratory bird species: 0 -> +5	0.2509 (0.1836)	0.6366 (0.6367)		
Waiting time reduced: 15 -> 7	0.6572*** (0.1898)	0.1923 (0.7841)		
Waiting time reduced: 15 -> 3	0.3960** (0.1808)	0.9000** (0.3665)		
Number of rest-stop benches: doubled	0.6954*** (0.1895)	0.7313* (0.4216)		
Number of rest-stop benches: tripled	-0.3101 (0.2193)	1.8739*** (0.3041)		
- Cost (10 EUR)	1.7823*** (0.1050)	0.7941*** (0.0443)		
Covariates of Scale				
Uncertain treatment	-0.4593*** (0.1345)			
Model diagnostics				
LL at convergence		-2,138.03		
LL at constant(s) only		-3,907.27		
McFadden's pseudo-R ²		0.4528		
Ben-Akiva-Lerman's pseudo-R ²		0.5736		
AIC/n		1.2181		
BIC/n		1.2685		
n (observations)		3,558		
r (respondents)		593		
k (parameters)		29		



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