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JEL classification: A130; H130; Q530; Z130

Keywords: public environmental expenditure; green behaviors; multidimensional analysis

Does Public Environmental Protection Expenditure Explain Private Green Performance? The Determinants of Green Behaviors in a Multidimensional Analysis.

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Abstract

This paper contributes to the current debate on the determinants of individual environmental behaviors. We move from the assumption that the Environment should be considered as a collection of different segments which individuals perceive and interact with separately. Such an assumption suggests that people's behaviors should be investigated in a multidimensional perspective. Building on this hypothesis, we derive a set of synthetic indicators measuring individual's performance on a set of distinct environmental areas. These summary indicators are then used to identify the determinants of individual environmental behaviors and attitudes. In addition to the traditionally investigated ones, we consider other possible determinants, such as the level of public environmental protection expenditure, the degree of personal satisfaction with current lifestyle, the individual worldview and need of reinforcement from other actors. Our analysis allows us to obtain a more comprehensive picture of the complex mechanisms behind the formation of environmentally responsible behaviors, thus providing useful insights for policy-making.

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1 Introduction

The emergence of environmental problems as a major policy issue reflects the growing concern about the effects of human activities on the environment. Governments' efforts devoted to achieve sustainable consumption and production patterns around the world seem to have performed relatively poorly with respect to the intended targets (see, for instance, the report on Sustainable Consumption and Production in Europe, ETC/CSP, 2011). Even though several causes for these shortcomings can be identified, it clearly emerges that a deep understanding of the mechanisms behind the formation of individual environmentally responsible behaviors and attitudes is essential and should be integrated into policy making.

We aim at enhancing our comprehension of such issues by focusing on how people's individual, socio-psychological and socio-economic characteristics translate into different attitudes and actions toward the environment.

Analyses exploring the relationship between people's environmental responsibility and their economic and social backgrounds have been carried out under several perspectives, among which two methodological and conceptual frameworks are particularly relevant. The first approach has been proposed by socio-psychological theories of behavior (among which are, for example, the Altruism, Empathy and Prosocial Behavior Models, Kollmuss and Agyeman, 2002), which emphasize how pro-environmental behaviors result from the interaction between the opposing forces of attitudes, values, motivations and worldviews on one side, and barriers to environmental responsibility on the other. Both these forces are viewed as originating from the individual's innermost and psychological backgrounds, his/her social context and, more recently, his/her institutional environment (Whitemarsh *et al.*, 2011). Some of these studies have investigated attitudinal factors leading to environmentally responsible behaviors (see, for instance, Kaiser *et al.*, 1999), while others have highlighted in particular the social and psychological origins of people's concerns over environmental issues (Dietz *et al.*, 1998).

The second approach is instead mostly proper of socio-economic analyses and focuses on less subjective factors, located outside the individual, which have generally been used to explain the variability of various proxys for the degree of greenness of individual behaviors. Owen and Videras (2006), for instance, investigate the impact of civic cooperation, environmental attitudes and behavioral intentions on willingness to sacrifice economic growth and income for

the sake of the environment, whilst Torgler and Garcia-Valiñas (2006) analyze how some socio-economic variables determine individual willingness to pay for the prevention of environmental damage. In the same line, Shen and Saijo (2007) consider the determinants of environmental concern in Shanghai, and Welsh and Kühling (2009) those of pro-environmental consumption in the region of Hanover, Germany.

Overall, however, agreement on the effects of some of the traditionally investigated determinants is hard to find in the extant literature, given the presence of sign-inconsistencies across results. One possible explanation lies in the use in most of these studies of a single, unidimensional variable as representative of overall individual environmental behavior, which is instead clearly multifaceted, and may impact differently on the various dimensions along which the human-environment relationship takes place. As argued by Stern (2000; p.409), "much early research on proenvironmental behavior presumed it to be a unitary, undifferentiated class. More recently it has become clear that there are several distinct types of environmentally significant behavior and that different combinations of causal factors determine the different types".

To overcome these limitations, we depart from the idea of treating environmental behavior as a single item. By exploiting the rich information on the British population in 2009 provided by the Survey of Public Attitudes and Behaviours toward the Environment (Defra, 2010), we identify six distinct dimensions through which individuals perceive, and interact with, the environment. Individual environmental performance on such dimensions can be represented by synthetic indicators built through the application of a Non Linear Principal Components Analysis (NLPCA). These indicators which measure the "greenness" of behaviors and attitudes are then used as dependent variables in a Seemingly Unrelated Regression (SUR) in order to estimate their determinants and to identify their inherent similarities and/or differences, while retaining their nature of "components" of a single, but multidimensional entity (the human-environment relationship). Through this approach it can be shown that many of the contrasting results found in previous literature can be clarified.

As a second step these indicators are sequentially (but inordinately) linked on the basis of the number of dimensions on which the individual can be considered as environmentally responsible, thus building a measure of overall responsibility whose determinants are hence investigated. In our analysis, in addition to the traditionally investigated ones, we include other

possible determinants which were previously not fully explored. Specifically, we bank on the idea that regional variability of public environmental protection expenditure could explain differences in individual environmental preferences (as suggested by Torgler and Garcìa-Valiñas, 2006), and investigate whether the amount of money spent by the government in the provision of environmental quality can affect how people "think" and behave with respect to the environment itself.

The rest of the paper is organized as follows: Section 2 presents the data used for the analysis, Section 3 derives individual environmental responsibility indicators, while Sections 4 and 5 present the estimated effects of several determinants on our measures of individual intra-dimensional and inter-dimensional responsibility. Section 6 concludes.

2 The Data

The data used in our analysis are taken from the 2009 Survey of Public Attitudes and Behaviours toward the Environment[1], which is representative of the population in England (Thornton, 2009). Consisting of 2,009 observations, the survey reports either the opinion or the stated actual behavior of the respondent (or both) on a wide range of environmentally relevant daily activities, these grouped into a number of issues which include: energy and water use in the home, purchasing behaviors, recycling habits and waste production and reuse, food purchasing/consumption and food waste, and travel. Furthermore, a number of questions are included to gauge respondents' knowledge of, and attitudes towards, various environmental issues as carbon offsetting, biodiversity, use of green spaces as well as the degree of involvement in volunteering in environmental organizations. This dataset appears then as particularly suitable for the investigation of individual environmental behaviors and attitudes from a multidimensional perspective.

To best exploit the information conveyed by the variables for the purposes of our investigation, their original codification has required in several cases a significant reorganization

[1]This Survey is commissioned by the Department for Environment, Food and Rural Affairs (Defra), together with the Energy Saving Trust. Previous releases refer to 1986, 1989, 1993, 1996-7, 2001 and 2007. The data for 2009 release was collected in February/March of the same year.

(i.e. merging, recoding and splitting)[2] so as to ensure that a lower value corresponds to a less environmentally responsible action or opinion.

For all the variables included in the analysis, it has also proven necessary to deal with non-responses, due to either the non applicability of the question (as for example when asking a person living in a house with *solid* walls whether he's ever thought of installing *cavity* walls insulation) or to statements of ignorance (e.g. the "don't know" response to, for instance, the question: *"Thinking about when you throw food away, how much does it personally bother you?"*). While for non applicability we simply decided to classify answers as system missing values, the latter case, that of ignorance, poses a few more questions about the best way to treat such a response. Albeit it could be plausibly argued that a declaration of ignorance is unequivocally proof of a lesser environmental responsibility, doubts persist on its actual position on the "environmental responsibility scale" needed for the subsequent analysis. In other words, should "don't know" be considered as a "neutral" response (i.e. one that is neither bad nor good but rather in between the two)? Or should it rather be considered as the worst of all possible answers because it reflects a total lack of interest of the individual on the matter at hand? To reduce the risk of inappropriately altering the scale of the environmental responsible behavior we have decided to consider the "don't know" response as a system missing value too[3].

To perform the multidimensional analysis presented in the next Section we retained 79 recoded variables from the dataset, of which a complete list is provided in Table 1.

In order to explore the role of public expenditure for the protection of the environment as a possible determinant of individual environmental behaviors and attitudes, as highlighted in the Introduction, we use data provided by the Public Expenditure Statistical Analyses for the

[2]For several variables, for instance, codification was either arbitrary, preventing us from ranking responses from a higher degree of eco-friendliness to a lower one, or responding to coding criteria which were not ensuring such a ranking. In most cases, the structure of the responses had to be accurately analyzed in order to find aggregation strategies that would ensure an *objective* ordering of the categories according to their environmental friendliness. Moreover, many of the variables had different (and mutually exclusive) sets of possible responses, conditional on the answer(s) that was (were) provided earlier in the questionary.

[3]The distribution of the "environmental responsibility" levels for each question in the sample is relevant for the creation of synthetic individual environmental responsibility indicators. Both to merge the "don't know" response with any of the existing categories, which would result in an excessive weight to be placed on one of a series of well identified groups of respondents, and to leave it as a separate one, would alter the distribution of the "environmental responsibility" levels.

year 2008/2009 (PESA, 2010). The PESA data are issued by the HM-Treasury, and report public expenditure levels in each of the nine British Government Regions, divided by sector and purpose. The levels of public environmental protection expenditures for the years 2004 to 2009 are reported in Figure 1.

Throughout the analysis, we assume that public expenditure will plausibly influence people's behavior immediately, due to the flexibility of individual behaviors, and especially of their attitudes and opinions[4]. On the contrary, the existence of feedback effects can be ruled out by considering that political reaction to shifts in people's behaviors tends to be lagged by at least one or more periods, following electoral cycles, and because of the rigidity of the political agenda (see, for instance, Ercolani and Pavoni (2008) that use cross-sectional individual data to exclude the presence of endogeneities in their assessment of the substitutability or complementarity between public and private consumption). Moreover, using cross-sectional data shields our analysis from the effect on individual behaviors and attitudes of shifts in time of the quality of environmental information in the media, or of the exposure to global environmental threats.

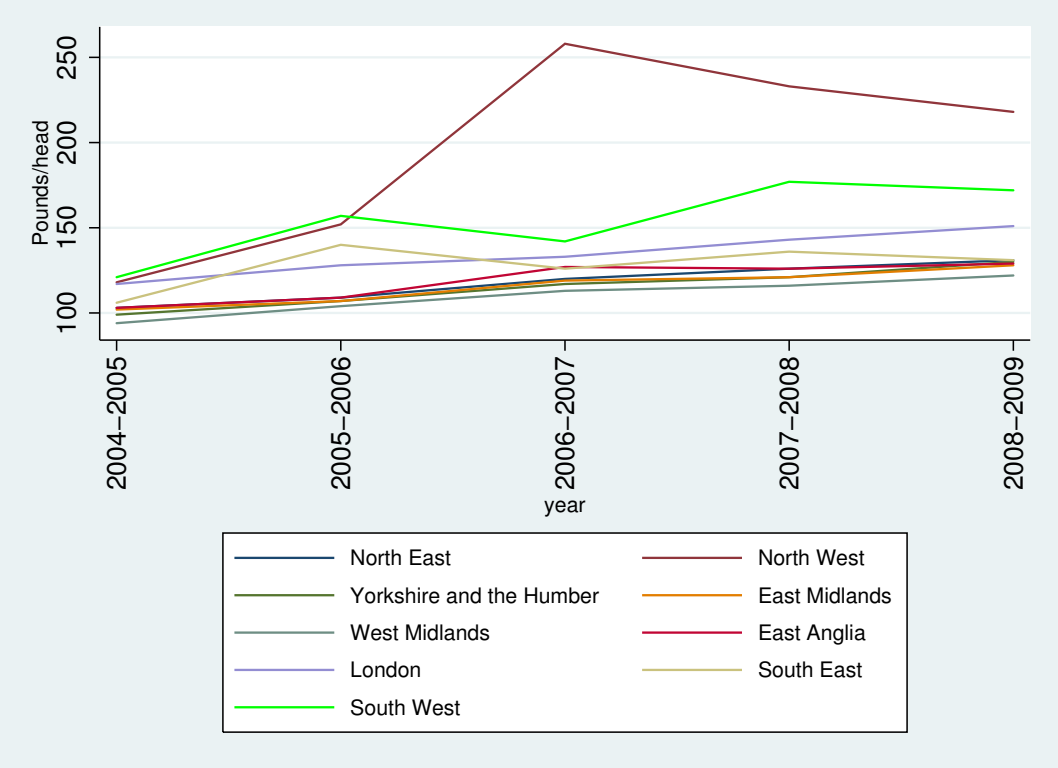
3 The Construction of Individual Environmental Responsibility Indicators

As noted in the Introduction, environmentally significant attitudes and activities can be grouped into different dimensions along which the interaction between humans and the environment takes place, whose boundaries are, however, far from being clear cut. Partly, this is due to the fact that single activities do not have the same impact on different human-environment dimensions (and rarely is such impact confined to a single dimension only), but also, and especially, to the individuals' limited perception of such different impacts[5]. Moreover, people tend to behave differently on each environmental dimension according to situational constraints, per-

[4]Nevertheless, correlations do not change sign if public environmental expenditure from the previous years is used.

[5]For example, the most immediately apparent effect of driving a car is the production of air pollution, but people neglect to take into account that, for example, the solvents used for the varnishing of the car, the disposal of exhausted lubricants during both production and usage, and the soap used to wash the car might end up in water pollution.

Figure 1: Public environmental expenditure 04-09 (Pounds/head)



sonal beliefs and knowledge[6]. Such considerations suggest the adoption of a multidimensional perspective when analyzing people's environmental performance.

The Defra survey offers us the opportunity for such a thorough analysis by providing comprehensive information about how the British relate to several aspects of the environment.

In order to conduct our research, a preliminary stage implies the construction of synthetic indicators for individual environmental performance in different areas, meaning that the multiplicity of items provided in the dataset have to be summarized in a more limited number of relevant variables, possibly one for each environmental domain. We have thus chosen to group the original variables into six, well identified sets, each describing a different environmental topic as suggested by common experience, by the DEFRA questionnaire itself, and subsequently confirmed by the correlational structure of the data[7].

[6]As highlighted by Heberlein (1981, p. 3), "no one experiences the environment as a whole, but rather separate, distinct aspects of the environment".

[7]To reduce the multidimensionality of a dataset, researchers can choose on the basis of their personal expertise or may let some statistical method suggest the most appropriate solution of data reduction. Even though in this analysis we adopt the first strategy, we have also performed an *exploratory* Non Linear Principal Components Analysis (NLPCA) on the raw variables in the dataset to uncover the underlying structure of the data. The

Table 1: Variables used to build the six human-environment interaction dimensions.

AWARENESS

- Knowledge on climate change
- Knowledge on global warming
- Knowledge on carbon footprint
- Knowledge on CO2 emissions
- Knowledge on biodiversity
- Overpopulation
- Limited amount of resources
- Present environmental situation
- Global awareness
- Agreement contribution of food production to climate change
- Understanding of contribution of food production to climate change

ATTITUDE

- Guilt
- Government should deal with: environment
- Level of distress at throwing food
- Attitude toward saving energy
- Attitude towards recycling
- Attitude towards water usage
- Attitude towards the environmental crisis
- Attitude towards changing habits for the sake of the environment
- Attitude towards the future effects of climate change
- Attitude - worth being responsible only if profitable
- Is willing to pay more taxes for the sake of the environment
- Concerned with the loss in local biodiversity
- Attitude towards waste and greed
- Attitude - resignation
- Priority of the environment relative to personal habits
- Is skeptical that his personal behavior is affecting the environment
- Concerned with the loss in local biodiversity
- Attitude - pride in local environmentÕs quality
- Attitude - priority of water saving
- Concerned with the public sector wasting energy
- Concerned with people wasting
- Stated overall attitude towards the environment

INVOLVEMENT

- Volunteered in conservation groups
- Buys plants who encourage wildlife for his/her garden
- Lifestyle and the environment (stated)
- Advices other people on ways they could help the environment
- Tries to persuade people to adopt a sustainable way of life
- Suggests environment-oriented improvements at work
- Buys local products
- Active in environmental protection (stated)
- Made donations to the Royal Society for the Protection of Birds (stated)

ENERGY & MOBILITY

- Cuts gas and electricity usage at home
- Buys energy efficient appliances
- Would turn the thermostat down by 1¡+
- Cuts usage of hot water at home
- Cut usage of hot water at home (actual)
- Installing solid wall insulation
- Installing draught exclusion
- Installing solar panels for electricity
- Installing solar water heating
- Installing a condensing boiler
- Switching to public transportation instead of driving
- Switching to an electric/LPG/hybrid car
- Buying or driving a more fuel efficient vehicle

FOOD & WATER

- Cuts on the use of water at home
- Cuts on the use of water at home (actual)
- Is committed to wasting less food
- Buying fresh locally produced, seasonal food
- Grows his/her own fruit/vegetables
- Installing water butt to collect rain
- Buys fish from sustainable sources
- Usually boils only as much water as needed
- Usually boils only as much water as needed (actual)
- Quantity of uneaten food usually thrown away
- Level of effort to minimize food waste

WASTE & RECYCLING

- Recycling rather than throwing away
- Checking if packaging is recyclable before buying
- Refuses too buy because of too much packaging
- Reusing items like bottles, bags, etc
- Using a non disposable shopper
- Composting
- Recycling rather than throwing away (effective)
- Refuses too buy because of too much packaging (effective)
- Reusing items like bottles, bags, etc (effective)
- Using a non disposable shopper (effective)
- Composting waste (effective)
- Recycling site coherence
- Curbside recycling coherence

The six group of variables are *Awareness* (AW), *Attitude* (ATT), *Involvement* (INV), *Energy and Mobility* (EM), *Food and Water* (FW), and *Waste and Recycling* (WR). Interestingly, it can be noticed that while the first two groups represent the "*Attitudinal*" elements of environmental behaviors, the remaining four describe "*Actual Behaviors*" *strictu sensu*.

Table 1 lists the variables included in each group.

The construction of synthetic indicators measuring the individuals' performance on each environmental domain (our latent information) allows us to examine the differences in how people behave within each dimension and the relationships among the dimensions themselves, thus obtaining a much clearer picture of the mechanisms behind the formation of environmentally responsible behaviors. To aggregate the original variables into such indicators we adopt Non Linear Principal Component Analysis (NLPCA) because of the categorical and Likert-type nature of the variables under analysis. Similarly to its linear version, NLPCA reduces a multiplicity of variables to a smaller number of orthogonal linear combinations called *components*[8] preserving the original structure of the data. It is nonetheless better suited to handle ordinal and categorical variables, since these are quantified through an optimal scaling process which retains the original variance as much as possible. In this particular case, given the nature of the variables, we choose to adopt an ordinal scaling, which ensures that the original categories are quantified so as to maintain their ordered relationship, while nonetheless allowing for nonlinearities.

In addition to maximizing the orthogonality between the components, NLPCA also makes sure that the quantified variables are weighted so that their correlation within each component is maximized, so that each component can be viewed as a new variable measuring some latent information conveyed by the data. Given that a number of components are extracted, these are ordered according to the amount of original variance they explain, with each one accounting for a portion of the variance not accounted for by the preceding ones, so that the first component

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use of such a statistical technique has the advantage of avoiding to force pre-established relationships between variables, since latent structures are uncovered by exploiting correlations among data (Linting, 2007). Results from the exploratory NLPCA suggest that six dimensions provide a good statistical fit, giving also the need of interpreting each component as an environmental behavior/attitude dimension.

[8]The i^{th} principal component is defined as:
$Z_i = a_{i1}X_1 + a_{i2}X_2 + ... + a_{iq}X_q$
where a_{ij} is the weight assigned to variable j on component i (Nardo *et al.*, 2005).

accounts for the largest amount.

Product of the NLPCA are the *Component Loadings*, defined as the correlation of each original variable with each component[9], and the *Object scores* which are defined as the sum over the standardized scores of each individual on the original variables weighted by their component loadings[10]. The object scores can thus be viewed as the scores of the individuals on the new variables created through the NLPCA.

We run six NLPCAs (one for each set of variables) and retain the object scores on the first principal component extracted on each group as our synthetic environmental responsibility index for that specific dimension[11]. The first component, in fact, summarizes most of the latent information contained in the data, accounting for the largest proportion of the total variance. Table 2 reports the amount of variance explained by the first component on each environmental dimension[12].

As it will be shown in the next Section, it is precisely by using these indicators that we will investigate the determinants of individual environmental behaviors.

Table 2: % of total variance explained by the first component for each environmental dimension

Environmental dimension	**% of variance explained**
Awareness	31.84
Attitude	32.39
Involvement	26.35
Energy & Mobility	22.37
Food & Water	26.34
Waste & Recycle	27.13

[9]The component loading for variable j is (Nardo *et al.*, 2005):
$r(X_j, Z_i)$ =corr$(x_j, a_{i1}X_1 + a_{i2}X_2 + ... + a_{iq}X_q)$.

[10]The object score for individual k on component i will be:
$\text{osc}_k(Z_i) = \Sigma_j x_{jk}(r(X_j, Z_i))$
where x_{jk} is the standardized score of individual $k$on variable J.

[11]i.e. individuals with lower scores in a given dimension can be considered as less responsible, meaning that they are performing relatively worse on several environmental items included in that dimension. For example, if all the variables included in EM measure the individual's level of responsibility on a set of energy consumption and transportation behaviors, the first component extracted from the NLPCA on the EM variables will provide us with a distribution of scores measuring, for each individual, the *overall* level of responsibility on energy consumption and transportation habits which emerges from his/her performance on all the single variables.

[12]It is worth reminding that NLPCA involves a process of maximization of the amount of variance of the original variables explained by each component.

4 The Determinants of an Environmentally Responsible Behavior: an intra-dimensional analysis

To a have a better understanding of which factors affect environmental behaviors, we analyze the indicators derived in the previous Section through a series of linear regression estimations. Given the nature of the problem at hand, and especially considering that the response variables measure different aspects of the same issue, we need to account for the fact that the disturbances could be mutually correlated: an exogenous shock on one dimension will very likely also affect the other ones, either directly (a shock affecting the disturbances of *all* the dimensions simultaneously, e.g. news about an environmental catastrophe, which can shift the individual behaviors and attitudes on all dimensions simultaneously) or indirectly, *via* the correlation of the disturbances (a shock affecting one particular dimension directly, but whose effects will "propagate" to the other ones, e.g. events which at first change the person's perception about, and behavior on, a single environmental dimension, but subsequently affect the others too). To allow for such a case we perform the analysis through a Seemingly Unrelated Regression model (SUR)[13].

The model for the j^{th} individual living in region i will then be:

$$\begin{cases} AW_j = \beta_{aw} X_{i,j} + \gamma_{aw} W_j + u_j \\ ATT_j = \beta_{att} X_{i,j} + \gamma_{att} W_j + v_j \\ INV_j = \beta_{inv} X_{i,j} + \gamma_{inv} W_j + \omega_j \\ EM_j = \beta_{em} X_{i,j} + \gamma_{em} W_j + \zeta_j \\ FW_j = \beta_{fw} X_{i,j} + \gamma_{fw} W_j + \eta_j \\ WR_j = \beta_{wr} X_{i,j} + \gamma_{wr} W_j + \varepsilon_j \end{cases}$$

where each equation ties the individual's score on each environmental dimension to a set of individual (W) and regional (X) covariates. Table 3 reports the estimated coefficients for the

[13] As shown in Table 3, the χ^2 test statistic for the Breusch-Pagan test of independence rejects the null hypothesis of uncorrelated residuals with a probability approaching one, confirming that the SUR model is indeed the right choice to perform these estimations.

model.

Regional covariates include regional population figures, pollution levels[14] and regional public expenditure for the protection of the environment. The first two variables are intended to control for the amount of people living in each region and for pollution levels. The choice of regional *per capita* levels of Particulate Matter (PM_{10}) rather than other types of pollutants does not affect the results. It has not been possible to include more than one type of pollutant simultaneously because of serious multicollinearity issues. As previously noted, the inclusion of regional environmental expenditure serves the purpose of investigating whether the individuals respond to variations in public expenditure for the protection of the environment and in which direction[15].

Individual covariates can be divided into three groups: personal characteristics, financial situation, and worldview and social motivations.

Personal characteristics include the respondent's sex, age, education[16] (five dummies, "no education" excluded), the number of children in the household, four dummies indicating the respondent's marital status (divorced, engaged, widowed and single (excluded)) and his/her area of residence (three dummies: city (excluded), town or village). Along with these, we include two dummies indicating whether the respondent usually reads broadsheet newspapers (excluded) or tabloids as additional controls.

Financial situation is summarized by a variable indicating the respondent's social grade[17] (from the lowest, coded 1, to the highest, coded 6), whilst the income variable has been left out of the analysis due to the extremely high number of missing values (nearly 45% of the sample). As additional control for the respondent's financial status, we include three dummies indicating

[14]Represented by the average regional Particulate Matter concentration, PM_{10}, for the year 2008, calculated using pollution data from the DEFRA data selector.

[15]Due to problems of multicollinearity with the level of public environmental expenditure, regional Gross Value Added (GVA) could not be included in the analysis.

[16]The DEFRA dataset does not contain any indication on the number of years of education each respondent completed, but rather a set of dummy variables indicating the group to which the highest level of education of the individual pertains. Since both formal (high school, college, MA, etc.) and informal education (namely vocational and other professional qualifications) have their own sets of dummies, to make them useful for our analysis it has been necessary to recode and aggregate them into five dummy variables, covering from total absence (Education 0, excluded category) to the highest level (Education 4 - PhD, MSc, Ma, etc..).

[17]Social grade classifies households based on the type of occupation of the chief income earner, where A corresponds to "higher managerial, administrative and professionals" and E to "state pensioners, casual and lowest grade workers, unemployed with state benefits only" (see http://www.nrs.co.uk/lifestyle.html).

whether his/her house is mortgaged, rented, or owned (excluded).

In addition to these variables, extensively explored by the literature, we also consider other possible determinants of environmental behaviors, which are at yet relatively unexplored.

Firstly, the respondent's stated level of satisfaction with his/her current lifestyle has been added to the satisfaction with his/her financial position, already explored by Torgler and García-Valiñas (2006), because of the suspect that individual inclinations to adopt an environmentally responsible lifestyle could be affected by the overall satisfaction with his/her lifestyle in general (not only by its financial aspects), as well as by the the respondent's overall perspective about his own life and expected material conditions in the future, these proxied by expectations about future economic conditions in UK[18]. Further, we also assume that individual predisposition to a greener life can be influenced by whether the respondent needs reinforcement from other socio-economic actors, such as the Government, the business sector, the respondent's closest entourage and the society in general[19]. The idea is that respondents with different levels of environmental performance might need reinforcement in their environmental behaviors from different societal segments.

Before presenting results from our regression analysis, it is worth turning to some of the inconsistencies that can be found in previous literature. In particular, the relationship between gender or age and environmental performance seems to be unclear. As far as gender differences are concerned, most studies suggest that, compared to men, women generally show greater participation in pro-environmental behavior and activism (Zelezny *et al.*, 2000), even though they appear more likely to engage in "private" pro-environment behaviors within the household (e.g., recycling, buying/eating organic) and less likely to engage in pro-environment "public" behaviors (e.g., volunteer time, attend public meetings) relative to men (see Hunter *et al.*, 2004 and the review of the literature here provided). Modest distinctions between men and women can be found concerning their environmental concerns, and generally these differences do not remain consistent in cross-country comparisons (Hunter *et al.*, 2004). On the opposite, McEvoy

[18]The three dummies *pessimist*, *neutral*, *optimist* were extracted by answers to the question: "*Do you think the general economic condition of the UK in the next 12 months will improve, stay the same or get worse?*".

[19]This information was extracted from the level of agreement to the questions: "*If the Government did more to tackle climate change I would do more too*", "*If Business did more to tackle climate change I would do more too*", and "*It's not worth me doing things to help the environment if other don' t do the same".*

(1972) finds that men are more likely to be concerned with environmental quality because of their higher propensity to get involved in local politics and organized groups.

Another debated relationship is that between environmental performance and age. Two forces make the issue difficult to interpret: the so called "age-effect" and "cohort-effect" (Buttel, 1979, quoted in Mohai and Twight, 1987). The *age effect* makes older individuals adverse to any change in the *status-quo* that could undermine the social resources they accumulated during lifetime (Hornback, 1974 in Mohai and Twight, 1987) and less prone to take pro-environmental actions given that they won't benefit of an improved environment (Whitehead, 1991; Carlsson and Johannson-Stenman, 2000). The latter effect denotes instead the shifting of people's attitudes due to inter-generational differences in the exposure to external events during youth (Vlosky and Vlosky, 1999): increased information on environmental deterioration and its effects on, e.g., health and biodiversity could be behind the increased environmentalism of later generations (Van Liere and Dunlap, 1980). Finally, Nord *et al.* (1998) show that age and environmentalism are tightly, strongly and positively related. On the other hand, Harris (1991) and Furman (1998) find only a weak relationship between age and environmental concern.

As hinted in the Introduction, the results from our SUR analysis, presented in Table 3, could help to unravel some of these controversial issues.

As far as individual covariates are considered, it is interesting to note that the existence of contradictory results concerning the relationship between gender and environmental responsibility appears much less paradoxical if we examine each dimension of environmental behaviors separately. According to our estimates, women tend to be more environmentally responsible than men only on four out of the six dimensions here considered. Men are in fact found *more* responsible than women on Energy and Mobility and on Awareness, partly confirming the idea that they are likely to be more aware of environmental issues because of their involvement in local politics, associations and informal groups (McEvoy, 1972). In general, however, men are less prone to display pro-environmental attitudes, to actively engage in activities devoted to the protection of the environment, or to adopt more responsible habits for food and water consumption and waste production and management, confirming that women show greener behaviors than men.

For what concerns the relationship between environmental responsibility and age, instead,

Table 3: Seemingly Unrelated Regressions for the determinants of each environmental dimension indicator

VARIABLES	AW	ATT	INV	E&M	F&W	W&R
Male	0.19274***	-0.12390***	-0.15018***	0.09742**	-0.12859***	-0.22949***
Age	0.02927***	0.03375***	0.03299***	0.05970***	0.02344***	0.02554***
Age sq	-0.00030***	-0.00022***	-0.00032***	-0.00055***	-0.00012	-0.00022***
Engaged	-0.11171	0.04723	0.00417	0.22423***	0.27066***	0.16231**
Divorced	0.01661	0.20824**	0.08019	0.24497**	0.18722*	0.14990
Widowed	-0.12104	-0.01092	-0.01176	0.09035	0.16911	0.12192
Town	0.01068	0.02053	-0.00681	-0.03691	-0.00592	-0.01616
Village	0.28105***	0.23126***	0.08976	0.03536	0.02287	0.12550
One child	-0.15746**	-0.05201	-0.08819	-0.03090	-0.07980	-0.16311**
Two children	-0.03030	-0.12729	-0.13424	-0.00127	-0.24606***	-0.15635**
Three children +	0.21824	-0.02978	0.28010	0.13295	-0.04528	-0.05397
Education 1	0.67680***	0.41263***	0.45656***	0.45226***	0.30044***	0.32175***
Education 2	0.25285***	0.13699**	0.19905***	0.25453***	0.25258***	0.13182**
Education 3	0.40727***	0.23821***	0.36360***	0.29008***	0.21270***	0.24530***
Education 4	0.59202***	0.33993***	0.38392***	0.35999***	0.20313***	0.26931***
Tabloid	-0.14638***	-0.14634***	-0.06692	-0.09685**	-0.08534*	-0.11745***
Social Grade	0.06335***	0.03804*	0.01281	0.05218***	0.02154	0.05009***
Mortgage	-0.12853*	-0.08256	-0.07547	0.01774	-0.15880**	-0.03196
Rent	-0.06776	-0.05887	-0.12569	-0.56040***	-0.28911***	-0.29988***
Economic satisfaction	0.13385***	0.08572*	0.03622	0.03015	0.04650	-0.05544
Lifestyle satisfaction	-0.01252	0.03455***	0.04354***	0.00989	0.02940**	0.03038**
Optimist	0.12362*	0.11318*	0.10430	0.11774*	0.06171	0.02487
Pessimist	0.13123**	0.13462***	-0.02365	0.03623	-0.00012	0.11485**
Social reinforcement	-0.15913***	-0.45679***	-0.24425***	-0.22844***	-0.32758***	-0.30744***
Institutional reinforcement	0.12823**	0.19881***	0.27024***	0.07196	0.13563***	0.07165
Business reinforcement	0.07556	0.23162***	0.20594***	0.13041***	0.13158***	0.18112***
P.Envir.Expenditure	0.03491***	0.03923***	0.01503	0.03696***	0.03902***	0.03244***
P.Envir.Expenditure sq	-0.00011***	-0.00012***	-0.00005	-0.00012***	-0.00013***	-0.00010***
Pc.Particulate Matter	-0.51655**	-0.41590*	0.21245	-0.55777***	-0.41398**	0.07218
Pc.Particulate Matter sq	0.03694*	0.02771	-0.02181	0.03301*	0.01795	-0.01439
Reg.Population	-0.09294**	-0.08744*	0.02543	-0.13484***	-0.07323*	0.03768
Constant	-1.87263*	-3.04109***	-3.20380***	-2.47907***	-2.44859***	-3.82764***
R-squared	0.18330	0.20781	0.13187	0.31394	0.22342	0.20463
Breusch-Pagan χ^2	3355.000					

the former is found to be a concave function of the latter with highly significant coefficients on both the linear and the quadratic terms on all dimensions (coefficients all significant at 99% confidence level) but one[20]. The only exception is Food and Water, where the relationship appears linear and increasing. This last result might, at first sight, give credit to those authors who find in the "age-effect", the force pushing people to acquire radical reactionary positions to any change in the status quo as they grow old (Whitehead, 1991; Carlsson and Johannson-Stenman, 2000). On the opposite, the quadratic relationship found suggests the prevalence of a "cohort effect" (Cutler, Kaufman and Glenn, 1975; Glenn, 1980; Inglehart, 1990). A careful inspection of the results reveals, in fact, that the positive branch of the age's effect is associated to people who were born or grew up in the "Environmentalism Era" which began between the late sixties and the early seventies (Heberlein, 1981). The descending branch of the parabola captures instead the presence throughout the society of people belonging to cohorts for which access to education and information during youth was extremely limited (especially for information on environmental risks and pollution), thus confirming the hypothesis formulated by Van Liere and Dunlap (1980) that the shift towards environmentalism is due to the increased relevance of environmental issues in the media and in the general culture. However, our findings might also be revealing the presence of a positive ageing effect rather than the traditionally accepted negative one, since for those born in the sixties onwards environmental responsibility increases with age (in line with Nord *et al.,* 1998). This result could though be due to the accumulation of information during the years rather than to inner mechanisms inherent to ageing.

Married or engaged individuals are likely to show more positive behaviors than singles. This is the case for Energy and Mobility, Food and Water and Waste and Recycling, on which couples are more responsible with a 99% significance level. On Awareness, Attitude and Involvement, though, the relationship is not significant. Surprisingly, being divorced has a positive and significant effect on Attitude, Energy and Mobility and Food and Water.

For what concerns the area of residence, it is interesting to note that whilst it is not possible

[20]Where the quadratic function subsists, we are mostly in the increasing branch of the parabola with turning points located roughly between 45 and 55 years, with the noticeable exception of Attitude, on which the turning point is shifted much further, at around 71 years. More discussion on these tipping points is provided at the end of this Section.

to distinguish people living in a city from town dwellers on neither of the six dimensions, living in a rural village has a significant effect on three dimensions. Village residents, in fact, show higher levels of awareness and a more positive attitude towards the environment, in addition to a more environmentally virtuous behavior on Energy and Mobility.

A surprising result arises from the inclusion of the "children" dummies. Contrary to what we would expect (and to the "parent effect" suggested by Dupont, 2004), the effect of the presence of at least one child in the respondent's household is generally not significant. However, a negative and significant effect of one child on Awareness and Waste and Recycling, and of two children on Food and Water and Waste and Recycling can be clearly detected.

Considering the respondent's education level, we can see that its effect is the expected one: as the level of education increases, the individuals' behaviors become progressively more responsible. The results from the inclusion of the "newspaper" dummies confirm this effect by showing that readers of tabloids are significantly less responsible than the readers of broadsheet newspapers (the reference category) on all dimensions.

Adopted as a proxy of income, as previously noted, social grade exhibits a positive and significant, although small, effect on the environmental scores on all dimensions except for Involvement, in conformity with most of the literature (Inglehart, 1990; Franzen, 2003; Torgler and García-Valiñas, 2006 among others). This effect, moreover, is confirmed by that of different types of the respondent's ownership claims on his home. As expected, by decreasing disposable income, mortgage and rent are associated to lower environmental scores. In particular we find that renting prevalently affects the scores on actual behaviors, while a mortgage lowers those on Awareness and Food and Water[21].

As far as worldview and social motivation are considered, the contribution of individual economic satisfaction yields no significant result except for the positive ones on the Awareness and Attitude dimensions. On the opposite, individuals' satisfaction with their lifestyle in general shows a positive and significant relationship on four dimension out of six[22]. Notably, no significant effect can be detected on Awareness, which is instead the dimension on which

[21]The respondent's ethnicity does not affect individual environmental behaviors, hence its exclusion from the analysis does not alter the results.

[22]Both these results have proven robust to the separate inclusion of these two variables and to the exclusion of Social Grade from the analysis.

we find the most significant effect of financial satisfaction. This result could be explained by supposing that an individual who is satisfied with his/her economic background is more inclined to dedicate time and energy to the collection of information on environmental issues, while for greener actual behaviors to be triggered, what is important is not the level of financial satisfaction but rather that of satisfaction with one's overall lifestyle. It can also be supposed that the two variables are sequentially linked, with financial satisfaction preceding and being a (not nearly sufficient) condition to achieve lifestyle satisfaction[23].

Other interesting insights are provided by results for individual worldview. Whilst pessimists and optimists can be hardly distinguished one from the other, they can be jointly distinguished from neutral people (the reference category) on the basis of their environmental knowledge and attitudes. In fact, both optimists and pessimists are statistically more aware and have a better attitude towards the environment. Further, while neither of the three categories can be distinguished on the basis of their involvement in environmental protection and of their Energy and Mobility or Food and Water habits, pessimists are likely to be more responsible in waste production and management than both neutrals and optimists. Moreover, it is interesting to notice that, wherever they can be simultaneously found on the same dimension, pessimism's positive contribution is much more significant (99% confidence level) than that of optimism.

Results on these two variables show us that while neither optimism nor pessimism can be said to push the individuals to take daily pro-environmental actions[24], both can be closely linked to those that we have called individual "attitudinal factors".

Concerning the kind of sector of the society the individual needs reinforcement from (Business sector, Government and general Others, intended both as closest entourage and society in general) to increase his/her responsibility, we notice that individuals claiming they "would do more to help the environment should the Institutions and the business sector be more active too" are found to be more responsible than those who don't claim as much on five out of our six dimensions.

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[23]What should be kept well in mind is that financial satisfaction is here not necessarily a synonym of high income or social grade. A person might be satisfied with his/her own financial situation (and state it in a survey) without being for this reason "rich".

[24]No significant effect can be detected on none of the "actual behaviors" dimensions, except for Waste and Recycling.

On the contrary, those who claim they would, but *conditionally on the Society acting more responsibly too*, are found to have lower scores on each of the six dimensions. The evident distinction between those who need social versus Government/Institutional and Business reinforcement emerging from this analysis can be quite convincingly explained by a few considerations on individuals' attitudes and inclinations. There is an intrinsic and relevant difference between one of the three types of actors people feel they need reinforcement from and the other two. Government and Business are in fact capable of actually enabling people to adopt more responsible habits through, for instance, the provision of public goods and services (e.g. improved public transportation means or easier access to locally distributed renewable energy). Thus, concerned people claiming they would do even more to help the environment if the institutions and/or business were willing to do the same, are actually stating that they would do more *if the institutions and/or business gave them the opportunity to do so*[25], reflecting thus a deeper commitment to environmental issues.

On the opposite, the society (intended as the group of individuals living more or less in proximity to the respondent) is generally incapable of providing such services on its own (with the exception of some formal or informal local organized groups). Thus, needing society's reinforcement reflects something radically different: a lower level of commitment and the need of social "reassurance" in one's individual actions.

In this sense, the two variables indicate that the two groups of individuals are qualitatively different from an environmental point of view: they jointly show us that the first group exhibits a well-established structure of environmental values, attitudes, and norms, and act independently of what the "others" do or think, whereas people constituting the second group show a less defined value structure, and rely on the "general" social norms to define and direct their behaviors and attitudes.

Our estimates for the impact of public environmental expenditure support the hypothesis that institutional concern towards the quality of the environment, as proxied by the level of public expenditure, is capable of triggering responses at the individual level. A concave, and highly significant effect can in fact be clearly detected on five out of the six indicators, the only

[25]It is worth nothing for a household to put aside materials for recycling if those dealing with their collection and disposal, whether public or private company, treat all waste as undifferentiated.

exception being that of Involvement.

Finally, both the population size and PM_{10} levels negatively affect environmental behaviors.

Given that, at least to the best of our knowledge, literature presenting comparable results to those here presented is lacking, we cannot rely on previous studies to confirm the quadratic (concave) relationships we find; namely those for age and, especially, public environmental protection expenditure.

Due to the proximity of the quadratic term to zero, we cannot rule out the possibility that the non-linear relationships found are due to an *a-priori* imposition of non-linearity in the estimated equations.

Following the considerations made by Bernard *et al.* (2011), to check the validity of our results we rely on robust inference on tipping points, which are defined by the ratio $\delta = -\beta_1/2\beta_2$, where β_1 and β_2 are the coefficients on the linear and quadratic term respectively. Specifically, we use Fieller's (1940, 1954) method to build confidence intervals for their estimated values[26] and, in addition, to checking for any interpretability, use them as a warning signal for the values of β_2 being in fact null.

Problems with traditional confidence intervals built using the Delta method arise when the ratio defining tipping points is weakly identified. Since this occurs when the *true* β_2 is near zero, a significant estimate of this parameter does not necessarily guarantee identification (Bernard *et al.*, 2011). Should this be the case, Delta confidence intervals will not be level-correct, i.e. will not contain the true level of the parameter with probability $1 - \alpha$, while at the same time appearing quite narrow.

Fieller's confidence intervals are instead robust to such weak identification and, using the authors' wording, "if β_2 is truly zero then the Fieller confidence interval set will be unbounded and will alert the researcher to this fact".

Thus, finding bounded and reasonably narrow *Fieller* confidence intervals for our tipping points will constitute evidence against the possibility of the quadratic parameter being in reality equal to zero, and in favor of the interpretability of tipping values.

Table 4 reports the estimated tipping points for age and public environmental protection expenditure for all estimated equations, as well as confidence intervals built using both the

[26]See Bernard *et al.* (2011) for computational and theoretical details.

Table 4: Tipping points and confidence intervals (years and Pounds/head).

Variable	Tipping point	Fieller CI $\alpha = 0.05$	Delta method CI $\alpha = 0.05$
		Awareness	
Pub. Env. Prot. Exp.	157.77	[136.815;166.223]	[147.79;167.75]
Age	49	[41.06;57.89]	[42.27;56.19]
		Attitude	
Pub. Env. Prot. Exp.	160.19	[146.782;166.06]	[152.368;168.02]
Age	75	[62.32;137.39]	[54.81;95.71]
		Involvement	
Pub. Env. Prot. Exp.	[165.55]	$]-\infty;\ 76.87] \cup [375.12;\ \infty[$	[146.53; 184.57]
Age	52	[44.89; 60.74]	[44.92; 58.52]
		Energy and Mobility	
Pub. Env. Prot. Exp.	160.23	[147.47; 165.9]	[152.56; 167.91]
Age	54	[42.14; 76.72]	[50.63; 57.92]
		Food and Water	
Pub. Env. Prot. Exp.	154.72	[137.71; 160.99]	[145.4; 164.03]
Age	[97]	$]-\infty;$ -1.89] $\cup$ [1.86; $\infty[$	[34.78; 159.25]
		Waste and Recycle	
Pub. Env. Prot. Exp.	162.61	[148.29; 169.02]	[154.44; 170.79]
Age	59	[38.31; 73.21]	[48.1; 70.35]

Delta and Fieller's method. As we can see, all Fieller confidence intervals are bounded and fairly narrow, except for those cases in which we find a linear relationship or no relationship at all (respectively: age on Food and Water and public environmental protection expenditure on Involvement). Although Fieller confidence intervals are wider than standard Delta ones, they will nevertheless contain the true value with the correct 95% probability. Moreover, the fact that the widths of the Fieller and Delta confidence intervals are quite close and by and large overlpping, provides evidence of strong identification of the estimated model. Where unbounded ones occur, their justification follows straightforwardly from the above discussion and from a comparison of Tables 3 and 4.

5 A measure of individual inter-dimensional responsibility

In this Section we investigate whether (any of) the covariates used to explain the intra-dimensional variability of individual scores also affect the probability of being simultaneously "responsible" on a plurality of dimensions. This analysis rests on the consideration that an individual exhibiting a green behavior on one dimension will likely also be pro-environment on one or more additional dimensions too. This will be especially true if environmental responsibility can be viewed as the product of the interaction of circumstances and underlying personal characteristics.

In addition to constituting a robustness check for the overall results above obtained (as in Coromaldi and Zoli, 2011), the following analysis also allows us to derive additional insights on the overall level of individual responsibility. If it is true, in fact, that a higher score on, say, Energy and Mobility, tells us that individual "one" is more responsible (in energy consumption and transportation behaviors) than individual "two" with a lower score on the same dimension, it tells us nothing of the overall responsibility of the two individuals when we consider all the dimensions simultaneously. It could well be possible for Energy and Mobility to be the only dimension on which "one" proves responsible, while on the opposite "two" could be responsible on all dimensions *except* on Energy and Mobility. Then, it could be sounder to compare them using a measure of overall responsibility, which we call "inter-dimensional" responsibility. To this end, we build a new categorical variable taking values according to the number of environmental dimensions on which the respondent behaves responsibly. In other words, it takes value "0" for an individual with low scores on all the environmental areas, "1" for an individual responsible on one dimension only, "2" for one that is responsible on two, and so on and so forth up to "6".

The problem is at this point to find a threshold value allowing us to discern environmentally responsible individuals from irresponsible ones on each dimension on the basis of their scores. Given the nature of the problem, a univocal and informed decision is hard to make. The most immediately evident candidate is the mean of each score distribution, which equals to zero by construction, and which identifies those respondents who overall behave neutrally on the

Table 5: Ordered Probit model

Male	-0.11167**
Age	0.04586***
Age sq	-0.00038***
Engaged	0.18454**
Divorced	0.31123**
Widowed	0.10410
Town	-0.03055
Village	0.29839***
One child	-0.09217
Two children	-0.16906*
Three children +	-0.05993
Education 1	0.68211***
Education 2	0.32279***
Education 3	0.47996***
Education 4	0.56141***
Tabloid	-0.12465**
Social Grade	0.06492***
Mortgage	-0.18019**
Rent	-0.40834***
Economic satisfaction	0.05701
Lifestyle satisfaction	0.03355**
Optimist	0.15073*
Pessimist	0.08840
Social reinforcement	-0.37599***
Institutional reinforcement	0.26192***
Business reinforcement	0.25309***
P.Env.Expenditure	0.05394***
P.Env.Expenditure sq	-0.00017***
Particulate matter	-0.58402**
Particulate matter sq	0.03668*
Reg.Population	-0.11742**

considered dimension[27]. Such a choice identifies individuals with a positive score as environmentally responsible, and we assign them the value "1" in a dimension-specific responsibility binary variable. The categorical variable (indicating our inter-dimensional responsibility) is then obtained by summing up on these dummies for each individual.

Table 5 shows the results[28] obtained from the estimation of an Ordered Probit model where such a categorical variable is used as dependent variable[29].

As it can be seen, results are all very similar to those obtained from the SUR analysis, or, in other terms, the coefficients have all the same sign as in Table 3. Hence we can conclude that the same variables which affect environmental behaviors in each dimension considered individually, also affect the individuals' inter-dimensional responsibility level. Quite interestingly, we can

[27]Other potential candidates are the first and third quartiles, as well as the median of the score distributions. It can be shown that results are confirmed by the use of such thresholds too.

[28]The results therein displayed have been estimated with cluster-robust standard errors.

[29]The same analysis based on the quantiles of the *logistic* distribution yields very similar results.

notice that men have a lower probability to score "6" on the inter-dimensional responsibility indicator, coherently with most of the previous literature. Finally, it is worth to underline the fact that needing institutional reinforcement and business sector reinforcement unequivocally shifts probability mass onto the higher extreme of the inter-dimensional indicator, while needing social reinforcement, on the opposite, increases the probability that the individual will score zero on all the single responsibility indicators[30].

6 Conclusions

Ever since environmental issues have entered the worldwide political and scientific agenda, a growing literature started exploring the human-environment relationship. Several studies, in particular, focus on people's behaviors, attitudes and concerns toward the environment, and their economic determinants. Among these, the vast majority thoroughly investigates the contribution of individual characteristics in shaping environmental preferences, mainly concentrating on individual determinants such as age, gender, education and the income level. For some of these determinants it is not possible to find a set of commonly accepted conclusions about their effect on individual pro-environment behavior, as different studies yield different and at times contrasting outcomes: namely gender and age. This because of the intrinsic difficulties inherent to the formulation of a method for the analysis of behaviors and attitudes, which are by definition volatile, difficult to observe in a scientifically proper setting, and subject to all kinds of bias both on the observed and the observer's side. It is even truer, though, when the object of the analysis is the extent to which those behaviors and attitudes are shaped by other, only marginally explored and equally elusive factors, such as social capital, individual worldview, political and social preferences among others.

Moreover, individual environmental preferences and/or behaviors have been usually represented by unidimensional variables, which as such convey limited information on only part of a higher dimensional problem.

The investigation here presented, relying on synthetic indicators of individual environmental

[30] As in the SUR analysis, the respondent's ethnicity was non significant and ininfluential, and has been omitted from the analysis.

performance which summarize a multiplicity of variables, provides a richer picture of individual environmental behaviors and attitudes. One of the achievements from the adoption of a multi-dimensional approach is that of making the contradictory results found in literature much less paradoxical. What emerges is that behaviors on different dimensions are differently affected by individual characteristics, thus emphasizing the complexity of the processes behind the formation of environmental preferences and behaviors. Especially, we provide evidence of the fact that individual characteristics interact with behaviors on different dimensions through effects of different magnitude and, more importantly, different sign. As illustrated above, for example, the long lived dispute on whether it is women or men that are more concerned with the protection of the environment appears from this analysis as misdirected,confirming the hypothesis that women and men adopt different behaviors in different dimensions.

An important result is that emerging from the inclusion of regional public expenditure for the protection of the environment; this result clearly shows us, in fact, that *institutional* environmental behaviors must without a doubt be considered as determinants of single individuals' environmental responsibility.

Moreover, we included variables indicating the particular societal segment on which the respondent relies to direct his/her environmental behavior. It emerged that while those "who would be more responsible should the Business sector and the Institutions be "greener" too" exhibit a more solid and defined structure of environmental values, and are more inclined to behave responsibly than people referring to "the Society", which instead appear as characterized by a weaker environmental commitment and rely on general social values, norms and practices to define their behaviors.

We saw, moreover, that while it is true that the respondent's "financial satisfaction" is relevant in predicting higher scores on Awareness and Attitude, it is Lifestyle Satisfaction that counts for higher scores on those which we consider "Actual Behaviors".

Finally, we also went beyond what we called *intra*-dimensional responsibility and investigated the respondent's *inter*-dimensional responsibility, finding that, overall, the same variables playing an active role in determining the intra-dimensional variability of behaviors, are also determining inter-dimensional responsibility.

In conclusion, the analysis here presented can have relevant implications from a policy

perspective. In a world in which the provision of economic incentives to people in order to raise the environmental sustainability standards of their day-to-day behaviors and attitudes will sooner or later become a priority of policy designers worldwide, knowing what effect different socio-economic characteristics have on the various human-environment dimensions is crucial to build *targeted* policies.

A multidimensional approach provides the bases on which to assess whether policies targeted on one specific group (as identified by a common characteristic) and on one particular environmental dimension will also affect its behavior on other dimensions. Especially, knowing whether this "collateral" effect will be positive or negative constitutes a major advantage in order to maximize the intended outcome of policies, while contextually limiting any other unwanted and perverse effects. Moreover, given that an important aspect emerging from the analysis is that public environmental expenditure does indeed constitute a determinant for an increased environmental responsibility, also public environmental expenditure levels should be accounted for in the policy-design processes.

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