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Greening lifestyles with good intentions: Cross-country evidence on the association between attitudes and environmentally significant actions

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Abstract

The environmental impact of contemporary lifestyles has come under increasing scrutiny. Recent evidence shows a considerable potential for individuals to intervene, their widespread willingness to do so but also sizeable barriers they face to reduce their environmental footprint. In this study we investigate whether pro-environmental attitudes can serve as potent drivers of individual actions with consequential environmental impact. Using a multi-level latent variable framework, we model the association between attitudes and a diverse range of environmentally significant actions and scale up the analysis to a cross-country setting using the 2017 wave of the Eurobarometer data. We find a moderate, positive association which holds beyond standard sociodemographic and country-level controls and exhibits a cumulative effect – higher attitudinal levels align with higher numbers of undertaken actions, including difficult, costly and high-impact ones. The observed levels of pro-environmental attitudes and actions are contingent on a country's economic affluence and individual socioeconomic status. This, we argue, is evidence of the limits of mitigation strategies which focus exclusively on attitudes-driven behavioral change without consideration for the influence of sociodemographic and country-level inequalities.

Introduction

As environmental risk assessments grow in alarm, a popular expectation is that individuals, acting on their concern for the environment and their own well-being, can initiate a large scale reduction of environmental footprint by adopting "greener" lifestyles. It would be an alternative to the flailing effort of state and international actors to push through a strong environmental agenda. But the realism of a large scale reduction in global footprint as the cumulative result of individuals taking actions to reduce their own footprint is an open question (Shove, 2010).

The focus of most social science research is on recording and explaining the high levels of individual concern for environmental issues (Brechin and Bhandari, 2011; McCright *et al.*, 2016). Research on whether individuals translate their concern into environmentally significant actions, while affirmative in its results, remains scant (e.g.: Pirani and Secondi, 2011; Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020) and evolves against considerable evidence on the strong infrastructural, informational, economic, social and psychological barriers to action (Steg and Vlek, 2009; Swim, Clayton and Howard, 2011) and on the questionable contribution of pro-environmental attitudes (Bamberg, 2003).

In the present study, we propose to test empirically the likelihood of individuals to translate their pro-environmental attitudes into environmentally significant actions. We investigate the presence of an association between attitudes and actions in the 2017 Eurobarometer survey on the 28 European Union (EU) member states. Given the EU population is the world's third largest source of carbon emissions (Janssens-Maenhout *et al.*, 2017), the empirical analysis provides a measure of scale of the potential environmental impact. A central question in the literature is whether any observable attitudes-actions association holds beyond individual and country-level differences. Our analysis shows that it does and goes further to address the much-debated influence of socioeconomic status and economic affluence on environmentalism (Franzen and Meyer, 2010; Fairbrother, 2013), evidence for whose positive effects we find on both pro-environmental attitudes and environmentally significant actions.

Explaining the Attitudes-Actions Association

Three prerequisites condition the occurrence of a large scale individual action-driven reduction in global environmental footprint: i) the presence of substantial potential for intervention open to individuals; ii) the willingness of a large enough number of them to act on this potential; and iii) a high likelihood for them to translate that willingness into actions susceptible to curb their individual footprint. Although the last one is the focus of our study, its analysis depends in part on research on the other two. Work on the potential of intervention is instructive on the type and number of actions worthy of analysis. On the second point, the literature on environmental concern is source of theoretical developments we show are relevant to the analysis of individual actions and their link to attitudes. We take on each point in order and then elaborate on our working hypotheses.

On potential for intervention

Individuals can intervene on behalf of the environment through the purchase, use, and disposal of personal and household products and services (Stern, 2000, pp. 409–410). These private-sphere behaviors are, in turn, at the center of substantial policy campaigns,

government investment and commercial development under the assumption there exists a formidable potential for action to curb greenhouse gas emissions (Shove, 2010).

It has been estimated 72 % of worldwide greenhouse gas emissions can be linked to the impact of household consumption (Hertwich and Peters, 2009). This hints at an immense potential for intervention (Weber and Matthews, 2008; Jones and Kammen, 2011). A large portion of it, close to a half in late-industrial countries[1], is due to indirect emissions, for which the contribution of individuals is difficult to pin down to a particular estimate or action. Estimates of the potential for intervention in direct emissions, over which individuals have more latitude, are more reliable.

In one of the more comprehensive studies, using American data on a series of thirty-three energy saving actions, Dietz and colleagues (2009) estimate their adoption can yield, over a ten year period, a 20 % decline in emissions of U.S. households. The authors conjecture similar reductions in countries with comparable carbon profiles like Canada and Australia and half the level of savings for European Union countries and Japan due to a less energy intensive household sector (Dietz *et al.*, 2009, p. 18455). The estimates represent a lower bound measure of environmental potential because, once again, they do not account for actions to reduce indirect emissions (e.g., food consumption) and actions not related to energy consumption (e.g., recycling, use of disposables, water consumption).

The main conclusion of this and similar studies (Gardner and Stern, 2008; Laitner and Ehrhardt-Martinez, 2010; Jones and Kammen, 2011) is the presence of an important theoretical margin for intervention available to individuals. There are two important caveats however. First: this margin of intervention spreads across a host of actions whose singular environmental contribution is comparatively small. Second: its realization depends on behavioral changes in individuals whose contribution on their own is infinitesimal. Both caveats condition the realization of the theoretical margin for intervention, first, on the scale of human involvement being global and, second, on the number and spread of actions being wide (Weber and Matthews, 2008). This, in turn, sets the conditions for a proper test of the likelihood of an individual-driven reduction in global environmental footprint: to perform the analysis in a cross-country setting and across a wide set of actions.

On willingness to take action

It is one thing for scientists to provide estimates of the potential for action on behalf of individuals, yet another for individuals to perceive the need to take action. In this respect, of the various available metrics, environmental concern is a commonly cited omnibus measure. It captures, at once, individuals' awareness of the negative impact of human activity on natural environment and their declared willingness to protect nature (Dunlap and Jones, 2002; Franzen and Meyer, 2010). Decades worth of research have established its rising trend worldwide (Dunlap and York, 2008; Brechin and Bhandari, 2011; McCright *et al.*, 2016), which appears to have plateaued recently at relatively high levels (Franzen and Meyer, 2010). An estimate, using 2010 ISSP nationally representative data, sets the mean level of environmental concern across 33 countries at 48 percent with modest between-country variation (Franzen and Vogl, 2013, p. 1003). Other cross-country metrics yield estimates of

[1] For example, indirect emissions accounted for 40% of total household emissions in France (Lenglart, Lesieur and Pasquier, 2010) and for 50% of emissions in the United States (Weber and Matthews, 2008) and the Netherlands (Kok, Benders and Moll, 2006).

similar magnitude (Brechin and Bhandari, 2011; Marquart-Pyatt, 2012; McCright *et al.*, 2015).

The observed high levels of environmental concern are not uniformly distributed across countries. A glance at competing explanations provides a sense of the potential drivers of environmental concern. One line of empirical research shows that environmental concern is positively associated with a country's economic prosperity. Economic prosperity is understood as providing the necessary (institutional, legal, infrastructural, commercial, etc.) means for countries and citizens to take environmentally friendly actions (Franzen and Meyer, 2010; Pampel, 2014) but also as a trigger, via increasing living standards, of post-materialist values in favor of environmental protection (Inglehart, 1995). Other lines of research highlight evidence on substantial environmental awareness across less affluent countries. Explanation for these findings include references to the role that the international system of environmental organizations, actors and treaties plays in developing countries (Frank, Hironaka and Schofer, 2000; Longhofer and Schofer, 2010), to the influence on concern of harsh, objective environmental conditions like pollution (Inglehart, 1995; Brechin, 1999), and to measurement bias which fails to capture underlying global dimensions of environmental concern (Dunlap and York, 2008; Marquart-Pyatt, 2012; Fairbrother, 2013). The bottom line is that the level of environmental awareness is even higher and extends beyond the citizens of affluent countries.

At the individual level, because it originates from subjective declarative statements, the record of high levels of environmental concern raises the question on whether it measures genuine concern and, in particular, a genuine willingness to take action. A common tendency in policy circles and in mainstream environmental research (Shove, 2010) is to treat environmental concern at face value – as an accurate proxy of the likelihood of individuals to act upon their attitudes and hence to infer this likelihood being high. An alternative reading sees in the observed high levels of environmental concern the result of status competition without clear correlate to actual behavior. Accordingly, individuals of certain social strata appropriate environmental norms for their associated positive symbolic value and assert their normative adherence to distinguish themselves from individuals of other social strata (Schor, 1998), regardless of their actual environmental footprint. The observed higher propensity of young, urban, well-educated and financially better-off citizens of prosperous economies to declare themselves concerned about the environment (Xiao and Dunlap, 2007; Pampel, 2014) serves as a case in point given the comparatively higher carbon footprint of that social stratum (Kennedy, Krahn and Krogman, 2014; Moser and Kleinhückelkotten, 2018). It is why it is worth checking on the association between attitudes and actions as we do in the following section and in the subsequent empirical analysis.

On attitudes-actions association

Evidence on the potential for intervention on behalf of individuals and on their observed high levels of concern serve as stepping stones for contemporary public policy campaigns, government investment and commercial development. These work under the premise that more and better knowledge coupled with diversification of consumer environmentally-friendly choices foster more enlightened individual behavior (Kollmuss and Agyeman, 2002; Shove, 2010).

The idea of a direct attitudes-actions link resonates with research from the early 1970s which conceptualized a causal and unmediated relation running from pro-environmental attitudes to individual actions (Kollmuss and Agyeman, 2002). The resulting

information deficit model has since come against consistent empirical findings. They show the attitudes-actions link to be tenuous (Bamberg, 2003)[2], sensitive to the choice and definition of measures (Stern, 2011, pp. 306–7) and to sampling heterogeneity (Steg and Vlek, 2009, p. 310).

Moreover, the attitudes-actions link is subject to multiple intervening factors. Empirical evidence from environmental social psychology (Steg and Vlek, 2009; Li *et al.*, 2019) points at the influence of cost-benefit decisions (Ajzen, 1991), moral or normative concerns (Schwartz, 1977; Stern, 2000) and affect (Steg, 2005). Empirical research in sociology privileges a cross-country perspective with focus on sociodemographic determinants. Pisano and Hidalgo (2014) classify handily that literature as a debate around the social bases of environmentalism (Greenbaum, 1995). One side of the debate crystallizes around the idea of there being a *hard social base* which refers to the relative alignment of environmentalism with a particular social group. That social group is circumscribed by observed consistent effects on attitudes and associated actions of higher socioeconomic status and of being female, an urban resident and of younger age (Xiao and Dunlap, 2007; López-Mosquera, Lera-López and Sánchez, 2015).

The other side of the debate sees this set of effects as either more complex and disparate than initially assumed (Dietz, Stern and Guagnano, 1998; Diamantopoulos *et al.*, 2003; Hadler and Haller, 2011) or as seeding explanatory power as information and experience of environmental problems disseminate widely within and across countries (Marquart-Pyatt, 2012): environmentalism has, in other words, a *diffuse social base* (Buttel and Flinn, 1974). In-between these two sides lies also evidence for a *soft social base*: the influence of sociodemographic determinants is present but varies by type of actions and is contingent on a country's affluence (Pirani and Secondi, 2011; Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020). The end-result is not a rejection as much as a more nuanced understanding of the mediating and moderating factors of the implied causal link running from attitudes to actions.

The debate on the attitudes-actions link and on the social base of environmentalism remains unsettled however. The reason is threefold. First, the empirical findings of social psychology research, which models the causal relation between attitudes and actions most rigorously, are subject to limitations inherent in experimental settings in replicability and generalizability on societal and global scale. Second, studies which scale up the analysis with cross-country survey data on attitudes and actions (for example: Hadler and Haller, 2011, 2013; Pirani and Secondi, 2011; Hadler, 2013; Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020) model the causal link without discounting the possibility of reverse causality. It is indeed plausible that when prompted to justify their actions survey respondents advance environmental and downplay competing (e.g., economic, health) motivations for status gains (Kennedy and Horne, 2019). If true, this would undermine the emphasis on attitudes as a target for intervention. Finally, most research using cross-country data relies on empirical evidence from measures of intentions to act from which inferences are made for actual behavior. Although there are reasons to believe measures of intention to act (e.g. declared willingness to pay) constitute a reliable proxy (Bamberg and Möser, 2007, p. 21), a direct measure of change in environmentally significant actions is the preferable

[2] Although Diamantopoulos and alia (2003) and more recently Morren and Grinstein (2016) offer a more nuanced perspective on this conclusion.

strategy to estimate the probability of an individual action-driven reduction in global environmental footprint.

Research Hypotheses

Taking stock of the unsettled practical, theoretical and empirical issues in contemporary research on the likelihood of individuals to take actions to curb their environmental footprint, we proceed to define a set of hypotheses to guide our subsequent methodological strategy and empirical analysis.

A starting hypothesis is to posit that *the association between pro-environmental attitudes and actions is a positive one* (H1). This first hypothesis reflects a longstanding argument in policy work and environmental research with support from afore-cited cross-country evidence that attitudes and actions go hand-in-hand. Second, we wish to observe whether this association, if present, concentrates to a few or instead concerns a range of actions. The carbon footprint of individuals is a sum of a diverse set of actions, some easier to commit to (e.g., more recycling) than others (ex., lower car use). Our review of research in environmental science pointed to the importance of a wide-ranging commitment for individuals if they are to maximize their environmental impact. In line with past findings (for example: Pirani and Secondi, 2011; Aral and Lopez-Sintas, 2020), *we expect to observe a positive association between the level of pro-environmental attitudes and the number of actions taken* (H2). This second hypothesis reflects the expectation about the association's strength.

It is worthwhile to make the case for the corresponding null hypotheses of a non-positive association with a narrow spread across action types. There are reasons to expect the relation between attitudes and actions to be more complex than we predict. Individuals have competing motivations (e.g., ethics, savings, health concerns, social status, habit and routine) to adopt an environmentally significant action that may play a stronger role in individual decisions than concerns over environmental footprint. It is therefore not unreasonable to expect that competing motivations weaken the association between attitudes and actions, potentially limiting the range of commitments if not entirely neutralizing or reversing the direction of the association.

Third, to test the potential of high environmental concern among individuals to serve as a driver for lowering carbon emissions, we wish to verify that the association is not spurious, explained away by well-known sociodemographic and country-level determinants of individual behavior. As per our literature review, environmentally significant actions, especially those with high impact, face important barriers at both individual and societal levels. This notwithstanding, comparative empirical research points out that affluent countries can afford to invest more resources to improve environmental quality (Franzen and Vogl, 2013) and that their citizens face lower barriers to action and lower trade-offs between maintaining high living standards, on one side, and on the other, paying for environmental quality (Franzen and Meyer, 2010; Pampel, 2014) or acting upon their post-materialist values (Inglehart, 1995). In this vein and following recent corroborating evidence with cross-country data (Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020), *we expect the attitudes-actions association to withstand the influence of individual- and country-level determinants* (H3).

Finally, we are interested to investigate the nature of the effect of individual- and country-level determinants. As Pisano and Hidalgo write (2014, p. 396), there is long-standing perception in the literature of environmentalism as driven by a "hard social base"

characterized, among others, by a consistent positive, direct (Franzen and Meyer, 2010; Pampel, 2014) or indirect (Inglehart, 1995), effect of socioeconomic status. But against this perspective stands a sizable list of national and comparative studies that show a complex influence of sociodemographic characteristics on environmental attitudes: positive in some cases, negative in others or absent altogether (Diamantopoulos *et al.*, 2003). While we take note of recent cross-country evidence on the tendency of sociodemographic determinants to be both context- and action-specific (Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020), we believe that by virtue of its relative political, socioeconomic and infrastructural homogeneity, the European Union region, on which our empirical analysis is based, presents a strong if somewhat unique test case for *the prediction that individuals with higher socioeconomic status are more likely to declare pro-environmental attitudes as well as to declare acting on them* (H4). The associated null hypothesis posits that socioeconomic status is decorrelated from attitudes and actions – there is a "diffuse social base". These contrasting predictions extend also to the effect of economic affluence: whether *the more affluent the country the higher the likelihood that individuals declare higher levels of pro-environmental attitudes and a higher number of actions taken* (H5). On the issue, the theoretical stands diverge as much as the findings. On one side, there is corroborating evidence on the link between a society's affluence and the engagement of its citizens in environmentally significant actions as recorded in a study of a large and diverse sample of 30, mostly OECD countries (Pisano and Lubell, 2017, p. 17), and on the other side, some evidence to the contrary in a sample of EU countries (Pirani and Secondi, 2011, p. 82)[3].

Methods

We rely on a latent variable modeling framework (Vermunt, 2003; Vermunt and Magidson, 2005) and version 5.1 of Latent GOLD® software to test our research hypotheses. This choice results from our interest to analyze the association between two phenomena – attitudes and actions – each of which we measure with a set of inter-correlated indicators. We use two separate latent variables to capture these correlations while simultaneously testing for an association between them and for the effects of individual- and country-level determinants, to which we refer as covariates. The advantage of this method is: first, to make no a priori assumption over the direction of causality (in contrast to the habitual approach in past work to treat behavioral measures or derived indices as dependent variables): and second, to incorporate covariates within the estimation and thence to preserve the probabilistic structure of the latent model, lowering information loss (in contrast to extracting posterior membership probabilities as dependent variable in a classic regression modeling framework).

Formally, the model is expressed as follows:

[3] Although a study with a more recent version of the Eurobarometer data on EU-member states from 2017 (Aral and Lopez-Sintas, 2020) identifies two clusters of countries which align according to economic affluence and are positively associated with pro-environmental attitudes and actions. Note however that the study does not include direct country-level controls, which we do in the empirical analysis here.

$$P\left(Y_j|v_i^{cov},w_j^{cov}\right) = \sum_{t=1}^{T}\left[P\left(Z_j = t|\, w_j^{cov}\right)\prod_{t=1}^{N_j}\left[\sum_{s=1}^{S} \begin{matrix} P\left(X_{ij} = s|\, v_i^{cov}, Z_j = t\right) \times \\ \prod_{k=1}^{K} P\left(Y_{ijk}|X_{ij} = s\right) \end{matrix}\right]\right]$$

where i refers to the sample of individual respondents and j refers to the countries from which they originate. We denote responses to questions to our indicator variables by k = 1,..., K, where Y_{ijk} = 1, if a respondent i from country j declares a certain level of agreement with an attitude or having performed a given action k, and Y_{ijk} = 0 otherwise. Vector Y_{ij} collects responses for an individual i and Y_j denotes the observed responses for the sample of respondents from country j. The model assumes that a limited number of segments, denoted s = 1,..., S, describe the patterns of responses of the full, cross-country sample. The model also assumes that the countries in the sample belong to a limited number of country segments, denoted by t = 1,..., T. For this multilevel aspect of the model we use a discrete latent variable X_{ij} to represent membership in the individual-level segments and another, higher-level discrete latent variable Z_j to represent membership in the country segments. On each latent variable we also include covariate effects: for respondents' sociodemographic characteristics, denoted by v^{cov}, on X_{ij} and for contextual, country-level characteristics, denoted by w^{cov}, on Z_j.

For more clarity, suffice it to distinguish between three components in the right-hand side of the equation, moving from left to right (Bijmolt, Paas and Vermunt, 2004, pp. 326–327): 1) the probability that country j, after controls for contextual differences, belongs to a particular country segment, 2) the probability that individual i, after controls for sociodemographic differences, belongs to a particular segment of response patterns, given the country segment membership, and 3) the probability of a particular response on indicator k, given the segment membership. The probabilities that we observe in our data on patterns of attitudes and actions correspond to a weighted average probability, where the weights are the country segment and individual segment probabilities.

Inspired from a study with comparable objectives and data structure (Bijmolt, Paas and Vermunt, 2004), this model specification contains a slight adaptation to our research hypotheses. We use a multilevel discrete latent factor model (Vermunt and Magidson, 2005, pp. 28–33). Like in the standard latent class framework the objective is to represent the associations between indicators by way of membership in the segments of an unobserved latent variable. The particularity of the discrete latent factor model is that we can load the measures of attitudes and actions on two separate latent variables, also known as factors, allowing for an association between them and, crucial to the test of our hypotheses H1 and H2, to measure the presence and eventual strength of the association. For the remaining hypotheses, the inclusion of covariate, sociodemographic and higher-level country-specific effects allows us to test the resilience of the association (H3) and to observe their specific contribution on each of the two latent factors (H4 and H5).

Data and Measures

For the empirical analysis we use the Eurobarometer 88.1 survey, which was administered by TNS Opinion between September and October of 2017 (European Commision and European Parliament, 2017). The survey includes the Special Eurobarometer 468 on the environment, "Attitudes of European citizens towards the environment", along a

nationally representative individual-level data for the 28 European Union (EU) member states with a total unweighted sample of 27,881 cases.

[Table 1]

Several reasons motivate this choice of survey data. First, the Eurobarometer survey offers perspective on a population of more than 500 million and a region, which is the third largest source of carbon emissions (Janssens-Maenhout *et al.*, 2017). Second, a focus on EU member states presents the advantage of relative cross-country consistency in environmental quality, available infrastructure, and legal and policy regulations. The backdrop of our choice is that the population sample is also more homogeneous on the observed country-level variables, yielding potentially lower estimates.

A third reason is the presence in the environmental module of a comparatively large number of measures of environmentally significant actions. The twelve measures retained for the analysis cover a comprehensive set of actions. These vary widely in their associated environmental impact (e.g., recycling versus purchase of a low-emission vehicle), reflect decisions with different temporal frames (e.g., routine, immediate use/consumption, investment) and with different associated costs and benefits (economic, physical, normative, symbolic, logistic, etc.).

This variety is important for the reliability of our empirical analysis. First, actions with high environmental impact are not widely accessible options due to high financial and temporal constraints, among others. Individuals are hence most likely to maximize their environmental impact if they take a mix of actions. Second, a variety of competing motivations lead people to engage in environmentally significant activity: impact is one; energy savings, health concerns, social status or simply habit are frequent alternatives (Shove and Warde, 2002; Warde, 2005). Moreover, often individuals take actions with the conscious intention to protect the environment even though the associated impact may be low (Stern, 2000). Lastly, worth noting is that most of the twelve measures capture behavioral change: respondents declare changes in their activities in the months or years preceding the interview. This fits well with our objective – not to explain the activity of individuals but to investigate factors that lead them to change it. There is evidence that the explanatory power of attitudes, while weak in regard to regular behavior, is greater in cases of behavioral change (Abrahamse and Steg, 2009). In sum, the Eurobarometer battery of actions captures a realistic dose of internal complexity to render it particularly adequate to explore the association between pro-environmental attitudes and actions and to infer from the findings its potential contribution to environmental change.

[Table 2]

Fourth, the environmental module contains a set of attitudinal measures. Although modest in number and range, there are three variables that reflect each an important element of environmental sensibility: i) a measure of general importance of environmental protection, ii) a measure of individual capacity to intervene, and, not least, iii) an assessment of personal experience of environmental consequences. Importantly, the Eurobarometer survey includes alternative attitudinal measures which we describe and exploit in the Supplementary Material to run robustness checks to discount the possibility for desirability bias – a potential problem with the module, which starts with questions on attitudes followed by questions on related behavior.

[Table 3]

Finally, the survey offers a standard set of sociodemographic measures. Occupation category and age at end of full-time education serve as proxies for socioeconomic status, our main individual-level explanatory variable of interest. There is no measure of financial resources; only a weakly associated control variable for "difficulties paying bills", which likely implies that the aforementioned two proxies pick up some effect of financial resources. We include several measures to control for characteristics on the level of individual respondents: their sex, age, employment status, household's size and residential area type.

To account for country-level effects we use external sources[4] to construct several measures. We use estimates of gross domestic product to measure economic affluence – our main variable of interest. We add several control variables. To tease out the hypothesized positive effect of economic affluence on pro-environmental actions, we use Gini estimates to control for distributional differences across countries. A measure for population density stands as a proxy for demographic pressures on the environment in a given country. Estimates of the Environmental Performance Index provide an overall control for country-level differences in meeting environmental challenges. A measure of the number of European Green Party MPs elected to the 2014 EU parliament acts as a proxy for the salience of environmental issues across EU member states.

Results

To reiterate, the objective of this paper is to test the presence, content and strength of the association between pro-environmental attitudes and actions with cross-country data and following controls for standard sociodemographic and contextual determinants.

A quick glance at the univariate statistics in table 2 corroborates general observations in the literature. All three attitudinal measures reflect a high degree of sensibility to environmental issues among European Union respondents. There is more variability in declarations on undertaken actions. On one end is recycling, which is at once the most cited commitment (66%) and, given the infrastructural development and environmental legislation of EU member states, probably among the least difficult and least costly environmentally significant actions. On the other end are actions whose undertaking is arguably more demanding: purchase of low-emission vehicles (8%), improving heating systems (13%), reduced car use (18%) and purchase of environmentally friendly products (19%). Except for the percentage of reports on improvements in energy equipment (31%), the observed hierarchy in the level of commitment follows a continuum of decreasing difficulty, cost and environmental impact.

[Table 4]

In table 4 we report the distribution of our attitudinal variables and a measure of the number of reported actions for different levels of education and GDP per capita. The results corroborate another established finding in the literature: the fact that socioeconomic status and economic affluence are positively associated with pro-environmental sensibility and the

[4] For GDP, Population density and Environmental Performance Index: (Yale Center for Environmental Law and Policy - Yale University *et al.*, 2018). For Gini: (World Bank, 2018). For EU Green Vote: "European Green Party," in Wikipedia: The Free Encyclopedia, (Wikimedia Foundation Inc) [encyclopedia on-line]; available from https://en.wikipedia.org/wiki/European_Green_Party#Since_2004; Internet; retrieved 5 June 2018.

number of declared environmentally significant actions (Franzen and Meyer, 2010; Pampel, 2014). The only exception is the negative association between GDP per capita and the perception of a direct effect of environmental issues on personal daily life and health. This may reflect the idea that objective environmental consequences are more hard felt in less affluent countries (Inglehart, 1995; Brechin, 1999). The inverse, positive association for that variable and education levels likely captures the fact that, on individual level, this perception depends on better understanding of the link between environmental issues and their impact on daily life and health (Hamilton and Morris, 2002; Gelissen, 2007). Finally, the correlation estimates in table 4 show that the association with the two variables (age at end of studies and GDP per capita) is quite weak for each of the attitudinal measures but stronger for the number of declared actions. This likely reflects that however widespread the concern about the environment is, socioeconomic factors determine how likely individuals are to translate their concern into concrete actions. Indeed, there are small differences in the distribution of the proportions for the top category of each attitudinal measure across the two socioeconomic variables. Yet, the difference in the mean of declared actions across the categories of both variables is much more pronounced.

[Table 5]

Table 5 presents a preliminary test which corroborates our expectations in hypotheses 1 and 2 about the association between attitudes and actions. There is a positive, if moderate, association between the number of declared actions and each pro-environmental attitude. Based on a simple index of the number of positive responses on the three pro-environmental attitudes, there also appears to be a cumulative effect in the observed association: the stronger the agreement of respondents across all three statements, the higher the number of actions they declare to have taken.

We move to a formal test of the attitudes-actions association with a model with two discrete latent factors: one, on which we load data from the three attitudinal variables, and another one, on which we load data from the measures of the dozen actions. Each factor can include two or more hierarchically ordered segments. A first step is to decide on the number of segments. Following exploratory analysis (see Supplementary Material), we settle for a model with three segments in each factor that represent clear distinctions between low, middle and high levels of, respectively, environmental sensibility and undertaken actions.

[Table 6]

We begin by estimating the model, model 1, without any controls but include a parameter for association between the two factors. The corresponding correlation coefficient is statistically significant and positive (see Table 6). The result validates our first hypothesis of a positive association between attitudes and actions. Moreover, the association is relatively strong with a correlation coefficient of 0.48. However, the robustness of this association needs to be tested against the possibility of confounding factors. There is much unaccounted heterogeneity at the level of individual respondents but also, given the cross-country sample, at the level of the 28 European countries. We re-estimate the model adding consecutively controls for individual-level characteristics (model 2) and for country-level differences (model 3). For the latter, in addition to country-level controls, we introduce country-level latent groups to account for any unobserved heterogeneity. Our model identifies two latent groups[5]. Northwestern countries fall in one group ("N-W EU") and eastern and southern

[5] Models with more than two latent groups did not converge to a solution.

European countries in the other group ("S-E EU"). The UK and Ireland are the only major exceptions: their conditional probabilities are equally split between the two groups (see Table 7).

[Table 7]

The comparison of models 2 and 3 with the initial model 1 shows an improvement in the goodness of fit statistics (i.e., lower estimates for the Bayesian Information (BIC) and Akaike Information (AIC) criteria based on the model's Log-Likelihood (LL)) following the inclusion of individual- and then country-level controls (see Table 6). This validates the pertinence of these controls for explaining differences across attitudes and actions. Importantly, however, the strength of the association remains almost unchanged. This implies that the inclusion of controls adds precision to the model parameters and, in particular, in the probability assignment of respondents to the various segments of the model. But the controls do not alter the underlying positive and strong relationship between the two latent factors which stand for environmental attitudes and actions. This result corroborates our third hypothesis that the attitudes-actions association withstands standard sociodemographic and economic controls.

[Table 8]

In table 8 we report the conditional probabilities to belong to one of the three segments of the attitudes and of the actions latent factors of the best-fitting model 3. In the case of the attitudes latent factor, the associated negligible sample size of the low-level segment (3%) reflects the consensual nature of environmental concern. There is greater variability across the segments of the actions factor; remarkably, there is a 31% conditional probability for respondents to belong in the high-scoring segment, which registers comparatively strong levels of declared commitment across all twelve action-types. These estimates provide a further validation of our second hypothesis. We predicted that the strength of the association is likely to depend on the presence of a cumulative effect of attitudes on the actions taken. This appears to be the case as illustrated by the conditional probabilities for the high-level segments of each factor. The positive association between the two factors implies that respondents who express favorable opinions across all three attitudes have higher conditional probabilities to respond in the affirmative on all twelve types of actions.

With the attitudes-actions association shown as robust (see Supplementary Material for additional tests), we turn to a description of the effects of the control variables on each of the latent factors. We present the corresponding model parameters in tables 9 and 10. These are odds ratios of a logistic model that measure, in the case of the individual-level variables, the odds to belong to a higher-level cluster on each latent factor; and in the case of the country-level variables, the odds to belong to the "N-W EU" latent group compared to the other, "S-E EU" latent group.

[Table 9]

We discuss the individual-level effects first. We expect greater likelihood for respondents with higher socioeconomic status to declare stronger environmental sensibility and engagement in a wider set of environmentally significant actions. The results in table 9 corroborate our fourth hypothesis. In the case of attitudes, the parameter estimates of two proxies for socioeconomic status attest to its positive effect: age at end of study and difficulties paying bills. Respondents whose full-time education ended at 15 or at an earlier age are 25% less likely to belong to a cluster with higher environmental sensibility;

respondents with frequent financial difficulties are 41% less likely, in contrast to the rest who are approximately 30% more likely.

In the case of actions, the contrasts are similar though more pronounced, both for the age at end of study and for financial difficulties. Further corroborating evidence on the effect of socioeconomic status comes from differences in the odds associated with respondents' occupation category. Upper service respondents are 3.5 times more likely to belong in a segment with a wider level of engagement; middle service respondents are 1.6 times more likely. Manual workers, on the other end, are 68% less likely and respondents without work experience are 50% less likely.

The observed difference in intensity between the effect of socioeconomic status on attitudes and on actions should come to no surprise. The variability in environmental attitudes is, like in previous research, much more nuanced than in respondents' declarations of actions taken. This is also reflected in the additional demographic differences associated with environmentally significant actions. Female respondents are 38% more likely to declare a wider engagement – a probable consequence of disproportionate exposure of women to environmentally significant actions via their higher share of domestic work (Pisano and Hidalgo, 2014, p. 397) as well as to gendered socialization cultures (Dietz, Kalof and Stern, 2002). Age factors in as well, with older respondents exhibiting higher odds to declare actions, which may reflect an increasing exposure to such actions over the life-course.

[Table 10]

Moving on to the country-level effects, our main focus is on the influence of economic affluence. We expect to observe a positive effect, meaning a greater likelihood to belong to the group of Northwestern EU states (N-W EU), whose residents have a higher probability to engage in a wider set of actions. The results corroborate our fifth hypothesis. A doubling of GDP per capita[6] is associated with a 2.05 times higher likelihood to belong to the "N-W EU" latent group. But GDP per capita masks potential unequal distribution of economic wealth, which may cancel out the supposed positive effect on individuals' capacity to take actions. The control for economic inequality – a Gini estimate – confirms our precaution: the associated statistically significant odds ratio shows a negative effect of inequality. The other control variables are associated with lower effects though in the expected direction. A higher percentage of MPs from the European Green Party and a better environmental performance increase the likelihood to belong to the "N-W EU" latent group.

Discussion and Conclusion

In a context of heightened awareness of the dangers of climate change, previous research has built solid evidence on the considerable potential for individuals to act upon it, their widespread willingness to do so but also the sizeable barriers that they face in taking up environmentally significant actions (Kollmuss and Agyeman, 2002; Steg and Vlek, 2009; Swim, Clayton and Howard, 2011; Li *et al.*, 2019). The ambition of this study is to scale up the analysis to the cross-country level at which the environmental impact of individual actions can only be meaningful. In line with the handful of similar recent studies (Pirani and Secondi, 2011; Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020), we contributed an analysis that engages directly with the association between pro-environmental attitudes and a comparatively wide set of environmentally significant actions.

[6] A base of 2 for the logarithm signifies the odds ratio refers to a doubling in the predictor.

We sought to answer the following questions: Is there an association between pro-environmental attitudes and actions? Does it imply environmentally significant impact? And does it hold beyond controls for individual- and country-level effects? The results of our analysis provide answers and highlight some interesting aspects.

First, we find a positive and strong association between attitudes and actions. We attribute that strength to a cumulative effect: stronger pro-environmental attitudes are associated with a wider range of actions individuals declare engaging in. This is interesting in light of the varying degrees of feasibility and the conflicting motivations (e.g., ethics, security, savings, health concerns, social status, habit and routine) that characterize environmentally significant actions. Most importantly, the finding upends a crucial caveat in empirical research on the environmental impact of individual-level behavioral change: while there is strong evidence that individuals have high theoretical margin for intervention (Gardner and Stern, 2008; Dietz *et al.*, 2009; Laitner and Ehrhardt-Martinez, 2010; Jones and Kammen, 2011), the realization to its full potential is conditional on behavioral change on a world scale and across a wide range of actions whose individual environmental contribution is otherwise infinitesimal (Weber and Matthews, 2008). We take the cumulative effect of attitudes on actions that we observe at the level of individual respondents and throughout the twenty-eight EU member states to be a positive signal of the likelihood of pro-environmental attitudes to act as a bottom-up, individual-level driver of behavioral change with high environmental impact.

Certainly, that likelihood depends, at the least[7], on evidence that the attitudes-actions association is not spurious. Our second important result is to demonstrate that the association withstands the introduction of a standard list of sociodemographic and country-level controls. The robustness of the association is evidence of the intrinsic nature of the link between attitudes and actions. While this notion has been questioned by some research using micro-level and experimental settings (Bamberg, 2003), albeit not all (Diamantopoulos *et al.*, 2003; Morren and Grinstein, 2016), the cross-country perspective adopted here increases the scope of the result and comforts similar recent findings (Pirani and Secondi, 2011; Pisano and Hidalgo, 2014; Pisano and Lubell, 2017; Aral and Lopez-Sintas, 2020).

Beyond our specific research questions, a third result is the strong, positive link between coherence of attitudes and actions and a country's level of economic affluence. We interpret this as evidence on how structural constraints condition individual actions. Whatever the willingness of individuals to comply with environmental norms and values, their ability to act is fundamentally limited by available infrastructure: legal, political, socioeconomic and material. To cite one obvious example whose logic applies widely, recycling practices are highly and evidently conditioned by the existence of dedicated facilities (Derksen and Gartrell, 1993). More generally, the greater convergence of attitudes and actions in more affluent societies points to the limits of mitigation strategies that focus exclusively on behavioral change (Maniates, 2001; Webb, 2012). But affluence alone is not enough to foster the adoption of pro-environmental attitudes and actions. Our results also confirm the impact of the distribution of wealth. In the sample of European countries

[7] Another aspect concerns the implicit assumption of a causal effect running from attitudes to actions. While our data do not permit a direct test of the assumption, we report in the Supplementary Material indirect evidence in support.

considered in this study, the more unevenly national wealth is distributed, the less likely it is that appropriate attitudes and actions will be adopted (Chancel, 2020).

And forth, the multilevel modeling strategy adopted in this article points to the influence of individual-level determinants on both attitudes and actions. In line with findings on the same data sample (Aral and Lopez-Sintas, 2020), on older versions of the Eurobarometer survey (Pirani and Secondi, 2011)[8] and on larger cross-country samples (Pisano and Hidalgo, 2014; Pisano and Lubell, 2017), our results demonstrate that socioeconomic status has an overall positive influence on a comparatively wide set of environmentally significant actions, in addition to a debated (Inglehart, 1995; Franzen and Meyer, 2010; Fairbrother, 2013) but hereby evidenced effect on pro-environmental attitudes.

The bottom line of our study is that pro-environmental attitudes may serve as potent drivers of individual actions with consequential environmental impact. Further and finer investigation is necessary to understand how to foster these drivers beyond the set of actions for which we observed this to be the case. We argued that the quality of such an investigation depends on its capacity to explore a wide range of actions with varying environmental potential, to measure environmental impact, to account for the interaction of individual and contextual characteristics, to scale up the analysis to a cross-country level, among others. While we have tried to stay close to these standards, we, like others before us, were tributary to substantial limitations in publicly available data. In privileging scale over detail in our choice of data, we have had to make compromises with the precision of our analysis and with the relevance of our results: in the inability to trace causal links between attitudes and actions; in the reliance on aggregate categories of self-reported behavior; in the absence of a direct measure of environmental impact; in the use of a sample of affluent and socio-politically homogeneous countries.[9] This notwithstanding, we believe this study addresses crucial blind spots in the present literature and helps push research forward. But we are also convinced that a full-fledged investigation of the subject is contingent on the future production of and public access to data that enables researchers to meet the above high standards. The stakes of climate change are by any measure a sufficient justification for the investment.

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[8] As well as in our close replication of the analyses with data from the Eurobarometer survey in 2011, results from which can be made available upon request.

[9] See the Supplementary Material for information on adjustments we try to make to compensate for these limitations.

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Name	Mneumonics	Sample size (in %) Unweighted	Weighted[a]
Austria	AT	3,7	1,8
Belgium	BE	3,6	2,2
Bulgaria	BG	3,7	1,5
Croatia	HR	3,7	0,9
Cyprus	CY	1,8	0,2
Czech Republic	CZ	3,6	2,1
Denmark	DK	3,6	1,1
Estonia	EE	3,6	0,3
Finland	FI	3,6	1,1
France	FR	3,6	12,5
Germany	DE	5,5	16,3
Great Britain	GB	4,9	12,2
Greece	GR	3,6	2,3
Hungary	HU	3,8	2,0
Ireland	IE	3,6	0,8
Italy	IT	3,7	12,1
Latvia	LV	3,6	0,4
Lithuania	LT	3,6	0,6
Luxembourg	LU	1,8	0,1
Malta	MT	1,8	0,1
Netherlands	NL	3,6	3,2
Poland	PL	3,6	7,8
Portugal	PT	3,8	2,0
Romania	RO	3,7	3,9
Slovakia	SK	3,9	1,1
Slovenia	SL	3,7	0,4
Spain	ES	3,6	9,1
Sweden	SW	3,7	1,9
Sample Size		27 881	27 881

[a] Weighted sample reflects country's population as propotion of total EU population.

Table 1. European Union member states, country codes and sample sizes

		in %
Attitudes of Environmental Sensibility		
Protect environment (Question: "How important is protecting the environment to you personnally?")		
Very important		56,4
Fairly important		38,8
Not very important		3,9
Not at all important		0,9
Individual responsibility (Statement: "As an individual, you can play a role in protecting the environment in your country")		
Totally agree		45,8
Tend to agree		43,2
Tend to disagree		8,3
Totally disagree		2,8
Environmental consequences (Statement: "Environmental issues have a direct effect on your daily life and health")		
Totally agree		40,3
Tend to agree		42,5
Tend to disagree		13,0
Totally disagree		4,1
Environmentally significant actions		
Question: "Have you done any of the following in the past six months?"		
Reduced Travel	"Chosen a more environmentally friendly way of traveling (walk, bicycle, public transport, electric car)"	24,5
Reduced Over-packaging	"Avoided buying over-packaged products"	24,4
Reduced Disposables	"Avoided single-use plastic goods other than plastic bags (e.g., plastic cutlery, cups, plates, etc.) or bought reusable plastic products	34,2
Increased Recycling	"Separated most of your waste for recycling"	66,1
Reduced Water consumption	"Cut down your water consumption"	27,8
Reduced Energy consumption	"Cut down your energy consumption (e.g., by turning down air conditioning or heating, not leaving appliances on stand-by, buying energy-efficient appliances)"	35,0
Purchased Labelled products	"Bought products with an environmental label"	19,1
Purchased Local products	"Bought local products"	43,5
Reduced Car use	"Used your car less by avoiding unnecessary trips, working from home (teleworking), etc."	17,8
Question: "There are different ways to reduce harmful emissions into the air. In order to reduce these problems have you done any ot the following in the last two years?"		
Improved heating system	You have changed your home heating system form a higher-emission system (e.g. coal, oil or wood-fired) to a lower one (natural gas, pellets, electricity, solar, etc.)	13,1
Improved energy equipment	You have replaced older energy-intensive equipment (hot water boiler, oven, dishwasher, etc.) with newer equipment with a better energy efficiency rating (for instance products labelled A+++)	31,7
Bought low-emission vehicle	"You have bought an electric car (car, motorbike, bycicle) or a low-emission car (e.g. an hybrid car)"	8,3

Table 2. Measures of attitudes and actions, definitions, and proportions

	in % (mean)
Individual-level	
Age	
15-24	13
25-39	23,1
40-54	25,1
55+	38,9
Sex	
Female	51,8
Urban status	
rural area or village	30,9
small to middle-sized city	43,7
large city	25,4
Household size	(2,6)
Age at end of full-time education	
15 or less	17,4
16-19	46,2
20 or more	36,4
Occupation category	
Upper service	10,5
Middle service	14,7
Non-manual workers	35,8
Manual workers	29
Never did paid work	10
Employment status	
active	48,2
Difficulties paying bills (last year)	
Most of the time	8,1
From time to time	25,4
Almost never/never	66,5
Country-level	
Gini	(32,4)
Environmental Performance Index 2018	(76,1)
GDP per capita	(36 153,3)
Population density	(177,4)
Green vote (% EU Parliament 2014 seats for Green party)	(5,2)

Table 3. Sociodemographic and country-level measures and means/proportions

	Age at end of studies				GDP per capita			
	<=15	16-19	=>20		Lower tier	Middle tier	Upper tier	
Attitudes[a]				K tau-c[b]				K tau-c[b]
Protect environment								
Very important	0,52	0,54	0,63	0,08	0,52	0,61	0,57	0,04
Individual responsibility								
Totally agree	0,38	0,43	0,54	0,11	0,36	0,45	0,58	0,15
Environmental consequences								
Totally agree	0,39	0,38	0,44	0,04	0,42	0,43	0,35	-0,09
Actions				Eta[c]				Eta[c]
Mean number of actions	2,64	3,19	4,13	0,24	2,71	3,5	4,17	0,25

[a] For reasons of readability, only proportions of the top attitudinal category are reported.

[b] Reported K tau-c estimates are significant at the p<.001 level and test the strength of association in 4 by 3 tables.

[c] Reported Eta estimates are for associations significant at the p<.001 level according to one-way ANOVA tests.

Table 4. Inter-category differences in attitudes (proportions) and number of actions (means) for selected covariates

	Number of Actions
Attitudes	
Protect environment	0,21
Individual responsibility	0,25
Environmental consequences	0,16
Index of pro-environmental attitudes[a]	0,24

Note: Association strength estimates are based on K tau-c statistics, which are significant at the p<.001 level.

[a] The index represents the number of positive responses ("Very Important", "Fairly Important", "Totally Agree", "Tend to Agree") to the three attitudinal variables.

Table 5. Estimates of association between attitudes and number of actions

M	Definition and number of segments	LL	BIC(LL)	AIC(LL)	Npar	F1-F2 Corr Coef.
1	F1=3 clusters (AES), F2=3 clusters (ESA) with F1-F2 association	-247 023	494 568	494 148	51	0,477 ***
2	M1 with individual-level covariates	-245 244	491 398	490 665	89	0,474 ***
3	M2 with 2 country-level latent groups and covariates	-244 308	489 630	488 814	99	0,465 ***

Note: *** p<.001; AES - Attitudes of environmental sensibility; ESA - Environmentally significant actions;
LL - Log Likelihood; BIC - Bayesian Information Criterion; AIC - Akaike Information Criterion.

Table 6. Goodness of fit statistics for best-fitting model with tests for attitudes-actions association and for addition of covariates

	Latent Group		Cumulative
	N-W EU[a]	S-E EU[b]	% of EU pop.
Overall	0,47	0,53	
By country			
Sweden	1,00	0,00	1,9
Luxembourg	1,00	0,00	2,0
Austria	0,98	0,02	3,8
Belgium	0,97	0,03	6,0
Denmark	0,96	0,04	7,1
Germany	0,92	0,08	23,4
Finland	0,91	0,09	24,5
Netherlands	0,91	0,09	27,7
France	0,84	0,16	40,2
Malta	0,75	0,25	40,3
Great Britain	0,52	0,48	52,5
Ireland	0,48	0,52	53,3
Slovenia	0,36	0,64	53,7
Czech Republic	0,31	0,69	55,8
Slovakia	0,30	0,70	56,9
Spain	0,12	0,88	66,0
Croatia	0,12	0,88	66,9
Hungary	0,11	0,89	68,9
Italy	0,10	0,90	81,0
Romania	0,04	0,96	84,9
Cyprus	0,02	0,98	85,1
Poland	0,02	0,98	92,9
Portugal	0,02	0,98	94,9
Greece	0,01	0,99	97,2
Estonia	0,01	0,99	97,5
Latvia	0,01	0,99	97,9
Lithuania	0,00	1,00	98,5
Bulgaria	0,00	1,00	100,0

[a] North-Western EU countries

[b] Southern and Eastern EU countries

Table 7. Conditional probabilities for membership in second order latent country groups of best-fitting Model 3

	F1: AES			F2: ESA		
	Low	Middle	High	Low	Middle	High
Size of segment	0,03	0,59	0,38	0,14	0,55	0,31
Att. of Environmental Sensibility (AES)[a]						
Protect environment						
Very important	0,03	0,40	0,86			
Individual responsibility						
Totally agree	0,01	0,25	0,81			
Environmental consequences						
Totally agree	0,00	0,17	0,79			
Env. Significant Actions (ESA)[b]						
Reduced Travel				0,10	0,25	0,54
Reduced Over-packaging				0,07	0,25	0,61
Reduced Disposables				0,08	0,37	0,81
Increased Recycling				0,43	0,73	0,91
Reduced Water consumption				0,17	0,29	0,46
Reduced Energy consumption				0,11	0,38	0,77
Purchased Labelled products				0,03	0,17	0,61
Purchased Local products				0,20	0,47	0,79
Reduced Car use				0,05	0,17	0,48
Improved heating system				0,06	0,13	0,30
Improved energy equipment				0,13	0,34	0,65
Bought low-emission vehicle				0,03	0,08	0,19
Country-level latent groups						
1	0,03	0,58	0,39	0,11	0,62	0,26
2	0,03	0,60	0,37	0,49	0,49	0,03

[a] For reasons of readability, conditional probabilities are reported only for the top category.

[b] Conditional probabilities refer to "Yes" category.

Table 8. Conditional probabilities for best-fitting Model 3 with two discrete latent factors, three clusters each and covariate effects

	F1: AES	F2: ESA
Age		
15-24	1,250	0,506 **
25-39	1,019	0,889
40-54	0,940	1,408 *
55+	0,835	1,578 **
Sex		
Female	1,002	1,382 ***
Age at end of studies		
15 or less	0,752 *	0,246 ***
16-19	1,132	0,905
20 or more	1,175	4,499 ***
Occupation category		
Upper service	1,310	3,468 ***
Middle service	1,028	1,572 **
Non-manual workers	1,094	1,144
Manual workers	1,067	0,320 ***
Never did paid work	0,636	0,502 *
Difficulties paying bills		
Most of the time	0,593 ***	0,482 ***
From time to time	1,309 *	1,090
Almost never/never	1,289 *	1,903 ***

Note: * p<.05, ** p<.01, *** p<.001. AES - Attitudes of environmental sensibility; ESA - Environmentally significant actions.
Categorical variables are effect-coded meaning that the reference category for each variable is its grand mean.
Not shown are parameter effects for urban status, household size and occupational status (active-inactive).

Table 9. Odds-ratio estimates of covariate effects on likelihood to belong to a higher-level cluster on the attitudes or actions discrete latent factors

	N-W EU[a] vs S-E EU[b] odds ratios
GDP/c (log_2)	2,051 ***
Gini	0,828 ***
EPI	1,086 **
Population density (log_2)	1,106
Green vote	1,127 ***

Note: ** p<.01, *** p<.001; Constant not reported.

[a] North-Western EU countries

[b] Southern and Eastern EU countries

Table 10. Odds ratio estimates for country-level covariate effects on belonging to second order latent groups

Supplementary Material

In this document we report information on the choice of model we use in the empirical analysis of the manuscript. In addition, we follow here with robustness tests and sensitivity checks to verify the statistical validity of the main results. We perform tests for the validity of the association between attitudes and actions as defined in the best-fitting model used in the manuscript. We also report information on tests for potential problems of desirability bias in the Eurobarometer measures of attitudes and actions.

Choice of best-fitting model

To represent the attitudes-actions association, we used in the manuscript a model with two discrete latent factors: one, on which we load data from the three attitudinal variables, and another one, on which we load data from the measures of the dozen actions. Each factor can include two or more hierarchically ordered segments. A first step is to decide on the number of segments using exploratory analysis varying the number of segments in each latent discrete factor. As reported in the table below, we tested models with two, three, four and five segments for each latent variable.

[Table 1SM]

The comparison of the associated goodness of fit statistics shows that increasing the number of segments lowers the estimates of the Bayesian Information and the Akaike Information criteria, indicating an improvement of fit. In each case, the correlation coefficient, which measures the association between the two latent variables, is statistically significant and increases in magnitude. This implies that the more each latent factor is partioned into segments, the better the approximation of the underlying data is and the stronger the estimated association. But this comes at the cost of interpretability as every additional partitioning of the latent factors yields ever smaller segments on both extremes whose substantive value is marginal. Our choice to focus the analysis in the manuscript on a model with three segments for each latent factor was made on purely substantive grounds to ease presentation and interpretation. Replication of the analyses including individual- and country-level controls for models with four and five segments does not alter the main conclusions reported in the manuscript.

Tests of the model of attitudes-actions association

We verify potential concerns about the possibility that the observed association between attitudes and actions is an artifact of our modeling strategy. Using confirmatory latent variable models to represent the association, we imposed its presence in order to explore how it changes following the inclusion of controls. But the observed resilience of the association does not invalidate the possibility that a model without the specification for an association between the latent dimensions for attitudes and actions yields a better fit to the data. We estimate two models without attitudes-actions association. One of the models, model 1', is a re-estimation of model 1 in table 6 in the manuscript (reproduced in table 2SM), which does not include any individual- and country-level controls. The second model, model 3', is a re-estimation of the best-fitting model 3 in table 6 (reproduced in table 2SM). For both models the estimates of the Bayesian Information and Akaike Information criteria of the

model's Log Likelihood are lower than the associated reference models and hence confirm the pertinence of the attitudes-actions association as predicted by hypotheses 1 and 2.

[Table 2SM]

Further evidence of support for the modeling strategy adopted in the manuscript comes from our close replication of the analysis with data from the 2011 Eurobarometer survey, to which we apply the same latent variable models and obtain results comparable to those reported here.[10] This is evidence to the replicability of our results beyond the 2017 data.

Finally, the reported effects in our main model (M3 in table 6) are validated by a re-estimation of the model using robust (sandwich) standard errors, which relax the assumption of constant variance for the residuals and are thus less sensitive to distributional assumptions about the indicators.[11]

Tests for causal direction of latent discrete factors with attitudes and actions

Cross-sectional data like the Eurobarometer survey we use render any inferences of causality running from attitudes to actions and vice versa problematic. Consequently, we privileged a modeling strategy that makes no assumption of causality and models the relation between attitudes and actions in terms of an association. This implies that causality may run in either or both directions without a clear indication of which one of these options is statistically more pertinent.

We can use however goodness of fit statistics to compare the original model with an association (model 3 in table 6) to models in which the relation is defined explicitly as the effect of one discrete latent factor on the other. In the table below we reproduce the estimates of the original model (model 3) along with the goodness of fit statistics for models with an effect of the "attitudes" latent factor on the "actions" latent factor (model 4) and vice versa (model 5). In each instance, we hold constant the original parameters of the indicators (attitudinal and action variables) – in other words, we force the definition of the two latent discrete factors to be identical across the three models. This reduces by 36 the number of parameters to be estimated and ensures the two new models converge to a solution (which is not the case with the full load of 99 parameters).

[Table 3SM]

The comparison of the goodness of fit statistics (i.e., lower BIC and AIC estimates indicate better fit) shows a marginal improvement of fit for model 4. This result would corroborate the argument for attitudes of environmental sensibility having a causal effect on environmentally significant actions. But the improvement of fit is small and the fit of model 5, which models the reverse causal effect, is comparable and almost identical to the fit of the original model with an association. Moreover, in all three models the estimated effect of the relationship between attitudes and actions has a very similar coefficient which is, in all three cases, statistically significant at the .001 p-level. Given that a comparison of goodness of fit statistics is not a direct test of causality, the most appropriate interpretation of these results is that the evidence points to a complex causality that likely runs in both directions.

[10] Additional results can be made available upon request.

[11] Further information is available upon request.

Tests for desirability bias in attitudinal and action measures

We also address the possibility of a desirability bias, which plagues any study of association between subjective attitudes and self-declared but directly unobservable actions. Recall that the attitudinal and behavioral measures in use in our analysis come from a special module in the Eurobarometer survey that poses a sequence of twenty questions related to the environment. Desirability bias may operate in three ways in our data.

First, respondents may adjust their declarations on the number of actions taken in accordance with their stated attitudes on questions, which, in our choice of variables, appear in the questionnaire prior to the behavioral measures. To discount this possibility, we re-estimate our main model (M3 in table 6) using only the three behavioral variables for which respondents report on recent investments to improve the heating system or energy equipment and on the purchase of a low-emission vehicle. Compared to the other nine behavioral measures of changes in usage, which are subject to pure subjective appraisal on behalf of the respondent, statements about concrete and costly past investments are arguably less sensitive to spontaneous adjustment and hence to desirability bias. The association between attitudes and actions in the resulting model (model 4) is still present and statistically significant at the .001 level. The correlation coefficient is lower, 0.29, than in the original model with all twelve behavioral measures but this is likely a consequence of the infrequent occurrence of such costly investments in the sample.

[Table 4SM]

Second, respondents may adjust their attitudinal statements in accordance with answers to preceding questions on attitudes toward the environment. Coupled with the previous mechanism, this one may bias upwards the observed association between attitudes and actions. To discount this possibility, we re-estimate our main model using only responses to the question "How important is protecting the environment to you personally" (model 5). This is the very first question that respondents receive in the Environment module and as such it is not subject to adjustment. The correlation coefficient (0.65) for the observed association is positive, strong and statistically significant at the .001 level. In addition, we re-estimate the model (model 6) with this single attitudinal variable and, as in the prior example, with only the three investment measures and obtain a comparable, positive and statistically significant correlation coefficient (0.36).

Finally, respondents may overstate their positive attitudes and declarations on taking concrete actions in order to stay in line with the relative public and scientific consensus around the consequences of environmental problems and with the perceived moral imperative for individuals to acknowledge these problems and to take action accordingly. If such overstatement concerns respondents' statements on one (e.g., attitudinal measures) but not the other (e.g., behavioral measures) sets of variables, then the observed association may be underestimated. If, however, respondents bias upward their statements systematically, we may overestimate the observed association between attitudes and actions. There is no obvious way to disentangle one from the other of these possibilities in the absence in the survey of comparable measures for both attitudes and actions related to the environment. But the Eurobarometer survey contains at least one alternative attitudinal measure that comes from a question posed in a section that precedes the Environmental module. Respondents are asked to choose two out of five items that "our society [should] emphasize to face major global challenges". We construct a binary Yes/No measure based on responses including the choice of "Protecting the environment", which was selected by 35% of

respondents (the second highest).[12] This new variable captures the attributed societal importance of environmental problems and as such differs from the personal experience of such issues in our original three attitudinal variables. We re-estimate our main model with this new attitudinal variable only (model 7). The resulting association (0.67) is again positive and statistically significant and in par with the observed strength in our test above with the measure of the perceived personal importance of environmental protection.

In sum, the above results lead us to conclude that the probability of the observed association being an artifact of desirability bias is low.

[12] The other options include: "social equality and solidarity" (45%), "free trade/market economy" (23%), "cultural diversity and openness to others" (19%), "progress and innovation" (30%), "traditions" (13%), "Other (spontaneous)" (1%), "None (spontaneous)" (1%) and "Don't Know" (4%).

Definition and number of segments	LL	BIC(LL)	AIC(LL)	Npar	F1-F2 Corr Coef.
F1=2 (AES), F2=2 (ESA) with F1-F2 association	-248 566	497 633	497 229	49	0,429 ***
F1=3 (AES), F2=3 (ESA) with F1-F2 association	-247 023	494 568	494 148	51	0,477 ***
F1=4 (AES), F2=4 (ESA) with F1-F2 association	-246 994	494 531	494 094	53	0,479 ***
F1=5 (AES), F2=5 (ESA) with F1-F2 association	-246 856	494 275	493 822	55	0,496 ***

Note: *** p<.001; AES - Attitudes of environmental sensibility; ESA - Environmentally significant actions; LL - Log Likelihood; BIC - Bayesian Information Criterion; AIC - Akaike Information Criterion.

Table 1SM. Goodness of fit statistics for models with two latent discrete factors and different numbers of segments

M	Definition and number of segments	LL	BIC(LL)	AIC(LL)	Npar
1	F1 (AES) =3 clusters , F2 (ESA) =3 clusters with F1-F2 association	-247 023	494 568	494 148	51
1'	M1 without F1-F2 association	-248 258	497 029	496 617	50
3	M2 with 2 country-level latent groups and covariates	-244 308	489 630	488 814	99
3'	M3 without F1-F2 association	-245 474	491 952	491 145	98

Note: AES - Attitudes of environmental sensibility; ESA - Environmentally significant actions;
LL - Log Likelihood; BIC - Bayesian Information Criterion; AIC - Akaike Information Criterion.

Table 2SM. Goodness of fit statistics comparing models with and without attitudes-actions association

Definition and number of segments	LL	BIC(LL)	AIC(LL)	Npar
M3 original with fixed latent discrete factor definitions (indicator effects)	-244 418	489 481	488 963	63
M4 F1 (AES) effect on F2 (ESA), with fixed definitions	-244 412	489 469	488 950	63
M5 F2 (ESA) effect on F1 (AES), with fixed definitions	-244 418	489 481	488 962	63

Note: AES - Attitudes of environmental sensibility; ESA - Environmentally significant actions;
LL - Log Likelihood; BIC - Bayesian Information Criterion; AIC - Akaike Information Criterion.

Table 3SM. Goodness of fit statistics for models with different definitions of the relation between the two discrete latent factors

M	Definition and number of segments	LL	BIC(LL)	AIC(LL)	Npar	F1-F2 Corr Coef.
3	Main Model (M3 in Table 6)	-244 308	489 630	488 814	99	0,465 ***
4	M3 with only actions on equipment improvements	-111 365	223 467	222 874	72	0,294 ***
5	M3 with only "Protect Environment" attitudinal variable	-191 050	383 010	382 277	89	0,650 ***
6	M5 with only actions on equipment improvements	-57 564	115 783	115 256	64	0,360 **
7	M3 with alternative attitudinal variable	-186 169	373 228	372 511	87	0,673 **

Note: ** p<.01, *** p<.001; LL - Log Likelihood; BIC - Bayesian Information Criterion; AIC - Akaike Information Criterion.

Table 4SM. Goodness of fit statistics and association estimates for models testing for desirability bias in attitudinal and action variables