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Children's Willingness to Pay for Environmental Protection

Valentino Dardanoni and Carla Guerriero

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Keywords: Discrete Choice Experiment; Children; Natural Capital; Environmental Protection; Willingness to Pay

JEL Classification: C93, Q51, D83

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Table of contents

CHILDREN'S WILLINGNESS TO PAY FOR ENVIRONMENTAL PROTECTION

VALENTINO DARDANONI AND CARLA GUERRIERO

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1. Introduction

The economic valuation of the environmental quality is crucial to quantify the contribution of biosystems and biodiversity to human well-being and it is an essential input to carry out cost-benefit analysis of environmental-related interventions (Botzen, 2018).

Stated preference techniques are commonly used to assign a monetary value to non-marketed goods and services. Examples in the environmental literature include valuation of inland wetlands; grasslands, mangroves and coral reefs, recreational and passive forests services, ecological and health risks from wastewater flooding in urban centers and the environments (Chiabai et al., 2011; Sen et al., 2014; Veronesi et al., 2013).

As demonstrated by the recent school climate strikes, very little has been done so far by policy makers to involve young generations in the debate for environmental protection (Currie and Deschenes, 2016; WHO, 2014). There are many reasons to study young people's preferences for environmental protection. Studying youth's preferences and how they change by age and socio-economic status may teach us more on adults' preferences (Sutter et al., 2019). Previous studies also suggest that children influence their family consumption choices (Dauphin et al., 2011). Dauphin et al.(2011), for instance, show that children aged 16 and above earning their own income are decision makers within the household.

Preliminary evidence suggests that, in their families, children do play a role when it comes to environmental related behaviours. In 2004, Dupont showed that the presence of children influences households' WTP for environmental goods improvements (Dupont, 2004). More recently, Lawson et al. 2019 provides evidence that child to parent intergenerational learning - transfer of knowledge, attitudes or behaviors from children to parents- may be a powerful pathway through which children foster climate change concerns among their parents (Lawson et al., 2019).

According to previous authors eliciting children's willingness to pay (WTP) for environmental interventions is challenging because children "do not have command over

resources and may not have the maturity to make trade-offs in a hypothetical market" (OECD, 2006).

Given the importance of involving children in the environmental debate, it is essential to investigate whether children have defined preferences for environmental protection (OECD, 2006). This study is part of a large research project exploring children's ability to be rational decision makers (Guerriero and Cairns, 2017). The aim of this study is to elicit children's WTP for environmental protection, using responses from a Discrete Choice Experiment conducted in Italy (Naples) with 360 children aged 8-19 years. We find that the majority (97.5 percent) of children are willing to pay their own money for environmental projects. The results of our study also show that children answers are scope sensitive to the size of the environmental improvement and to the price of the voluntary contribution for the project. Consistently with previous studies conducted with adults, we find a "distance decay": children's willingness to pay is higher for projects targeting Italy vs. projects aimed at foreign countries (Botzen, 2018; Sogaard and al., 2016). We find evidence that WTP for environmental protection in Italy is higher for females. Furthermore, our results suggest that children's and parents' environmental attitudes influence the probability to select the status quo. In particular, results suggest that the higher the environmental concern the lower the probability of choosing the status quo option. Family income does not seem to affect children's WTP while individual pocket allowance negatively affects it.

The remaining part of this paper is structured as follows: the next section synthesizes the existing literature on children and the previous studies conducted with the children of this study. Section 3 details about the discrete choice experiment and the questionnaire employed for data collection. Section 4 outlines the econometric approach we use for modeling preferences and Section 5 describes the relevant results from the analysis. The last section concludes the paper.

2. Previous Literature

Since the first study conducted in 2001 by Harbaugh et al. to test children's rationality, there has been an increasing number of experimental papers studying the economic behaviours of children and adolescents (Sutter et al., 2019). The majority of the studies conducted focused on three main dimensions of economic behaviors: rationality of children's choices, children's time and risk preferences (Sutter et al., 2019). The studies results consistently suggest that even young children show transitive choices and apply strategic reasoning in interactive games. As expected, the studies also found that age plays an important role in children's development of economic reasoning as it only when children move to adolescents that their behaviour assimilate with those observed among adults (Brocas and Carrillo, 2018a,b; Sutter et al., 2019).

The present study is part of a large research project investigating children's ability to be independent economic agent (Guerriero et al., 2018, 2017). The understanding of money is an essential prerequisite for children to be considered active and rational economic agents. Without money knowledge, children cannot understand more specific concepts e.g. price-objects correspondence and budget constraint(Furnham, 2008).

A previous research conducted with younger children involved in this study suggests that, even at younger ages (six and seven years old), our respondents scored high in all the different domains of money understanding (e.g ability to assign different values to money, the notion of a budget constraint, and the correct use of change during transactions) (Guerriero et al., 2017; Berti and Bombi, 1981). Complementary to these findings Guerriero and Cairns (2017) also showed that the majority of children receive money from their parents as a regular allowance (76%) and that, as in in other European countries, the amount children receive as birthday and festive gifts increases as children get older (Furnham, 1999).

To the best of our knowledge, there is only one study investigating children ability to answer to stated preference questions. Guerriero et al. in 2018 investigated, using a contingent valuation approach, children's WTP for their own health risk reduction (Guerriero et al., 2018). The study, involving also the parents of the children, found

that even younger respondents are able to make a trade-off between money and health risk reductions. The majority of the children interviewed in the contingent valuation study showed scope sensitive answers (higher WTP for larger health risk reduction of having an asthma attack).The findings of Guerriero et al. (2018) study also suggest that children's WTP is influenced by individual characteristics such as age, gender and health status. Using parents-children dyads the study showed that, compared to parents, a higher proportion of children consider their budget constraint when answering to WTP (Guerriero et al., 2018).

3. Data and Methods

Ethical approval for this study was received by the Italian CNR Ethical Committee and the London School of Hygiene and Tropical Medicine Ethical Committee. Informed written consent and informed assent were obtained from parents and children.

Discrete Choice Experiments (DCE) and Contingent Valuation studies (CV) are the most common methods to value public goods such as environmental policies. Unlike CV studies, which directly ask respondents how much they are willing to pay for a specific change (e.g. in health risk), DCEs present respondents with a choice set, in which alternatives, described as a set of attributes, are mutually exclusive. Compared with CV technique, DCE have the capacity to describe a choice situation with a range of attributes that reflects the different characteristics of the good being valued (Louviere et al., 2010). When a cost attribute is included, marginal utility estimates for changes in the level of each attribute can be converted into WTP estimates (Hole and Kolstad, 2012). Given these several advantages, DCE is a widely-used technique in economics, marketing, and transportation to understand preferences and predict demand for a very wide range of goods, services, and policies (Barbier and Hanley, 2009; Czajkowski and al., 2017; Hensher, 2010; Bateman et al., 2004).

3.1. **Study Design.**

This study was designed according to the state-of-the-art recommendations for DCE. Given that this is the first DCE experiment valuing environmental protection with children, the design of the DCE began with qualitative interviews

using focus groups to investigate respondents' awareness of policy relevant attributes. Further qualitative research was also carried out to refine the attributes description and the wording to use in the cheap talk (Jerrod and Wuyang, 2019). Before conducting the DCE a study investigating respondents' use and understanding of money was also carried out (results from younger children are reported in (Guerriero and Cairns, 2017)). The questionnaire used in the final study asked also about respondents' socio-demographic characteristics, and included warm-up questions about the respondents' attitudes toward environmental protection (Krupnick and Adamowicz, 2007). The second part of this study employed a DCE to elicit respondents willingness to pay for environmental protection. All images and accompanying wording were tested in the focus group discussions and pilot study to ensure a satisfactory understanding and scenario acceptance by respondents (Johnston et al., 2002; Horne et al., 2005).

3.2. **Discrete Choice Experiment.** Our DCE begins with a cheap talk during which we made sure that the scenario and the projects being valued were clearly understood (Jerrod and Wuyang, 2019). During the talk, we also paid attention that children perceive their responses as influencing the provision of the item being valued (i.e. consequentiality applies)[1] and we encourage truthful preference revelation. Consistently with previous studies on cheap talk efficacy in reducing hypothetical bias, the cheap talk was spoken aloud and included a opportunity cost description (Jerrod and Wuyang, 2019; Bateman et al., 2004).

According to a recent review, one of the main issues for economists working with children is to refer to money or use money as economic incentive (Sutter et al., 2019). In psychology, it is well known that the understanding and use of money at younger ages varies significantly among age groups and socio-economic status (Berti and Bombi, 1981; Furnham, 2008). For this reason previous experiments conducted with children to investigate their time and risk preferences start using money as incentive with children aged six or above (Sutter et al., 2019). Compared to previous economic studies

[1]Consequentiality scripts are used in DCE to increase participants' perception that their answers will influence the outcome being valued.

using money with children, we collected preliminary information on children individual understanding and use of money. This information was essential to design realistic price attribute levels and to gain preliminary evidence on the ability of children to grasp the choice alternatives proposed (Guerriero et al., 2017). After the cheap talk, children are asked to complete the DCE considering their own budget constraint. A budget reminder was also made at the beginning of each choice set.

The scenario presented makes clear that the voluntary donation for environmental protection was due only once every year and each respondent has to decide whether and if so how much to contribute in the present year to observe the described outcome in the following year. The environmental program consisted in a voluntary contribution with annual payment and annual improvement of the natural capital. The attributes and levels are shown in Table 1, while Figure 1 shows an example of a choice card (additional details on the experiment are shown in the Appendix A). The DCE used generic attributes common to both alternatives (unlabeled design) and includes a status quo option. Each of the choice sets (see an example in Figure 1) consists of three alternatives characterized by three attributes: the annual donation paid for the environmental good; the geographical area targeted by the environmental projects: Italy and any foreign country different from Italy (see Appendix A for further details).

The environmental project is described as a set of actions aimed at protecting wildlife habitats and endangered species of flora and fauna (Carlsson and Martinsson, 2001). The two geographical targets of the projects in the DCE are designed on the basis of two projects currently managed by the World Wildlife Foundation [2]. One choice option was always a zero-additional-cost opt-out, which was associated with "Some environmental degradation" in both Italy and in the other parts of the world. Given that the experiment was designed to estimate the trade offs children were willing to make between environmental protection and their income (pocket money), the policy questions comprised only three attributes: (i) the size of the environmental quality in Italy; (ii) the size of the environmental quality in countries different from Italy and

[2]see WWF for Italy https://sostieni.wwf.it/wwf-for-italy.html

(iii) the voluntary annual contribution for the environmental project. Four possible action levels were used to depict the effect of the project on natural capital. The design of visual aid to use in the experiment is based on a previous study conducted in the Netherlands by (Botzen, 2018). Each bar has three squares and a red line. The red vertical line indicates the present environmental quality and on the left of the red line there is environmental degradation (black square) while the right (two green squares) contains environmental improvements from the current status. A legenda was given to each child during the DCE (the legenda provided is in the Appendix A). In the experiment the attributes have four possible levels (see Table 1) generating a full factorial design of 64 combinations of attributes and levels.

Using Ngene, we construct a Bayesian D-efficient experimental design based on priors obtained from the pilot study data (Scarpa et al., 2005). This led to a final DCE including six choice sets plus a dominated choice set.

Table 1. Attribute names and levels.To Append here.

Figure 1. Example of choice set. To Append here.

3.3. **Discrete Choice Model estimation.** The results of the DCE are used to assess individual preferences within the random utility model (RUM) framework proposed by Thurstone in 1927 and further developed by Luce 1959 and McFadden in 1974 (Luce, 1959; McFadden, 1973). According to RUM individuals' choice is determined by indirect utilities for choice alternatives. Given that the researchers cannot directly observe all the individual factors affecting their utility, individual ith choice behavior is broken-down into two additive and separable parts: a systematic (observable) component determined by the characteristics of the alternative j in choice task t, and a second random (unexplained) component representing idiosyncratic variation in respondent choices. The utility associated with individual i choice of alternative j at choice task t can be formalized as follows:

$$U_{ijt} = \alpha_i p_{jt} + \beta_i' x_{ijt} + \epsilon_{ijt} \tag{1}$$

where p_{jt} is the price of alternative j in choice task t , x_{ijt} is the vector of $K \times 1$ characteristics of alternative j in choice task t, α_i, β_i are individual specific parameters and ϵ_{ijt} is an error term assumed to be independent identically distributed (IDD) type I extreme value. The Conditional Logit (CL) model in which α_i and β_i do not vary among individuals is the starting point for most analyses of DCE. The popularity of CL is associated with a number of properties which make it easily computable. Despite its popularity, the CL is not the best model to analyze our data as it fails to account for random taste variation between respondents ignoring that individuals may attach different values to alternatives within the choice set based on their observed ad unobserved attitudes and tastes.

A common solution to account for the potential heterogeneity between respondents' tastes is to use the random coefficient logit model which is also known as mixed logit (MIX). In the MIX model, the preference coefficients are no longer assumed fixed, but considered to vary according to a predefined distribution (usually normal or lognormal), which offers a representation of the unobserved heterogeneity between respondents' tastes.

The main objective of DCE is to estimate WTP estimates. The WTP value for a given attribute is estimated by calculating the ratio of the attribute coefficient to the price coefficient.

$$MWTP_{ik} = -\beta_{ik}/\alpha_i$$

.

The standard approach to estimate WTP from MIX model is to assume a distribution for the coefficients and estimate the WTP as the ratio of the two randomly distributed terms. Depending on the choice of distributions for the coefficients this can lead to WTP distributions which are heavily skewed and that may not even have defined moments. One common solution to address this issue is to assume a constant cost coefficient which unrealistically implies that all the respondents have a constant marginal utility of money (Meijer and Rouwendal, 2006).

Train and Weeks (2005) suggest that a way to circumvent this problem is to estimate the mixed logit in WTP space (MIX-WTP) (Train and Weeks, 2005). The MIX-WTP involves estimating the distribution of WTP by re-formulating the model in such a way that the coefficients represent the WTP measures. When using MIX-WTP models, the researcher makes a priori assumptions directly about the distributions of the welfare estimates rather than on the attribute coefficients parameters (Train and Weeks, 2005).

The WTP space model assumes that the utility of subject i in the choice set t is a function of price p_{jt} and non-price attributes x_{jt} so that utility can be written as:

$$U_{ijt} = \lambda_i[p_{jt} + \gamma_i' x_{jt}] + e_{ijt}$$

where λ_i equals α_i/σ_i, σ_i is an individual-specific scale parameter and e_{ijt} is IID type 1 extreme value with constant variance. According to Train and Weeks (2005), WTP estimates obtained from WTP space have a smaller variance than those estimated from MIX models.

4. Model Specification

In each of the seven choice sets respondents are asked to choose between three possible alternatives: the status quo (SQ) alternative A, alternative B and alternative C. In principle, since our study is unlabeled, apart from attributes and their levels no other elements should influence respondents' utility. However, researchers generally include an alternative specific constant for the SQ to allow for unobserved effects (e.g. loss aversion, inertia) beyond the attributes in the choice sets. We include a SQ term (ASC_{SQ}) taking value of 1 for the alternative describing the SQ and zero otherwise in all the models considered. For each of the three alternatives the utility that the individual i obtains by selecting the alternative j in the choice set t is:

$$U_{ijt} = \delta_i ASC_{SQ} + \alpha_i PRICE_{jt} + \beta_{Ii} ITALY_{jt} + \beta_{Wi} WORLD_{jt} + \epsilon_{ijt} \qquad (2)$$

where ITALY denotes the size of the environmental quality in Italy and WORLD denotes the size of the environmental quality in countries different from Italy.

The potential impact of respondents' characteristics on children's WTP was explored by including interaction terms of the attribute and individuals' characteristics. Attributes of the DCE are interacted with demographic variables (age and gender), level of concern for environment (Envir) is interacted with the SQ while the price attribute is also interacted with subject-specific monthly pocket allowance (PockAll):

$$\delta_i = \delta_{i0} + \delta_{Envir} Envir_i$$

$$\alpha_i = \alpha_{i0} + \alpha_{Age} Age_i + \alpha_{Gender} Gender_i + \alpha_{PockAll} PockAll_i + \omega_i^{\alpha}$$

$$\beta_{Wi} = \beta_{Wi0} + \beta_{WAge} Age_i + \beta_{WGender} Gender_i + \omega_i^{\beta_W}$$

$$\beta_{Ii} = \beta_{Ii0} + \beta_{IAge} Age_i + \beta_{IGender} Gender_i + \omega_i^{\beta_I}$$

with ω_i^{α} following a lognormal distribution and ω_i^{δ},$\omega_i^{\beta_W}$ and $\omega_i^{\beta_I}$ being normally distributed.

Overall, we estimate eight models. Five in Preference Space, namely (1) the CL model, (2) the CL model with interactions, (3) the MIX model with independent random coefficients, (4) the MIX model with independent random coefficients and interactions, (5) the MIX Model with correlated random coefficients; and three in the WTP space, namely: (6) the MIX-WTP model with independent random coefficients, (7) the MIX-WTP model with independent random coefficients and interactions and (8) the MIX- WTP model with correlated random coefficients.

We use Maximum Likelihood Estimation for models 1 and 2 and Simulated Maximum Likelihood with 2500 Halton draws for the estimation of models from 3 to 8. To explore the effects of socio-demographic variables on children models are run with and without interactions terms. Attribute levels of choice were coded in the way described in Table 1 with the exception of price that is divided by 100. Gender is coded 0 for girls and 1 for boys, age is mean-centered.

Robustness checks are conducted to test the validity of our results.As in Campbell et al.(2008) monotonicity of respondents' choices is tested by including in the DCE a

dominated choice set [3] (Campbell et al., 2008). The first robustness check assesses the consequence of excluding from the analysis children who failed to answer correctly to the dominated choice set. All the models were run twice: with and without respondents who failed to answer correctly to the dominated choice set (see Appendix B.). The second robustness check is conducted to investigate the effect of accounting for family socio-economic background and parental attitude towards environment on our main results (see Appendix C).

Table 2. Descriptive Statistics of the Sample.To Append here.

5. Results

The basic socio-demographic characteristics of the sample are provided in Table 2. The mean age of the children interviewed was 14 years old (range 8-19 years old) with 56 percent of males. The median monthly pocket allowance is 30 euro. All but 10 respondents completed the choice tasks. 9 (2.5 percent of respondents) children always choose the SQ. The level of concern for environment was measured using a 5-point Likert scale ranging from 1 (not concerned at all) to 5 (very concerned). The median value in the population was three (mean 2.5;SD .61).

If within a choice set one option dominates the others it would be clearly inconsistent for the respondent not to chose it. We initially checked this monotonicity test. Overall 35 respondents failed to pass the test choosing the dominated option. To explore the characteristics of the subjects who failed to pass the monotonicity test we ran a logit regression with dependent variable taking value of one if a subject passed the monotonicity test with age and gender as regressors. The age coefficient is significantly positive (Odds Ratio:1.22 with Standard Error:.03) and is higher for females vs. males (OR:.63;SE:.09). Results reported in this section are those for all respondents. Results from the sample excluding those who failed to answer correctly to the dominated choice set are reported in the Appendix B.

[3]One alternative is said to dominate a second when it is at leas as good as the second in terms of every attribute.

5.1. **Results from preference space models.** Tables 3 reports the results of the five preference space models (Table 4 shows the marginal effects for Model 1 and 2). As shown in the Table, independently from the model used, the attribute coefficients are strongly statistically significant. The positive signs of the World and Italy coefficients show that children value higher levels of environmental protection more than lower levels. Previous studies conducted with adults eliciting preferences for environmental protection found a significant "distance decay" of the respondents answers: the mean WTP is a decreasing function of the respondents' location from the site (Botzen, 2018; Sogaard and al., 2016). Consistently with adults' findings, in our study the coefficients World and Italy are always positive and significant but the size of the coefficient is larger if the project is targeting the environment in Italy vs. the rest of the World. In line with our expectations, we found that the price coefficient is always negative and highly significant indicating that children look at the price of their voluntary contribution when selecting the alternative and that the price has a negative effect on their utility. From Model 3 to 5 the significant standard deviations of the attributes' parameters indicate that there is heterogeneity in preferences for environmental improvements as well as for the price coefficient. In Model 1, 3 and 5 the SQ option is found to be consistently negative and significant indicating that leaving the current situation would result in increasing utility. This result is consistent with our a priori expectations, since in our study the SQ option comes with a zero cost but not in terms of environmental quality which, in absence of any intervention, would deteriorate in Italy and the rest of the World.

Models 2 and 4 estimate the interaction of the attributes with the explanatory variables. Both models show that the marginal-disutility of cost is higher for females and increases with age. The negative significant interaction of pocket allowance with the price of voluntary donation indicates that "richer" children are more sensitive to the size of the donation amount.

Girls also show an higher marginal utility from environmental protection in Italy compared to boys. The degree of subjective perceived importance of environmental

protection interacted with the SQ is negative and statistically significant indicating that a more favorable attitude towards environmental protection affects negatively the likelihood of choosing the SQ. This result is consistent with previous studies conducted with adults investigating SQ "effect" in DCEs (Meyerhoff and Liebe, 2009; Scarpa et al., 2005). Interestingly, once the interaction between environmental concern and SQ is included, the ASC_{SQ} coefficient becomes positive indicating children's preference for the SQ. This result may be explained by several possible factors such as perceived choice task complexity, protest attitude or a consequence of loss aversion (Meyerhoff and Liebe, 2009; Kahneman et al., 1991). To compare models we reported three goodness of fit measures: the Log-likelihood (LL), the Aikaike Information Criteria and the Bayesian Information Criteria. Overall these criteria suggest that model 4 is the best fitting model for our data.

Table 4 shows the results of the correlations between the attribute coefficients. The only statistically significant correlation is between the marginal utility of money and environmental protection in Italy.

Table 5 reports the mean, CIs and the standard deviation of the willingness to pay measures obtained from the models reported in Table 3.[4] The mean WTP estimates derived from CL models are substantially lower compared with those estimated using a MIX model. In the CL model the mean willingness to pay for environmental protection in countries other than Italy is 31 euro, while for projects targeting Italy is 63 euros.

Results from WTP space models. Table 6 presents the results of WTP space models 6,7 and 8. A normal distribution is assumed for the WTP of non price attributes. The interpretation of WTP space coefficients is straightforward as they represent respondents' marginal WTP for each attribute. Consistently with the results in the previous section, all attribute coefficients have the expected signs and are highly significant. The positive signs of the parameters for Italy and World indicate that higher levels of these attributes affect utility positively. In contrast, increasing the price of the voluntary contribution decrease the likelihood of selecting the alternative. Compared

[4]Confidence intervals for the WTP values are obtained using the Delta method.

with previous models the interaction coefficient between price and pocket allowance is no more significant. Table 7 shows the correlation between WTP space coefficients. As seen, using this approach all the correlations are statistically significant.

The mean WTP for environmental protection in Italy and in the rest of the World are 67 and 28 euros respectively. As noted in previous studies conducted with adults by (Sonnier et al., 2007; Train and Weeks, 2005; Hole and Kolstad, 2012) these estimates are much lower if compared with those of MIX models and more similar to those obtained from the traditional CL models (Sonnier et al., 2007; Train and Weeks, 2005). Consistently with previous findings, also the distributions of WTP estimates are smaller compared with those of preference space models. However, the MIX models fit the data better independently from the criteria adopted (LL, Bic and Aic) considered (Train and Weeks, 2005; Hole and Kolstad, 2012).

6. Conclusions

This study investigates children's WTP for environmental protection. We designed and administered a DCE to 370 children aged 8-19 years in Naples (Italy). Given that this is the first DCE on environmental protection conducted with children, this raises the question as to whether they are genuinely able to provide meaningful answers to DCE questions, as result, a dominated choice set was included in the DCE to test the quality of children's answers. Overall 35 respondents failed to pass the test by choosing the dominated option. Consistently with previous studies investigating the development of economic reasoning we found that age was a predictor of the probability of choosing the not-dominated alternative (Sutter et al., 2019). All the models suggest that the children interviewed passed the scope test: they have an increased marginal utility for higher degree of environmental protection while the price coefficients are negative and highly significant. This result is relevant for the reliability of the stated preference valuation since it has been conducted with children as young as eight years. Our results suggest that children are concerned about environmental protection and

willing to sacrifice part of their own money to contribute to environmental improvement. In previous studies conducted with adults, familiarity and proximity with the good being valued has shown to significantly affect respondents' WTP (LaRiviere et al., 2014; Botzen, 2018). Independently from the model used for the analysis, we find that children are willing to pay more for environmental projects targeting Italy vs. projects targeting other parts of the World (Botzen, 2018; Sogaard and al., 2016). Results of the analysis also show that females compared to males have a higher marginal utility from environmental protection actions targeting Italy (Stern et al., 1993). This is in line with previous research conducted in the field of social psychology suggests that individuals willingness to pay is positively correlated with personal attitudes towards environmental quality and that women, compared to men, are more conscious of the link between environment and subjective well-being . The marginal dis-utility of price is also influenced by socio-demographic characteristics: older respondents and females caring more for money (Botzen, 2018; Sogaard and al., 2016). Robustness test assessing the effect of family characteristics suggest that socioeconomic status does not influence children's WTP for environmental protection but there may be an inter-generational transfer of attitudes towards the environment.

Economic evaluation can play a fundamental role in placing a price on ecological goods and services and to quantify their benefits to human welfare (Barbier and Hanley, 2009). Given the pace of economic development, preserving and restoring the natural capital and halting Climate Change are the biggest challenges for the future. The majority of previous theoretical models used in family economics did not include child utility function (Bateman et al., 2004). Nonetheless, some studies show that children influence household choices, such as choice of holiday destinations and products to buy (Dauphin et al., 2011; Adamowicz and Dosman, 2006). This study for the first time investigates if children have defined preferences for public policies aimed at improving environmental quality (Dupont, 2004). Whether children affect their parents' preferences playing an active role within families is an important and unexplored research question for future studies.

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7. Tables and Figures

TABLE 1. Attribute names and levels

Attributes	**Description**	**Levels**
Italy	Annual improvement of the natural capital in Italy	Some degradation, No change from current status, Some Action , A lot of Action
World	Annual improvement of the natural capital in part of the World different from Italy	Some degradation, No change from current status, Some Action , A lot of Action
Price	Price of the annual voluntary contribution	€16, €32,€60, €200

Figure 1. Example of choice set.

1.1

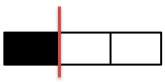
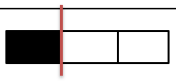
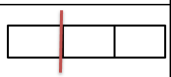
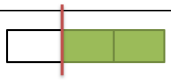
Where?	A	B	C
 ITALY			
 REST OF THE WORLD			
Annual Payment	€0	€16	€60
Questions			
Which among the three alternatives would you choose?	○	○	○
Between B e C, which alternative would you choose?		○	○

TABLE 2. Descriptive Statistics of the Sample

	Mean (SD))	Min	Max
Females	44%	0	1
Age	13.7(2.94)	8	19
Monthly pocket allowance	€56(96.4)	0	475
Environmental Concern	2.52 (0.61)	1	5
Education			
Primary/Elementary	68		
Secondary	71		
High School	227		

TABLE 3. Results from Preference Space Models.

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean (SE)					
World	0.415***	0.490***	0.543***	0.628***	0.608***
	(0.0393)	(0.0633)	(0.0701)	(0.107)	(0.0772)
Price	-1.292***	-1.605***	-0.854***	-1.161***	-0.892***
	(0.0749)	(0.122)	(0.0887)	(0.101)	(.105)
Italy	0.817***	1.041***	1.350***	1.821***	1.678***
	(0.0463)	(0.0864)	(0.0983)	(0.165)	(0.135)
ASC_{SQ}	-0.549***	1.860**	-2.102***	0.758	-2.012***
	(0.166)	(0.821)	(0.221)	(0.897)	(0.238)
Age*Italy		0.0456		0.225**	
		(0.0609)		(0.0899)	
Gender *Italy		-0.390***		-0.526***	
		(0.127)		(0.181)	
Age*World		-0.0389		0.0591	
		(0.0513)		(0.0748)	
Gender*World		-0.120		-0.0450	
		(0.102)		(0.148)	
Age*Price		-0.344***		-0.790***	
		(0.0875)		(0.154)	
Gender*Price		0.707***		1.432***	
		(0.181)		(0.330)	
Envir*ASC_{SQ}		-1.009***		-1.037***	
		(0.351)		(0.346)	
Pocket allowance*Price		-0.00153**		-0.00336**	
		(0.000680)		(0.00139)	
SD					
World			0.806***	.0.924***	.838***
			(0.0712)	(0.0893)	(.0785)
Italy			0.701***	. 0.948***	1.113***
			(0.0954)	(0.127)	(.123)
Price			-1.215***	-0.892****	-1.092***
			(0.0805)	(0.0910)	(.1044)
LL	-1981.02	-1609.44	-1640.00	-1332.53	-1617.52
AIC	3970	3240	3294	2693	3255
BIC	3985	3283	3321	2747	3293
N	7,557	5,835	7,557	5,835	7,557

TABLE 4. Marginal Effects from Preference Space Models 1 and 2.

VARIABLES	Model 1 dy/dx	Model 2 dy/dx
World	0.078***	0.089***
	(0.0079)	(0.0121)
Price	-0.245***	-0.291***
	(0.0122)	(0.0207)
Italy	0.155***	0.189***
	(0.0088)	(0.0158)
ASC$_{SQ}$	-0.104***	0.337**
	(0.0293)	(0.1492)
Age*Italy		0.009
		(0.0109)
Gender*Italy		-0.071***
		(0.0232)
Age*World		-0.007
		(0.0093)
Gender*World		-0.022
		(0.0186)
Age*Price		-0.0626***
		(0.0155)
Gender*Price		0.129***
		(0.0331)
Envir*ASC$_{SQ}$		-0.180***
		(0.0625)
Pocket allowance*Price		-0.0002**
		(0.0001)
N	7,557	5,835

TABLE 5. Correlation between coefficients in preference space Model.

	World	Italy	Price
World	1	0.21	-0.08
Italy		1	0.84*
Price			1

TABLE 6. WTP estimates using Preference Space models

Model 1	Mean	SE	95%CI
World	0.32		0.25-0.39
Italy	0.63		0.57-0.70
Model 1			
World	0.30		0.23-0.39
Italy	0.65		0.55-0.77
Model 2			
World	0.54	0.09	0.35-0.73
Italy	1.57	0.14	1.28-1.85
Model 3			
World	0.58	0.10	0.39-0.76
Italy	1.60	0.15	1.32-1.89
Model 4			
World	0.74	0.11	0.52-0.95
Italy	2.03	0.19	1.64-2.42

Note: price coefficient in the MIX model is assumed to be lognormally distributed

TABLE 7. Results from WTP space Models

	Model 6	**Model 7**	**Model 8**
Mean(SE)			
ASC_{SQ}	-0.462***	0.775***	-0.311***
	(0.0911)	(0.2542)	(0.0674)
World	0.278***	0.267***	0.391***
	(0.0316)	(0.0348)	(0.0330)
Italy	0.667***	0.681***	0.735***
	(0.0305)	(0.0414)	(0.0375)
Price	-0.958***	-1.165***	-0.985***
	(0.0888)	(0.1100)	(0.0829)
Age*World		-0.011	
		(0.02824)	
Gender *World		-0.045	
		(0.0488)	
Age*Italy		0.045	
		(0.0352)	
Gender *Italy		-0.217***	
		(0.0597)	
Age*Price		-0.211***	
		(0.4111)	
Gender *Price		0.361***	
		(0.0723)	
Pocket Allowance*Price		-.0006	
		(.0003)	
Envir*ASC_{SQ}		-0.482***	
		(0.1150)	
SD			
World	0.419(0.0391)***	0.357(0.0340)***	0.427(0.0342)***
Italy	0.353(0.0287)***	0.314(0.0311)***	0.342(0.0255)***
Price	0.846(0.1059)***	-0.798(0.1259)***	0.564(0.0985)***
LL	-1706.33	-1369.22	-1651.61
AIC	3426	2766	3323
BIC	3473	2821	3362
N	7,557	5,835	7,557

TABLE 8. Correlation between coefficients in WTP space models

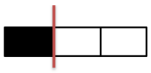
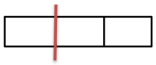
	World	Italy	Price
World	1	0.08***	-0.34***
Italy		1	-0.26***
Price			1

Appendix A. Description of the Discrete Choice Experiment

Figure A.1. Description used for the attributes in the Experiment.

	Nature in Italy includes plants and animals in our country. This includes our national nature, varying from the Alps to our Mediterranean sea, and from the dolphins to the roes.
	The nature outside Italy includes all nature in the world with the exception of plants and animals in the earlier mentioned areas. This involves tropical rainforests and coral reefs, the North Pole and the Antarctic, as well as endangered species, such as tigers and pandas.
Annual Payment	This last element involves a voluntary donation which you are willing to pay with your own money for the positive changes in nature in the presented management option. This donation concerns natural improvements only.

Figure A.2. Legenda used in the Experiment.

	**Small degradation:** Without additional nature protection, nature will gradually degrade. This means a decline in quality and quantity of nature in the coming year.
	**No change:** To maintain nature at current levels, additional nature conservation efforts are needed. In this case, quality and quantity of nature will not change in the coming year.
	**Small improvement**: With some additional effort in nature conservation, we can achieve slight improvements in the quantity and quality of nature in the coming year.
	**Major improvement:** And if major conservation efforts are done, we can even realize major improvements in nature. This implies substantially more nature areas and higher levels of biodiversity in the coming year.

Appendix B. Analysis excluding children who choose the dominated choice set.

Table 1. Appendix B. Results from Preference Space Models.

	Model 1	Model 2	Model 3	Model 4	Model 5
Mean (SE)					
World	0.562***	0.631***	0.772***	0.801***	0.717***
	(0.0378)	(0.0685)	(0.0756)	(0.110)	(0.0780)
Price	-1.414***	-1.710***	-1.026***	-1.279***	-0.988***
	(0.0799)	(0.1341)	(0.0936)	(0.1101)	(.0933)
Italy	0.924***	1.147***	1.596***	1.973***	1.800***
	(0.0479)	(0.0969)	(0.1240)	(0.1906)	(0.1479)
ASC_{SQ}	-0.230	2.279**	-1.791***	0.055	-1.777***
	(0.1717)	(0.8961)	(0.2525)	(1.0297)	(0.2713)
Age*Italy		0.0102		0.233**	
		(0.0684)		(0.1040)	
Gender *Italy		-0.376**		-0.420**	
		(0.1465)		(0.2118)	
Age*World		-0.116**		-0.008	
		(0.0550)		(0.0719)	
Gender*World		-0.096		0.074	
		(0.1144)		(0.1413)	
Age*Price		-0.301***		-0.842***	
		(0.0972)		(0.1799)	
Gender*Price		0.698***		1.511***	
		(0.1986)		(0.3800)	
Envir*ASC_{SQ}		-1.098***		-.727*	
		(0.3923)		(0.3998)	
Pocket allowance*Price		-0.001*		-0.003**	
		(0.0008)		(0.0016)	
SD					
World			0.806***	.0.924***	.838***
			(0.0712)	(0.0893)	(.0785)
Italy			0.701***	. 0.948***	1.113***
			(0.0954)	(0.127)	(.123)
Price			-1.215***	-0.892****	-1.092***
			(0.0805)	(0.0910)	(.1044)
LL	-1981.02	-1609.44	-1640.00	-1332.53	-1617.52
AIC	3970	3240	3294	2693	3255
BIC	3985	3283	3321	2747	3293
N	6,822	5,289	6,822	5,289	6,822

Table 2. Appendix B. Results from WTP space Models.

	Model 6	Model 7	Model 8
Mean(SE)			
ASC_{SQ}	-.252***	.601**	-.154***
	(.0792)	(.2617)	(.0426)
World	.326***	.302***	.425***
	(.0792)	(.0357)	(.0311)
Italy	.668***	.685***	.728***
	(.0287)	(.0432)	(.0352)
Price	-1.132***	-1.311***	-1.172***
	(.1307)	(.1222)	(.0937)
Age*World		-.050*	
		(.0259)	
Gender *World		-.012	
		(.0457)	
Age*Italy		.031	
		(.0372)	
Gender *Italy		-.223***	
		(.0582)	
Age*Price		-.175***	
		(.0486)	
Gender *Price		.359***	
		(.0486)	
Pocket Allowance*Price		-.0005	
		(.0003)	
Envir*ASC_{SQ}		-.364***	
		(.1170)	
SD			
World	.36(.034)***	.29(.031)***	.42(.03)***
Italy	.35(.024)***	.33(.032)***	.33(.02)***
Price	.90(.124)***	-.81(.131)***	.59(.10)***
LL	-1706.33	-1369.22	-1651.61
AIC	3426	2766	3323
BIC	3473	2821	3362
N	6,822	5,289	6,822

Appendix C. Analysis including family characteristics

The formation of economic preferences at younger ages and how their are influenced by family characteristics including parents' preferences is a topic that received increasing attention in the recent years (Doepke and Zilibotti, 2014). This study collected data from parents (either the mother or the father) of the children included in the analysis. Overall 173 parents provided personal information including age, gender, family budget and attitudinal and behavioural indicators (for further details on the variables collected see(Guerriero et al., 2018). Table 8 report the results of the descriptive statistics of the sample interviewed. As expected, the majority of respondents are the mothers of the children interviewed. Table 8 also reports family income and parent's concern of the environmental effects on children's health measured on a 5-point Likert scale. This measure was included in the present analysis to investigate its influence on children's probability of choosing the SQ alternative. Table 9 reports the results of Model 2, 4 and 7 including three additional interactions terms: (standardized) family budget interacted with World and Italy attributes. The third covariate included in the models is the interaction test between parental concern on environmental effects on children's health and children SQ marginal utility. As observed the results of the study do not change after including these additional variables. The attributes are highly statistically significant; the family income does not seem to affect children's WTP for environmental protection. Despite being high for the whole sample the degree of environmental concern of the parents affects negatively children's probability of choosing the SQ alternative. This results is consistent with those of a previous study assessing children's WTP for asthma risk reduction (Guerriero et al., 2018). The study conducted with the same parents-children dyads showed that children's WTP is positively influenced by their parents' WTP.

Table 1 Appendix C. Descriptive Statistics of the Parents Sample

	Share/Mean(SD)
Females	69%
Age	45.6(8.53)
Family Income	€827(736.12)
Environmental Concern	4.64 (0.66)

Table 2 Appendix C. Results including family characteristics

VARIABLES	Model 2	Model 4	Model 7
World	0.499***	0.569***	0.253***
	(0.101)	(0.163)	(0.060)
Price	-1.709***	-1.145***	-1.030***
	(0.197)	(0.188)	(0.155)
Italy	1.131***	1.985***	0.752***
	(0.156)	(.307)	(0.229)
ASC_{SQ}	7.556***	10.42***	4.722***
	(1.836)	(3.144)	(1.208)
Age*Italy	0.032	0.180	0.430
	(0.103)	(0.147)	(0.054)
Gender *Italy	-0.673***	-0.762***	-0.356***
	(0.216)	(0.304)	(0.941)
Envirparent*ASC_{SQ}	-0.588	-1.12**	-0.351
	(0.338)	(0.488)	(0.186)
Familyinc*World	0.155	-0.060	-0.006
	(0.338)	(0.138)	(0.058)
Familyinc*Italy	0.041	0.024	-0.039
	(0.092)	(0.179)	(0.047)
Age*World	-0.030	0.107	0.201
	(0.080)	(0.118)	(0.048)
Gender *World	-0.026	0.237	0.040
	(0.158)	(0.231)	(0.094)
Age*Price	-0.320**	-0.641***	-0.172***
	(0.128)	(0.259)	(0.059)
Gender *Price	0.893***	1.579***	0.439***
	(0.303)	(0.590)	(0.107)
Envir*ASC_{SQ}	-2.234***	-2.975***	-1.586**
	(0.709)	(0.590)	(0.567)
Pocket Allowance*Price	-0.002	-0.002	0.000
	(0.001)	(0.001)	(0.000)
SD			
World		0.832***	0.348***
		(0.140)	(0.056)
Price		0.988***	0.707***
		(0.108)	(0.236)
Italy		-0.752***	0.248***
		(0.229)	(0.047)
LL	-516.41	-437.59	-461.99
AIC	1062	911	959
BIC	1153	1020	1062
N	2,244	2,244	2,244

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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