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Determinants of pro-environmental attitude and behaviour among European Union (EU) residents: differences between older and younger generations

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Abstract
Global awareness of environment-related problems is progressively becoming a priority for public authorities all around the world. This led to the creation of environmental policies and a frequent sensitisation of citizens to the risks, associated with environmental damage, which calls for a balanced and competitive socioeconomic development system and a better quality of life for the population. This eco-friendly change requires the development of environmental awareness at both institutional and individual levels. Accordingly, by using ordered probit models and secondary information from the Eurobarometer on attitudes of citizens towards the environment, this study contributes to understanding the differences in the determinants of pro-environmental attitude and behaviour among European Union residents, and more particularly, differences between older and younger generational groups. Our results show that residents from older generations, women, living in cities or large urban areas, not living alone, with no economic difficulties, part of the wealthier classes of society, and with higher life satisfaction, are associated with a higher pro-environmental behaviour. In addition, results show that some determinants are highly correlated to the type of generation considered, such as household composition, class of society, or attitude towards life satisfaction.

Keywords Pro-environmental attitude · Pro-environmental behaviour · Ordered probit model · Generational differences · Determinants · European Union (EU) residents

1 Introduction

Environmental protection remains more than ever a central concern in the development of public policies in many countries throughout the world. Accordingly, pro-environmental behaviour has received increasing attention within academics, especially about the main factors that induce people's pro-environmental behaviour, which has been mainly conducted from two broad perspectives. Some authors assume, explicitly or not, that environmental attitudes determine environmental behaviour and thus focus on the factors

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influencing environmental attitude (e.g. Liu et al. 2018; Shen and Saijo 2008). Others seek evidence of the causality of environmental behaviour by a set of factors, including environmental attitudes (e.g., Aral and López-Sintas 2022; Casaló and Escario 2018; Rodríguez-Barreiro et al. 2013). In this respect, different studies have found a gap between behavioural intentions and behaviour (Dixit and Badgaiyan 2016; Liu and Bai 2014; Zhang et al. 2016).

In addition to the previous, age is a variable that has proven to impact both pro-environmental attitudes and behaviour (Casaló and Escario 2018; Shen and Saijo 2008). Previous research has found higher environmental attitudes among younger people, but weaker environmental behaviours compared to older adults (Casaló and Escario 2018; Shen and Saijo 2008). Disparities in attitudes due to age can be related to either the life cycle or generational effects (Neundorf and Niemi 2014). People who are part of the same generation, share a lot of commonalities that might impact their attitudes: all members are born, attend school, start working, have children, and retire at roughly the same age (Mannheim 1952), and they have gone through similar historical events like wars, the development of new technologies, and other social shifts, at the same time (Ryder 1985). Although previous research has considered age as a factor in the pro-environmental attitudes and behaviour of European Union (EU) residents, there is no literature available analysing changes in other determinants according to generational differences.

Considering the previous information, the main goal of this paper is to analyse and compare the determinants of both pro-environmental attitude and behaviour, and their possible differences according to generation. Particularly, this study focuses on possible differences between older [Builders (born between 1925 and 1945), Baby boomers (born between 1946 and 1964), Generation X (born between 1965 and 1980)] and younger generations [Millennials (born between 1981 and 1996), Generation Z (born between 1997 and 2012)]. The present paper also aims to compare the impact of socioeconomic variables, information sources and attitudes as determinants of both environmental attitude and behaviour.

The general research question that the present investigation aims to answer is: "Are there any differences between the determinants of pro-environmental attitude and behaviour and is there any generational effect behind those differences?". Also, more specifically, the study aims to answer the following specific research questions: (1) Are there differences in the effects of socioeconomic variables on pro-environmental attitude and behaviour?; (2) Do certain information sources influence differences in the pro-environmental attitude and behaviour of EU residents; (3) Is there any influence of attitudinal variables (life satisfaction) on environmental attitude and behaviour?; and (4) What are the differences in the determinants of pro-environmental attitude and behaviour according to the place of residence (country) in the EU?.

The present investigation offers three considerable contributions to the previous literature: (1) according to our best knowledge, it is the first paper that analyses differences in the determinants of pro-environmental behaviour and attitude amongst younger and older residents of countries part of the EU, (2) it uses the most recent available EU data on the subject (European Commission 2020), as other studies draw on older Eurobarometer surveys (Aral and López-Sintas 2023, 2022) and (3), while other studies focus on individual drivers of specific pro-environmental behaviours, such as recycling, water and energy saving, purchasing of organic products (e.g., Aral and López-Sintas 2022; Corrado et al. 2022; Wang et al. 2016; Welsch and Kühling 2009; Yadav and Pathak 2017), we measure overall pro-environmental behaviour by focusing on the number of actions (who does more?), rather than specific drivers.

The remainder of this paper is structured as follows. Section 2 presents the literature review and theoretical framework. Section 3 concerns the data and methodology. Section 4

highlights the main results, while Sect. 5 discusses them. Finally, the work is concluded in Sect. 6.

2 Literature review and theoretical framework

Since the beginning of the twentieth century, the focus of environmental behaviour research has progressively turned to psychological factors such as attitude. In most studies, environmental attitude appears to be the major determinant of environmental behaviour, such as recycling, car use or environmentally responsible purchasing behaviours (Bamberg and Möser 2007; López-Mosquera et al. 2015; Ritter et al. 2015; Rodríguez-Barreiro et al. 2013). However, some empirical evidence has shown that positive environmental attitudes do not always lead to effective pro-environmental behaviours (Casaló and Escario 2018; Heimlich and Ardoin 2008; Pirani and Secondi 2011). In particular, Casaló and Escario (2018) find that the association between behaviour and attitude depends on the intensity of environmental attitude.

Since the early 1970s with the emergence of "environmental consciousness", several studies have attempted to determine the individual and social factors related to attitude and environmental behaviour. The main variables used are age, gender, income, education, social class, and family size (Botetzagias et al. 2015; Pirani and Secondi 2011). Regarding age, the literature suggests that younger people usually have a more positive environmental attitude towards the natural environment than elders, though research evidence also suggests that young people engage in considerably fewer pro-environmental behaviours (Casaló and Escario 2018; Shen and Saijo 2008). One explanation for this might be the sacrifices in terms of convenience and costs often become a barrier for younger people and prevent the transition from environmentally friendly attitudes to actual behaviours (Peattie 2010). On the contrary, Wang et al. (2021) advance in the theory of generativity and the positive psychology of ageing to explain the positive pro-environmental behaviour of older adults. The first one posits that ageing involves a re-examination of life roles and a shift towards an other-centred orientation as it is associated with increased wisdom and less selfishness. The latter proposes that old adulthood offers gains and areas of growth, such as an enhanced appreciation of the fragility and beauty of life, which enables them to be better citizens and conservationists.

Differences in the attitudes and behaviours associated with age can be in part due to generational differences (Neundorf and Niemi 2014). A generational cohort is defined as a collection of people who share a similar age and have gone through similar historical events at the same time (Ryder 1985). Generations are not chosen; neither do members of a generation choose to belong to it or even realise they do (Kowske et al. 2010). Rather, generation membership is determined by an age group's common historical position sharing the same age range for the waging of wars, the development of new technologies, and other social shifts, and in which all members are born, attend school, start working, have children, and retire at roughly the same age (Mannheim 1952). In addition, contextual variations may explain different behaviours of individuals from the same generation. For example, Lauterbach and De Vries (2020) showed differences in public opinion towards the EU depending on the country of residence and its experience of the Eurozone crisis. In this way, experience, culture and social norms can explain differences in attitudes and behaviour within the same generation, underlining the value of considering national variabilities

when studying generations. So far, in the literature, how the determinants of pro-environmental attitude and behaviour differ, according to younger and older generations, has not been analysed.

Furthermore, regarding other socioeconomic and demographic factors, generally, most literature suggests that women (Casaló and Escario 2018; Farahmand et al. 2014; Pirani and Secondi 2011; Torgler et al. 2008), highly educated (Aral and López-Sintas 2023; Casaló and Escario 2018; Cheung et al. 2015; Golob and Kronegger 2019; Petrovic et al. 2013; Robelia et al. 2011; Yucedag et al. 2018), with good income levels (Aral and López-Sintas 2023; Casaló and Escario 2018; do Paço and Raposo, 2009; López-Mosquera et al. 2015; Yucedag et al. 2018), married couples (Dupont 2004; Jacob et al. 2009; Patel et al. 2017), and urban residents (López-Mosquera et al. 2015; Shen and Saijo 2008) tended to exhibit more environmental behavioural intentions. Despite these statements, the literature is not uniform. A significant number of inconsistencies can be highlighted. For instance, Aral and López-Sintas (2023) and Mostafa (2007) state that environmentalists are mostly men, Casaló and Escario (2018) and Shen and Saijo (2008) note that income is not a significant predictor, Aral and López-Sintas (2023) and Cheung and To (2019) are not aligned with the couple's argument and, finally, Torgler and García-Valiñas (2007) show that relationship with the size of the town is not so obvious.

In addition, other factors that might be related to pro-environmental attitudes and behaviour, are related to the information sources, and other attitudinal variables. Considering that concern for or interest in environmental problems is an important driver of pro-environmental behaviour (Czap and Czap 2010; Saphores et al. 2012; Suttibak and Nitivattananon 2008), then information and improved knowledge could activate the necessary environmental awareness. In this respect, some authors have argued that environmental knowledge and pro-environmental attitudes are highly interconnected and strengthen each other (Bamberg 2003). Research states that knowledge of environmental problems, their consequences and possible solutions (action, skills and strategies) can lead to changes in behaviour at the individual level (e.g., Botetzagias et al. 2015; Gifford and Sussman 2012; López-Mosquera et al. 2015; Saphores et al. 2012). This raises the question of the role played by information sources.

For a while, it has been well-known that information sources play a significant role in the environmental education and knowledge of people. Recent studies (e.g. Robelia et al. 2011; Petrovic et al. 2013; Xu and Han 2019) have highlighted the positive effect of digital media on the environmental education of youngsters, while traditional media remains the main source of environmental knowledge for the older (Cheung et al. 2015).

Various studies show that developing environmental awareness and related environmental behaviour can have positive effects on life satisfaction. Brown and Kasser (2005) found that ecologically conscious consumers have a higher level of perception of their well-being. Nassani et al. (2013) and Xiao and Li (2011) indicated that consumers had higher life satisfaction if they reported green purchase intention and behaviour. Then, a study in Canada and the US led by Schmitt et al. (2018) revealed that respondents who were more frequently engaged in pro-environmental behaviour were related to higher life satisfaction. The same results have been observed in the UK (Netuveli and Watts 2020). Nevertheless, the direction of this relationship does not seem straightforward. Other authors suggest that high levels of life satisfaction can explain pro-environmental behaviour (Kaida and Kaida 2016; Wang and Kang 2019).

Based on the previous literature review, Fig. 1 depicts the focus of our article, but it is not exhaustive, as other factors or relationships not considered may influence the analysis. Specifically, Fig. 1 summarises the relationships that we aim to study in this investigation. First, how

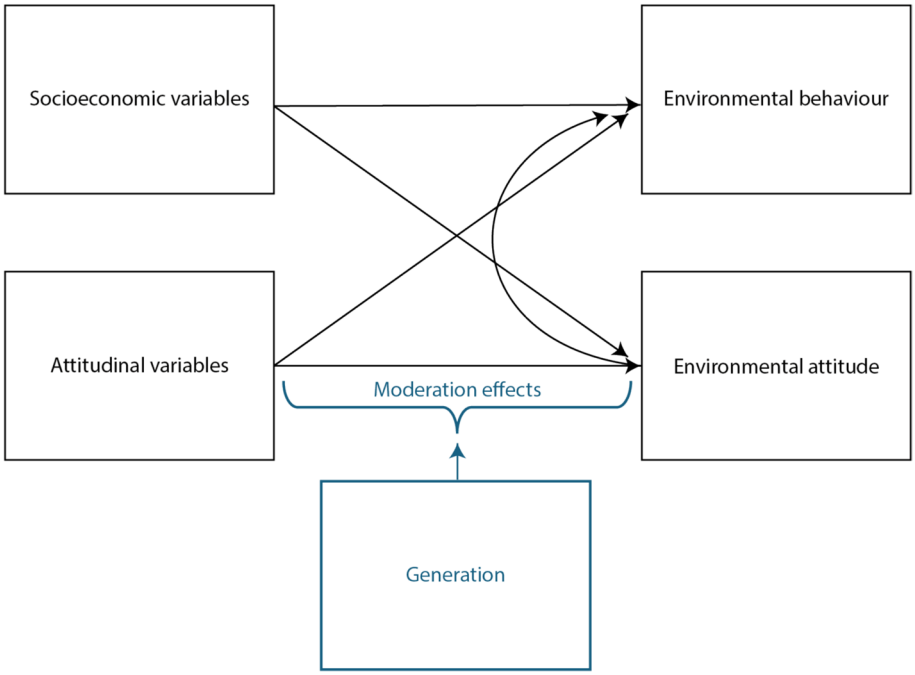


Fig. 1 Causal model of relationships

socioeconomic and attitudinal variables influence pro-environmental attitude and behaviour. Second, how pro-environmental attitude is a direct determinant of pro-environmental behaviour. Third, how the generation of the residents could moderate the previous relationships.

3 Methodology

The methodology used in this paper assumes that both the attitudes towards the environment (represented by the self-reported importance of the environment of the respondent) and the pro-environmental behaviour (represented by the number of environmentally friendly actions done in the past six months by the respondent) are related to some economic, demographic, and other characteristics and opinions of EU residents.

The estimated ordered probit models are based on the random utility modelling approach, which assumes that the latent dependent variable Y_i is dependent on two elements: (1) a linear combination of vectors of independent variables X_i and parameters θ_i that have to be estimated; and (2) an error term ε_i that allows obtaining for the individual i the non-observed factors. The latent regression model used in this paper can be found in Eq. (1). Further information about the model can be found in "Appendix 1".

$$Y_i = \sum_{k=1}^{K} \theta_i X_i^k + \varepsilon_i \tag{1}$$

The data comes from the survey "Special Eurobarometer 501, Attitudes of European citizens towards the environment" which was carried out between 6 and 19 December 2019

within the 27 EU Member States and Great Britain. This survey is a follow-up of the Special Eurobarometer from 2017 and is based on face-to-face interviews with 27 498 respondents from different social and demographic groups. It was conducted by the Kantar Public Brussels network at the request of the European Commission, with the main goal of measuring the evolution of the Europeans' concern about environmental issues (European Commission 2020). After excluding respondents who refused to answer certain questions that were of interest regarding this research, we ended up with 27,346 observations. In "Appendix 2", the distribution of the sample according to the country of residence of the participants is presented.

In the current study, two dependent variables were used. The first one, which is related to pro-environmental behaviour, is based on the number of environmental actions done by the respondents in the past six months. In the questionnaire, a list dividing the environmental behaviour into 14 actions was proposed to the respondent, who then had to pick the ones he/she had undertaken. The list of actions can be seen in "Appendix 3". The first dependent variable was built by considering different levels of environmental behaviour, according to the number of environmental actions undertaken by the residents. Thus, 4 levels were created:

- (1) Low level of pro-environmental behaviour—(0–3 actions undertaken)
- (2) Mid-low level of pro-environmental behaviour—(4–7 actions undertaken)
- (3) Mid-high level of pro-environmental behaviour—(8–10 actions undertaken)
- (4) High level of pro-environmental behaviour—(11–14 actions undertaken)

Meanwhile, the second variable, which is related to pro-environmental attitude, corresponds to the perception of the importance of protecting the environment. In the questionnaire, using a scale (from 1 to 4) the respondents were asked to measure how protecting the environment was important for them. The second dependent variable was built considering this 4-scale response, as follows:

- (1) Low level of pro-environmental attitude—Response to question: Not at all important
- (2) Mid-low level of pro-environmental attitude—Response to question: Not very important
- (3) Mid-high level of pro-environmental attitude—Response to question: Fairly important
- (4) High level of pro-environmental attitude—Response to question: Very important

Concerning the independent variables, they are related to the attitudes, economic and demographic characteristics of respondents. They were built accordingly as shown below:

- Attitude towards the environment—two levels: (1) The environment is fairly important to me, (2) The environment is very important to me.
- Country of residence of the resident—28 levels according to each country of residence of each resident.
- Generation—four levels: (1) Builders (born between 1925 and 1945), (2) Baby boomers (born between 1946 and 1964), (3) Generation X (born between 1965 and 1980), (4) Millennials and Generation Z (born between 1981 and 2012).
- Gender—two levels: (1) Man, (2) Woman
- Household composition—two levels: (1) Not living alone, (2) Living alone

- Place of living—two levels: (1) Cities/ large urban area, (2) Rural area/Towns and suburbs/small urban area
- Social class—six levels: (1) The working class of society, (2) The lower middle class, (3) The middle class, (4) The upper middle class, (5) The higher class, (6) Another answer.
- Income (Economic difficulties paying the bills) —2 levels: (1) Most of the time, (2) From time to time or almost never/never
- Life satisfaction—3 levels: (1) Very satisfied, (2) Fairly satisfied, (3) Not very or not at all satisfied.
- Environmental information sources—6 levels: (1) Newspapers or magazines, (2) Television news or radio or films/doc, (3) Family/friends/etc., (4) Books/scientific lit or brochures or events or museum, (5) Online soc networks or internet, (6) Other

If more information is needed about the original questions and the descriptive statistics, please refer to the report associated with the questionnaire: "Special Eurobarometer 501, Attitudes of European Citizens towards the Environment" (European Commission 2020).

In this investigation, six ordered probit models were estimated: three for analysing environmental attitude and three for environmental behaviour. For each of them, separate models were estimated for the full sample, for the sample of the younger respondents (born after 1980) and for the sample of the older respondents (born before 1980). Also, for each of the models, we estimated the marginal effects, which are a measure of how much the probability of being part of a specific category for the dependent variable is affected by a change in the values of the independent variables that were used in the models.

4 Results

Table 1 shows the results of the environmental behaviour and attitude models. Meanwhile, the marginal effects of the environmental behaviour and the attitude models can be found respectively in "Appendixes 4 and 5".

4.1 Differences between determinants of attitude towards the environment vs environmental behaviour

The results of the behaviour models (Table 1) show that in all cases, the attitude towards the environment is significantly and positively correlated with environmental behaviour, suggesting that higher concern for the environment is related to a higher number of green actions by EU residents. However, the marginal effects ("Appendixes 4 and 5") show that the highest positive effect in considering the environment as very important is associated with the second level of actions towards the environment ($y = 2$), suggesting that the highest environmental concern is not necessarily equivalent to the highest levels of environmental behaviour, indicating that other factors also take part in the behaviour.

Moreover, according to the results of the behaviour and attitude models (Table 1), there are similarities between the determinants of environmental behaviour and environmental attitude, but they are not exactly the same. While factors such as age, gender, social class, income, life satisfaction and environmental information sources are significantly related in different scales for both attitude and behaviour, other variables such as the household composition and the place of living are relevant for the behaviour but not for the attitude,

Table 1 Behaviour and attitude ordered probit models

Variable		Behaviour model			Attitude model		
		Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)	Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)
Attitude towards the environment	The environment is fairly important to me	0.3835***	0.3675***	0.3883***			
	The environment is very important to me	0.8737***	0.8809***	0.8709***			
Country of residence	BE—Belgium	0.1781**	0.0719	0.2184**	−0.035	−0.0133	−0.0257
	DK—Denmark	0.4782***	0.5242***	0.4572***	−0.0852	−0.1303	−0.0794
	DE—Germany	0.32***	0.2936**	0.3184***	−0.0773	−0.0433	−0.0763
	GR—Greece	−0.1926**	−0.1172	−0.2305**	0.6825***	0.6447***	0.7118***
	ES—Spain	−0.0624	0.0321	−0.1054	0.426***	0.4182**	0.4437***
	FR—France	0.3698***	0.313**	0.3914***	0.3509***	0.4545***	0.3283***
	IE—Ireland	−0.1162	0.0356	−0.1918**	−0.0656	0.0893	−0.1201
	IT—Italy	−0.3242***	−0.1809	−0.4033***	0.0043	0.2781*	−0.0815
	LU—Luxembourg	0.3264***	0.5142***	0.2516**	0.1985**	0.2331	0.196*
	NL—The Netherlands	0.5946***	0.5833***	0.5923***	−0.2098**	−0.1206	−0.235**
	PT—Portugal	−0.3319***	−0.2622*	−0.3677***	0.2838***	0.3237**	0.2961***
	GB-UKM—Great Britain	0.2073***	0.1287	0.2381**	0.3704***	0.24	0.4564***
	AT—Austria	0.0828	0.0758	0.0762	−0.2678***	−0.0483	−0.3563***
	SE—Sweden	0.7449***	0.8521***	0.7209***	0.7538***	0.8879***	0.7284***
	FI—Finland	0.3356***	0.4111***	0.2989***	−0.2071**	−0.1433	−0.2243**
	CY—Cyprus (Republic)	0.0114	0.034	−0.0126	0.757***	0.6964***	0.7973***

Table 1 (continued)

Variable		Behaviour model			Attitude model		
		Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)	Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)
	CZ—Czech Republic	−0.3228***	−0.2858**	−0.3464***	−0.0272	0.1131	−0.0639
	EE—Estonia	0.0887	0.3175**	0.0105	−0.1844**	−0.2223	−0.1596
	HU—Hungary	−0.3079***	−0.2671*	−0.3306***	0.0912	0.1133	0.1069
	LV—Latvia	−0.0522	0.0305	−0.0891	−0.2313***	−0.429***	−0.1387
	LT—Lithuania	−0.1174	−0.0033	−0.1653*	−0.0996	−0.1051	−0.0837
	MT—Malta	−0.2376***	−0.2529	−0.2443**	0.6285***	0.7525***	0.598***
	PL—Poland	−0.4481***	−0.3135**	−0.5176***	−0.0577	−0.1882	0.0296
	SK—Slovakia	−0.0788	−0.1176	−0.0793	0.0423	0.2246	0.0026
	SI—Slovenia	0.1588**	0.1594	0.1516	0.3916***	0.3765**	0.4152***
	BG—Bulgaria	−0.4334***	−0.5013***	−0.4145***	0.4782***	0.5343***	0.4805***
	RO—Romania	−0.4585***	−0.5761***	−0.3872***	0.083	0.1593	0.0777
	HR—Croatia	−0.3732***	−0.4269***	−0.349***	0.0074	0.0045	0.0379
	Other countries	Reference					
Generation	Born between 1946 and 1964 (Baby boomers)	0.2616***		0.2558***	−0.0098		−0.0008
	Born between 1965 and 1980 (Generation X)	0.2762***		0.2663***	−0.1297***		−0.1112***
	Born after 1980 (Millennials and Generation Z)	0.1909***			−0.1816***		
	Born between 1925 and 1945 n (Builders)	Reference					

Table 1 (continued)

Variable		Behaviour model			Attitude model		
		Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)	Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)
Gender	Man	−0.137***	−0.1992***	−0.121***	−0.1898***	−0.191***	−0.1887***
	Woman	Reference					
Household composition	Not living alone	0.0878***	−0.0169	0.1107***	−0.034*	−0.0388	−0.0325
	Living alone	Reference					
Place of living	Cities/ large urban area	0.0739***	0.067**	0.0727***	0.0165	0.0485	0.0026
	Rural area/Towns and suburbs/small urban area	Reference					
Social class	The lower middle class	0.1291***	0.1416***	0.1268***	−0.0237	−0.0104	−0.0267
	The middle class	0.1057***	0.0896**	0.1118***	0.0676***	0.0221	0.0861***
	The upper middle class	0.1974***	0.3748***	0.1328***	0.125***	0.0276	0.1729***
	The higher class	0.1746*	0.0749	0.2065*	0.3544***	−0.0251	0.5428***
	Other Answers	0.0019	−0.0035	0.0033	−0.0098	0.0683	−0.0661
	The working class of society	Reference					
Income (economic difficulties)	Most of the time	−0.1143***	−0.1589***	−0.0959***	−0.1387***	−0.234***	−0.1086***
	From time to time or almost never/never	Reference					

Table 1 (continued)

Variable		Behaviour model			Attitude model		
		Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)	Full sample	Born after 1980 (millennials and generation Z)	Born in 1980 or before (builders, baby boomers and generation X)
Life satisfaction	Very satisfied	0.1095***	0.0632	0.1206***	0.5695***	0.4081***	0.6242***
	Fairly satisfied	0.0672***	0.0061	0.0838***	0.1914***	0.0682	0.2244***
	Not very or not at all satisfied	Reference					
Environmental information sources	Newspapers or magazines	0.2344***	0.2355***	0.2361***	0.16***	0.1296***	0.1661***
	Television news or radio or films/doc	0.2691***	0.2143***	0.3175***	0.4446***	0.3343***	0.519***
	Family/friends/etc	0.2333***	0.2417***	0.2347***	0.1636***	0.1584***	0.1698***
	Books/scientific lit or brochures or events or museums	0.4391***	0.4794***	0.4246***	0.3396***	0.3851***	0.3238***
	Online social networks or internet	0.3608***	0.3535***	0.3692***	0.3428***	0.4301***	0.3163***
	Other	Reference					
Thresholds		Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Threshold parameters							
Threshold (1 to > 2)		1.5199***	1.1647***	1.5691***	−1.7963***	−1.7476***	−1.6959***
Threshold (2 to > 3)		2.9046***	2.5036***	2.9758***	−0.8563***	−0.8109***	−0.7494***
Threshold (3 to > 4)		3.7616***	3.3715***	3.8305***	0.7998***	0.8563***	0.912***
Model adjustment							
Final log-likelihood		−25,217	−6785.337	−18,375.55	−22,251.14	−5996.191	−16,181.8

Table 1 (continued)

Thresholds	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
McFadden's R^2	0.1131395	0.1066402	0.1181325	0.0706	0.0681826	0.0755294
AIC	50,538	13,668.6	36,853	44,602.2	12,086.3	32,461.6

Significancy codes: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

evidencing some differences in the determinants. Moreover, the relative level of association of each variable also differs between attitudes and behaviour models.

4.2 Differences in the determinants of pro-environmental attitude and behaviour between older and younger generations.

When samples are split according to younger and older generations, there are some differences between groups. For example, it can be observed that a higher level of pro-environmental behaviour is only significant in the older generations in countries such as Belgium, Greece, Ireland, Italy, the UK, Lithuania and Malta (Table 1). On the contrary, for Estonia, the highest level of pro-environmental behaviour is only significant for the younger generational group. Moreover, it can be observed that there is a higher level of significant pro-environmental behaviour for those not living alone and those satisfied with their lives, but only for the older generations (Table 1).

Subsequently, for both generational groups, there is a positive relationship between a higher level of environmental behaviour and a preference for books, scientific literature, brochures or events, as information sources in environmental aspects. However, as a secondary source of information, models' results suggest that residents with higher environmental attitude prefer information sources like television news, radio or films/documentaries if they are part of older generations (Builders, Baby boomers and Generation X) and social networks or the Internet if they are part of younger generations (Millennials and Generation Z).

4.3 The relationship of socioeconomic variables and attitudinal variables with pro-environmental attitude and behaviour

Figure 2 presents the marginal effects for the highest levels of environmental behaviour and attitude, in order to better understand differences in the correlation of the different variables with pro-environmental attitude and behaviour. Considering the generation as an independent variable, there is a higher pro-environmental behaviour associated with Baby boomers (born between 1946 and 1964) and Generation X (born between 1965 and 1980). However, the highest environmental attitude is related to the oldest generation (Builders, born between 1925 and 1945), who paradoxically, are associated with the lowest environmental behaviour.

Concerning gender, results suggest that women are related to a higher level of pro-environmental attitude and behaviour. Moreover, household composition seems to be correlated only with behaviour and not attitude, as residents not living alone are related to higher levels of pro-environmental behaviour. A similar case occurs with the place of living, which is only significant for the behaviour models, and suggests a higher pro-environmental behaviour level for those living in cities or large urban areas.

For the class of society, the results evidence a correlation between higher pro-environmental attitude and behaviour, and residents who are part of the highest classes of society (upper middle and high class). Surprisingly, there is a higher pro-environmental behaviour associated with the upper-middle class rather than the highest class, but the differences do not seem to be significant. For the income variable, as expected, there is a lower level of pro-environmental behaviour and attitude associated with residents who have more economic difficulties.

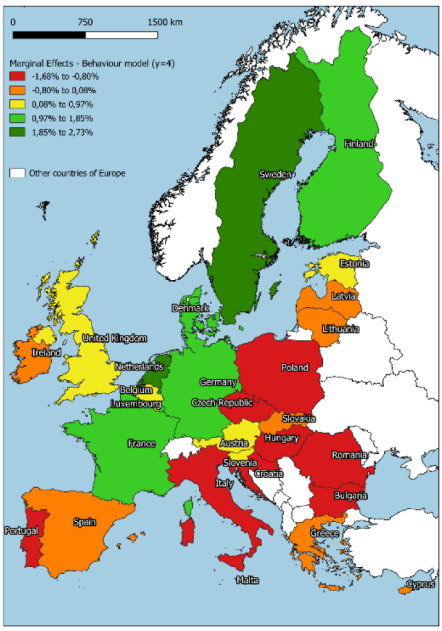
Variable		Marginal Effects (%)	
		Full sample - Behavioural model (y=4)	Full sample - Attitude model (y=4)
Generation	Baby boomers	**0.96 %**	-0.39 %
	Generation X	**1.01 %**	**-5.16 %**
	Millenials and Generation Z	**0.70 %**	**-7.23 %**
	Builders	Reference	
Gender	Man	**-0.50 %**	**-7.55 %**
	Woman	Reference	
Household composition	Not living alone	**0.32 %**	-1.35 %
	Living alone	Reference	
Place of living	Cities/ large urban area	**0.27 %**	0.66 %
	Rural area/Towns and suburbs/small urban area	Reference	
Social class	The lower middle class	**0.47 %**	-0.94 %
	The middle class	**0.39 %**	**2.69 %**
	The upper middle class	**0.72 %**	**4.98 %**
	The higher class	0.64 %	**14.10 %**
	Other answer	0.01 %	-0.39 %
	The working class of society	Reference	
Income (Economic difficulties)	Most of the time	**-0.42 %**	**-5.52 %**
	From time to time or almost never/never	Reference	
Life satisfaction	Very satisfied	**0.40 %**	**22.66 %**
	Fairly satisfied	**0.25 %**	**7.62 %**
	Not very or not at all satisfied	Reference	
Environmental information sources	Newspapers or magazines	**0.86 %**	**6.37 %**
	Television news or radio or films/doc	**0.99 %**	**17.69 %**
	Family/friends/etc	**0.85 %**	**6.51 %**
	Books/scientific lit or brochures or events or museums	**1.61 %**	**13.51 %**
	Online soc networks or internet	**1.32 %**	**13.64 %**
	Other	Reference	

Fig. 2 Marginal effects (y = 4). Socioeconomic, information sources and attitudinal variables. Note: marginal effects in bold letters when significant ($p < 0.05$)

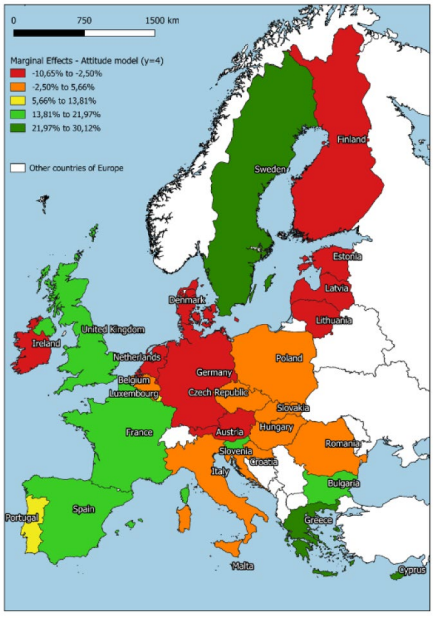
Moreover, results suggest that attitudinal aspects of residents might also be related to their environmental attitude and behaviour, as residents with higher life satisfaction were found to be related to a higher level of pro-environmental attitude and behaviour.

4.4 Differences between country of residence on pro-environmental attitude and behaviour

In terms of the country of residence, residents from Northern and Western Europe are correlated with the highest probability of being part of the most important level of environmental behaviour (y = 4), as shown in the marginal effects of Fig. 3a. Meanwhile, residents of Sweden and Greece are associated with the highest probability of having the highest level of environmental concern (see Fig. 3b).



(a) Behaviour model



(b) Attitude model

Fig. 3 Marginal effects (y = 4)—distribution per country

5 Discussion

Our results show that even though attitude is related to environmental behaviour and there are similarities in their determinants, they are not exactly the same. Environmental attitude is linked to a positive impact on environmental behaviour (Aral and López-Sintas 2022; Hadler and Haller 2011; Pirani and Secondi 2011; Pisano and Lubell 2017), but it is not correct to affirm that every people that have an environmental concern are projecting that interest into action. Our results are in line with Casaló and Escario (2018), the association between environmental attitudes and environmental behaviours depends on the intensity of the attitudes. However, we provide a further analysis by identifying that a threshold seems to exist above which other variables are essential to driving behaviour. Strong environmental attitudes are not enough to explain proactive environmental behaviour. In fact, the results of the present study, evidence that the generation, country of residence, household composition and place of residence show the biggest differences between attitudes and behaviour as will be detailed in the following paragraph. In the scope of our study, these are the variables that could have the greatest influence in reducing the gap between attitude and behaviour.

There are clear differences in the determinants of pro-environmental behaviour and attitude between older and younger generations. Our results suggest that two of the older generations (Baby Boomers and Generation X) seem to be associated with higher levels of pro/environmental behaviour than the younger generations. This is partially in line with recent literature, which associates older people with higher environmental behaviour (Aral and López-Sintas 2022; Casaló and Escario 2018; Wiernik et al. 2013; Pirani and Secondi 2011; Sánchez et al. 2016). It is worrying for the future that the younger generations (Millennials and Generation Z) are associated with lower environmental behaviour. In this sense, there is a need for higher efforts to encourage the young generation to a higher level of pro-environmental action. The Internet and digital social networks play a key role in environmental education, particularly for the younger (Cheung et al. 2015; Petrovic et al. 2013; Robelia et al. 2011), and could be a key lever to increase the dissemination and acceptance of reliable environmental information to the younger generations in a way, that they could increase higher pro-environmental behaviour in these generations. However, paradoxically, the increasing share of leisure time that young people spend virtually resulted in less and less time spent in the natural environment, and this consequently reduced their environmental engagement (Dąbrowski et al. 2022). An important factor determining the relationship with the environment is the contact with the natural world. It is particularly important during childhood and adolescence (Arnold et al. 2009). In this line, older generations have spent more time developing pro-environmental skill sets (e.g. how to grow a vegetable garden, how to cook from scraps, how to repair objects, etc.). Policies need to tackle these problems in order to increase the younger's willingness and capabilities to act in favour of natural environment, as well as using the older generation's skillset and experience as a lever for environmental actions.

Apart from reliable information, economic issues might be another structural issue that has caused a lower level of pro-environmental behaviour of younger generations, as previous literature has demonstrated that economic difficulties in Europe are usually more prominent in younger populations due to reduced employment opportunities after the 2008 Great Recession (Schoon and Bynner 2019). Usually, pro-environmental actions require more expensive costs that some young people are not able to afford. As a result, structural issues related to deficient economic conditions of younger generations might need

to be solved, before a greener behaviour could be expected. In addition to this, actions are needed to make sustainable behaviours more affordable and attractive for the younger generations. On the other hand, it is interesting to notice, that for the younger generations, the wealthiest group was associated with one of the lowest levels of environmental behaviour. This might be due to the high standard lifestyle, which elicits actions that directly or indirectly are contradictory to preserving the environment (Starr et al. 2023). Future research demands the need for strategies by authorities to control this sort of rebound effect.

Moreover, from the results related to the countries of residence, it was found that Sweden evidenced the highest marginal effects for the highest level of both environmental attitude and behaviour. This is not a surprise considering that when it comes to recent rankings on international environmental issues, Sweden has consistently come out on top (Marbuah 2019). Some reasons to explain the previous is that Sweden is one of a select group of progressive nations that are regarded as setting the pace in environmental policymaking with notable implementation success (Jänicke 2005), is a pioneer in market-based policy instruments such as environmental taxes (e.g. gasoline tax) and Swedish residents are willing to significantly increase their financial contributions and/or modify their present or future lifestyle in order to improve environmental quality (Marbuah 2019). In addition, the fact that in Finland and most countries of Western Europe (except France and the UK), there is a high likelihood of high environmental behaviour and relatively lower environmental attitude, suggests that there might be policy-related aspects that might be leading residents of these countries towards a higher green behaviour, without them even noticing it. Thus, stronger environmental policies in other countries could also be a solution to force the increase of the environmental behaviour of the residents.

On the other hand, it was found that Eastern and Southern countries in the EU tend to have the lowest level of environmental behaviour. Also, it is worrying that some countries like Spain, Greece and Bulgaria are associated with a relatively high environmental attitude, which is not reflected in their environmental actions. Although economic, social, and cultural disparities between the countries are likely to explain these differences (do Paço et al. 2013), they might also be a consequence of residents having no clear idea of how to be more environmentally friendly, despite their concerns, suggesting that more environmental education might help to close this gap.

In addition, some of the differences in pro-environmental attitude and behaviour between EU countries may have been shaped by similar historical events experienced by residents of the same generation. Builders have been particularly affected by major events such as World War II and the postwar period. Similarly, the effects of the postwar period had a significant impact on Baby boomers. Possibly, the living conditions of these periods may explain in part some of the differences in the pro-environmental attitude and behaviour of the oldest generations. Furthermore, the postwar course of events, with most of Eastern Europe falling under the Soviet Union and communist influence, Southern countries under political instability of some authoritarian regimes, and Western European countries establishing democratic governments, may have also shaped their environmental behaviour. However, it is worth noting that cultural differences and social norms associated with the different countries may have an impact on the environmental behaviour of the same generation (Lauterbach and De Vries 2020).

Regarding the variables related to the economic status such as class of society and income, it is clear that residents with the best economic conditions are related to a higher environmental behaviour. This is in line with similar investigations such as Eom et al. (2018), Kennedy and Givens (2019) and Shen and Saijo (2008). A reason to explain this is that economic difficulties might overshadow environmental concerns and actions. In

addition, as previously mentioned, sometimes being environmentally friendly is costly, as actions such as the acquisition of environmentally friendly products usually imply a higher cost, representing even more negative consequences in the financial aspect. Wealthier people are less preoccupied with economic restrictions and may pursue more post-materialistic goals, such as individual self-fulfilment or environmental protection (Casaló and Escario 2018).

For other variables, such as gender, our results seem to confirm that men are associated with a lower level of environmental behaviour compared to women (Aral and López-Sintas 2022; Farahmand et al. 2014; Pirani and Secondi 2011; Torgler et al. 2008). One explanation for this is that the natural role of women as caregivers and nurturers implies cooperation and compassion and predisposes them to have a greater concern for the preservation of life and the environment (Hunter et al. 2004).

Meanwhile, similarly as found by Duarte et al. (2017) and Léger and Pruneau (2015), our results suggest that the structure of the household is correlated to pro-environmental behaviour. Interestingly it only has an impact on older generations, suggesting a higher environmental behaviour for those not living alone. Subsequently, our results suggest that people living in urban areas are correlated with a higher level of pro-environmental behaviour. This is only associated with the younger generations, suggesting a probable environmental educational gap between the young generations living in rural areas and urban areas. Indeed, Dąbrowski et al. (2022) highlight that such barriers are most common in rural areas and small towns, where as a result residents from Generation Z indicated laziness or forgetfulness in the context of environmental issues.

Finally, the fact that there is associated a higher pro-environmental behaviour and attitude for those respondents that have higher life satisfaction, is in line with several studies in the literature, which have taken place in different contexts such as China (Wang and Kang 2019; Xiao and Li 2011), Sweden (Kaida and Kaida 2016), Saudi Arabia (Nassani et al. 2013), the US (Brown and Kasser 2005; Jacob et al. 2009; Schmitt et al. 2018), Canada (Schmitt et al. 2018) and the UK (Netuveli and Watts 2020). The reason behind these results might be that the well-being perceived by the respondents when they are satisfied with their lives conducts them to positive actions related to environmental care.

6 Conclusions

This investigation looked at the factors that determine the environmental attitude and behaviour of EU residents. With this study, we contribute to the debate concerning differences in environmental attitudes and behaviours by comparing their drivers, with a special focus on the differences according to generational groups. We also explore the influence of environmental attitude as a possible determinant of environmental behaviour. The use of adequate representative data from the Eurobarometer survey on the attitudes and behaviour of residents in the 27 EU countries and Great Britain towards the environment enhances the robustness and credibility of the results (European Commission 2020).

The findings of this investigation present very important and useful insight for authorities and policymakers, as the current research reaffirms that there are structural issues that need to be addressed in order to increase pro-environmental behaviour amongst EU residents. Also, the findings of this research evidence the need to sensitize residents to the risks associated with environmental damage and the need to adopt a greener lifestyle. This is particularly important for EU nations, which are called to deliver on the EU Green Deal, which has the ambition to make the EU the first climate-neutral continent by 2050. The information can be used for a better informed and bolder policy design and to better target the beneficiaries of policy actions. Also, results can help to understand which segments of the EU residents should be prioritised on the actions taken.

Our findings indicate that there are similarities in the determinants of environmental attitude and behaviour, but the determinants are not exactly related to environmental attitude and behaviour in the same way. This shows that analysing the determinants of pro-environmental behaviour by studying the determinants of attitudes is not as reliable as some previous investigations have suggested. Although there is an undeniable relationship between them, there are still some important differences that cannot be ignored. Moreover, considering different generational groups in the equation, added more differences in the determinants of pro-environmental attitude and behaviour between younger and older groups, with variables such as the household composition, class of society or life attitudinal variables, having the highest effects.

In general, the results show that socioeconomic and attitudinal variables are significantly correlated with pro-environmental behaviour, with residents being born between 1946 and 1980 (Baby Boomers and Generation X), who are women, living in cities or large urban areas, not living alone, with no economic difficulties, who are part of the wealthier classes of society and with higher life satisfaction, being likely to have a higher environmental behaviour in terms on the numbers of green actions. Moreover, we also found that the information sources also impact environmental behaviour, with books or scientific literature being the options that encourage higher environmental behaviour.

This study is not exempt from limitations. Although the data is highly reliable due to the sample size and representativeness, since it is secondary data information, we could not structure a more specific survey for the goal of the study. Future research should be encouraged with primary data to compare the results of this secondary information. Also, another limitation from the methodological aspect is that the estimated ordered probit models do not consider the unobserved heterogeneity, so they assume that the parameters estimated are fixed. This limitation can be overcome in future studies by using alternative models such as a zero-inflated ordered probit model or a grouped latent class ordered probit model with class probability functions. Despite this, it is important to highlight a word of caution, that a model that accounts for unobserved heterogeneity would difficult the interpretation of the parameters, which might affect the efficacy in the formulation of policies. In addition, it is important to highlight that the results from this study are based on a questionnaire executed just before the COVID-19 pandemic, thus further research should identify the possible effects of the pandemic on pro-environmental behaviour and attitude.

Appendixes

Appendix 1

Further information about the model

Considering that the dependent variable is not observable, it can be measured by a set of indicators y_i, representing the various categories that constitute it. For the first dependent variable (pro-environmental behaviour), the indicators for the pro-environmental behavioural model are shown in Eq. 2.

- 1st level—Actions towards the environment (0–3 actions): $y_i = 1$ if $Y_i \leq \mu_1$
- 2nd level—Actions towards the environment (4–7 actions): $y_i = 2$ if $\mu_1 < Y_i \leq \mu_2$
- 3rd level—Actions towards the environment (8–10 actions): $y_i = 3$ if $\mu_2 < Y_i \leq \mu_3$
- 4th level—Actions towards the environment (11–14 actions): $y_i = 4$ if $\mu_3 < Y_i$ (2)

Moreover, for the second dependent variable (pro-environmental attitude), the indicators for the attitudinal model are shown in Eq. 3.

- 1st level: Self-reported environmental concern—Not at all important: $y_i = 1$ if
- 2nd level: Self-reported environmental concern—Not very important: $y_i = 2$ if $\mu_1 < Y_i \leq \mu_2$
- 3rd level: Self-reported environmental concern – Fairly important: $y_i = 3$ if $\mu_2 < Y_i \leq \mu_3$
- 4th level: Self-reported environmental concern—Very important: if $y_i = 4$ if $\mu_3 < Y_i$ (3)

In the previous equations, μ_1, μ_2 and μ_3 are category threshold parameters that must be estimated considering that $\mu_1 < \mu_2 < \mu_3$. The category thresholds show the points in which the level of self-reported environmental importance or behaviour varies because of a high latent change in the latent preference.

Considering a distribution function for the error term F (cumulative distribution function cdf which is the normal distribution for the ordinal probit models) and setting $\mu_0 = -\infty$ and $\mu_J = \infty$, the probabilities for each of the indicators y_i can be obtained based on Eq. 4.

$$P(y_i = j) = P(\varepsilon_i \leq \mu_j - \theta X) - P(\varepsilon_i \leq \mu_{j-1} - \theta X) = F(\mu_j - \theta X) - F(\mu_{j-1} - \theta X) \quad (4)$$

Appendix 2

See Table 2.

Table 2 Sample features

Country of residence	Frequency	Percentage (%)
FR—France	1067	3.90
BE—Belgium	986	3.61
NL—The Netherlands	1043	3.81
DE—Germany	1535	5.61
IT—Italy	1038	3.80
LU—Luxembourg	311	1.14
DK—Denmark	1034	3.78
IE—Ireland	941	3.44
GB-UKM—Great Britain	936	3.42
GR—Greece	1034	3.78
ES—Spain	997	3.65
PT—Portugal	1108	4.05
FI—Finland	1020	3.73
SE—Sweden	1015	3.71
AT—Austria	959	3.51
CY—Cyprus (Republic)	485	1.77
CZ—Czech Republic	995	3.64
EE—Estonia	982	3.59
HU—Hungary	1055	3.86
LV—Latvia	1002	3.66
LT—Lithuania	1021	3.73
MT—Malta	461	1.69
PL—Poland	1073	3.92
SK—Slovakia	981	3.59
SI—Slovenia	996	3.64
BG—Bulgaria	964	3.53
RO—Romania	1147	4.19
HR—Croatia	1039	3.80
Other	121	0.44
Total	27,346	100

Appendix 3

See Table 3.

Table 3 Actions towards the environment

Actions towards the environment
Chosen a more environmentally friendly way of travelling (walk, bicycle, public transport, electric car)
Avoided buying over-packaged products
Avoided single-use plastic goods other than plastic bags (e.g., plastic cutlery, cups, plates, etc.) or bought reusable plastic products
Separated most of your waste for recycling
Cut down your water consumption
Cut down your energy consumption (e.g., by turning down air conditioning or heating, not leaving appliances on standby, buying energy-efficient appliances)
Bought products marked with an environmental label
Bought local products
Used your car less by avoiding unnecessary trips, working from home (teleworking), etc
Joined a demonstration, attended a workshop, took part in an activity (e.g., a collective beach or park cleanup)
Changed your diet to more sustainable food
Spoken to others about environmental issues
Bought second-hand products (e.g., clothes or electronics) instead of new ones
Repaired a product instead of replacing it

Appendix 4

See Table 4.

Table 4 Marginal effects—behaviour model

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Attitude towards the environment	The environment is fairly important to me	− 15.28%***	8.95%***	4.93%***	1.40%***	− 14.65%***	8.36%***	4.90%***	1.40%***	− 15.46%***	9.18%***	4.90%***	1.38%***
	The environment is very important to me	− 34.80%***	20.38%***	11.22%***	3.20%***	− 35.12%***	20.03%***	11.74%***	3.35%***	− 34.67%***	20.60%***	10.98%***	3.10%***
Country of residence	BE—Belgium	− 7.09%**	4.15%**	2.29%**	0.65%**	− 2.87%	1.64%	0.96%	0.27%	− 8.70%**	5.17%**	2.75%**	0.78%**
	DK—Denmark	− 19.05%***	11.15%***	6.14%***	1.75%***	− 20.90%***	11.92%***	6.98%***	1.99%***	− 18.20%***	10.81%***	5.77%***	1.63%***
	DE—Germany	− 12.75%***	7.46%***	4.11%***	1.17%***	− 11.71%**	6.68%**	3.91%**	1.12%**	− 12.68%***	7.53%***	4.01%***	1.13%***
	GR—Greece	7.67%**	− 4.49%**	− 2.47%**	− 0.71%**	4.67%	− 2.67%	− 1.56%	− 0.45%	9.18%**	− 5.45%**	− 2.91%**	− 0.82%**
	ES—Spain	2.49%	− 1.46%	− 0.80%	− 0.23%	− 1.28%	0.73%	0.43%	0.12%	4.20%	− 2.49%	− 1.33%	− 0.37%
	FR—France	− 14.73%***	8.63%***	4.75%***	1.35%***	− 12.48%**	7.12%**	4.17%**	1.19%**	− 15.58%***	9.26%***	4.93%***	1.39%***
	IE—Ireland	4.63%	− 2.71%	− 1.49%	− 0.43%	− 1.42%	0.81%	0.47%	0.14%	7.64%**	− 4.54%**	− 2.42%**	− 0.68%*
	IT—Italy	12.92%***	− 7.56%***	− 4.17%***	− 1.19%***	7.21%	− 4.11%	− 2.41%	− 0.69%	16.06%***	− 9.54%***	− 5.09%***	− 1.43%***
	LU—Luxembourg	− 13.00%***	7.61%***	4.19%***	1.20%***	− 20.50%***	11.69%***	6.85%***	1.95%***	− 10.02%**	5.95%**	3.17%**	0.89%**
	NL—The Netherlands	− 23.68%***	13.87%***	7.64%***	2.18%***	− 23.25%***	13.27%***	7.77%***	2.22%***	− 23.58%***	14.01%***	7.47%***	2.11%***

Table 4 (continued)

Variable	Marginal effects (%)											
	Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
PT—Portugal	13.22%***	−7.74%***	−4.26%***	−1.22%***	10.45%*	−5.96%*	−3.49%*	−1.00%*	14.64%***	−8.70%***	−4.64%***	−1.31%***
GB-UKM—Great Britain	−8.26%***	4.83%***	2.66%***	0.76%***	−5.13%	2.93%	1.71%	0.49%	−9.48%**	5.63%**	3.00%**	0.85%**
AT—Austria	−3.30%	1.93%	1.06%	0.30%	−3.02%	1.72%	1.01%	0.29%	−3.03%	1.80%	0.96%	0.27%
SE—Sweden	−29.67%***	17.37%***	9.57%***	2.73%***	−33.97%***	19.38%***	11.35%***	3.24%***	−28.70%***	17.05%***	9.09%***	2.56%***
FI—Finland	−13.37%***	7.83%***	4.31%***	1.23%***	−16.39%***	9.35%***	5.48%***	1.56%***	−11.90%***	7.07%***	3.77%***	1.06%***
CY—Cyprus (Republic)	−0.45%	0.26%	0.15%	0.04%	−1.36%	0.77%	0.45%	0.13%	0.50%	−0.30%	−0.16%	−0.04%
CZ—Czech Republic	12.86%***	−7.53%***	−4.15%***	−1.18%***	11.39%**	−6.50%**	−3.81%**	−1.09%*	13.79%***	−8.19%***	−4.37%***	−1.23%***
EE—Estonia	−3.53%	2.07%	1.14%	0.32%	−12.66%**	7.22%**	4.23%**	1.21%**	−0.42%	0.25%	0.13%	0.04%
HU—Hungary	12.26%***	−7.18%***	−3.96%***	−1.13%***	10.65%*	−6.07%*	−3.56%*	−1.01%*	13.16%***	−7.82%***	−4.17%***	−1.18%***
LV—Latvia	2.08%	−1.22%	−0.67%	−0.19%	−1.21%	0.69%	0.41%	0.12%	3.55%	−2.11%	−1.12%	−0.32%
LT—Lithuania	4.67%	−2.74%	−1.51%	−0.43%	0.13%	−0.08%	−0.04%	−0.01%	6.58%*	−3.91%*	−2.08%*	−0.59%*
MT—Malta	9.46%***	−5.54%***	−3.05%***	−0.87%***	10.08%	−5.75%	−3.37%	−0.96%	9.73%**	−5.78%**	−3.08%**	−0.87%**

Table 4 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
	PL—Poland	17.85%***	− 10.45%***	− 5.76%***	− 1.64%***	12.50%**	− 7.13%**	− 4.18%**	− 1.19%**	20.61%***	− 12.24%***	− 6.53%***	− 1.84%***
	SK—Slovakia	3.14%	− 1.84%	− 1.01%	− 0.29%	4.69%	− 2.68%	− 1.57%	− 0.45%	3.16%	− 1.88%	− 1.00%	− 0.28%
	SI—Slovenia	− 6.33%**	3.70%**	2.04%**	0.58%**	− 6.36%	3.63%	2.12%	0.61%	− 6.03%	3.58%	1.91%	0.54%
	BG—Bulgaria	17.26%***	− 10.11%***	− 5.57%***	− 1.59%***	19.98%***	− 11.40%***	− 6.68%***	− 1.91%***	16.50%***	− 9.80%***	− 5.23%***	− 1.47%***
	RO—Romania	18.26%***	− 10.69%***	− 5.89%***	− 1.68%***	22.97%***	− 13.10%***	− 7.68%***	− 2.19%***	15.42%***	− 9.16%***	− 4.88%***	− 1.38%***
	HR—Croatia	14.86%***	− 8.70%***	− 4.79%***	− 1.37%***	17.02%***	− 9.71%***	− 5.69%***	− 1.62%***	13.90%***	− 8.25%***	− 4.40%***	− 1.24%***
	Other countries	Reference											
Generation	Born between 1946 and 1964 (Baby boomers)	− 10.42%***	6.10%***	3.36%***	0.96%***					− 10.19%***	6.05%***	3.23%***	0.91%***
	Born between 1965 and 1980 (generation X)	− 11.00%***	6.44%***	3.55%***	1.01%***					− 10.60%***	6.30%***	3.36%***	0.95%***

Table 4 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
	Born after 1980 (Millennials and Generation Z)	−7.60%***	4.45%***	2.45%***	0.70%***								
	Born between 1925 and 1945 (builders)	Reference											
Gender	Man	5.46%***	−3.20%***	−1.76%***	−0.50%***	7.94%***	−4.53%***	−2.65%***	−0.76%***	4.82%***	−2.86%***	−1.53%***	−0.43%***
	Woman	Reference											
Household composition	Not living alone	−3.50%***	2.05%***	1.13%***	0.32%***	0.68%	−0.39%	−0.23%	−0.06%	−4.41%***	2.62%***	1.40%***	0.39%***
	Living alone	Reference											
Place of living	Cities/large urban area	−2.94%***	1.72%***	0.95%***	0.27%***	−2.67%**	1.52%**	0.89%**	0.25%**	−2.89%***	1.72%***	0.92%***	0.26%***
	Rural area/towns and suburbs/small urban area	Reference											

Table 4 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Social class	The lower middle class	−5.14%***	3.01%***	1.66%***	0.47%***	−5.64%***	3.22%***	1.89%***	0.54%***	−5.05%***	3.00%***	1.60%***	0.45%***
	The middle class	−4.21%***	2.47%***	1.36%***	0.39%***	−3.57%**	2.04%**	1.19%**	0.34%**	−4.45%***	2.64%***	1.41%***	0.40%***
	The upper middle class	−7.86%***	4.60%***	2.54%***	0.72%***	−14.94%***	8.52%***	4.99%***	1.42%***	−5.29%***	3.14%***	1.67%***	0.47%***
	The higher class	−6.96%*	4.07%*	2.24%*	0.64%*	−2.99%	1.70%	1.00%	0.28%	−8.22%*	4.88%*	2.60%*	0.73%*
	Another answer	−0.08%	0.05%	0.02%	0.01%	0.14%	−0.08%	−0.05%	−0.01%	−0.13%	0.08%	0.04%	0.01%
	The working class of society	Reference											
Income (economic difficulties)	Most of the time	4.55%***	−2.66%***	−1.47%***	−0.42%***	6.34%***	−3.61%***	−2.12%***	−0.60%***	3.82%***	−2.27%***	−1.21%***	−0.34%***
	From time to time or almost never/never	Reference											
Life satisfaction	Very satisfied	−4.36%***	2.55%***	1.41%***	0.40%***	−2.52%	1.44%	0.84%	0.24%	−4.80%***	2.85%***	1.52%***	0.43%***
	Fairly satisfied	−2.68%***	1.57%***	0.86%***	0.25%***	−0.24%	0.14%	0.08%	0.02%	−3.34%***	1.98%***	1.06%***	0.30%***
	Not very or not at all satisfied	Reference											

Table 4 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Environmental information sources	Newspapers or magazines	− 9.34%***	5.47%***	3.01%***	0.86%***	− 9.39%***	5.36%***	3.14%***	0.89%***	− 9.40%***	5.58%***	2.98%***	0.84%***
	Television news or radio or films/doc	− 10.72%***	6.28%***	3.46%***	0.99%***	− 8.54%***	4.87%***	2.86%***	0.81%***	− 12.64%***	7.51%***	4.00%***	1.13%***
	Family/friends/etc	− 9.29%***	5.44%***	3.00%***	0.85%***	− 9.64%***	5.50%***	3.22%***	0.92%***	− 9.34%***	5.55%***	2.96%***	0.83%***
	Books/scientific lit or brochures or events or museums	− 17.49%***	10.24%***	5.64%***	1.61%***	− 19.11%***	10.90%***	6.39%***	1.82%***	− 16.90%***	10.04%***	5.35%***	1.51%***
	Online social networks or internet	− 14.37%***	8.42%***	4.64%***	1.32%***	− 14.09%***	8.04%***	4.71%***	1.34%***	− 14.70%***	8.73%***	4.66%***	1.31%***
	Other	Reference											

Significancy codes: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Appendix 5

See Table 5.

Table 5 Marginal effects—attitude model

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (Builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Country of residence	BE—Belgium	0.04%	0.27%	1.08%	− 1.39%	0.02%	0.11%	0.41%	− 0.53%	0.03%	0.20%	0.80%	− 1.02%
	DK—Denmark	0.10%	0.67%	2.63%	− 3.39%	0.16%	1.06%	3.98%	− 5.20%	0.08%	0.60%	2.47%	− 3.16%
	DE—Germany	0.09%	0.60%	2.38%	− 3.07%	0.05%	0.35%	1.32%	− 1.72%	0.08%	0.58%	2.37%	− 3.03%
	GR—Greece	− 0.77%***	− 5.34%***	− 21.05%***	27.16%***	− 0.79%***	− 5.24%***	− 19.67%***	25.70%***	− 0.75%***	− 5.42%***	− 22.12%***	28.29%***
	ES—Spain	− 0.48%***	− 3.33%***	− 13.13%***	16.95%***	− 0.51%**	− 3.40%**	− 12.76%**	`**	− 0.47%***	− 3.38%***	− 13.79%***	17.64%***
	FR—France	− 0.40%***	− 2.74%***	− 10.82%***	13.96%***	− 0.56%***	− 3.70%***	− 13.87%***	18.12%***	− 0.35%***	− 2.50%***	− 10.20%***	13.05%***
	IE—Ireland	0.07%	0.51%	2.02%	− 2.61%	− 0.11%	− 0.73%	− 2.72%	3.56%	0.13%	0.91%	3.73%	− 4.78%
	IT—Italy	0.00%	− 0.03%	− 0.13%	0.17%	− 0.34%*	− 2.26%*	− 8.49%*	11.09%*	0.09%	0.62%	2.53%	− 3.24%
	LU—Luxembourg	− 0.23%**	− 1.55%**	− 6.12%**	7.90%**	− 0.29%	− 1.90%	− 7.11%	9.29%	− 0.21%	− 1.49%*	− 6.09%*	7.79%*
	NL—The Netherlands	0.24%**	1.64%**	6.47%**	− 8.35%**	0.15%	0.98%	3.68%	− 4.81%	0.25%**	1.79%**	7.30%**	− 9.34%**
	PT—Portugal	− 0.32%***	− 2.22%***	− 8.75%***	11.29%***	− 0.40%**	− 2.63%**	− 9.88%**	12.90%**	− 0.31%***	− 2.25%***	− 9.20%***	11.77%***
	GB− UKM—Great Britain	− 0.42%***	− 2.90%***	− 11.42%***	14.74%***	− 0.29%	− 1.95%	− 7.32%	9.57%	− 0.48%***	− 3.47%***	− 14.19%***	18.14%***
	AT—Austria	0.30%***	2.09%***	8.26%***	− 10.65%***	0.06%	0.39%	1.47%	− 1.92%	0.38%***	2.71%***	11.07%***	− 14.16%***

Table 5 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (Builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
	SE—Sweden	−0.85%***	−5.90%***	−23.24%***	29.99%***	−1.09%***	−7.22%***	−27.09%***	35.40%***	−0.77%***	−5.54%***	−22.64%***	28.95%***
	FI—Finland	0.23%**	1.62%**	6.38%**	−8.24%**	0.18%	1.17%	4.37%	−5.72%	0.24%**	1.71%**	6.97%**	−8.91%**
	CY—Cyprus (Republic)	−0.86%***	−5.92%***	−23.34%***	30.12%***	−0.85%***	−5.66%***	−21.25%***	27.76%***	−0.85%***	−6.07%***	−24.78%***	31.69%***
	CZ—Czech Republic	0.03%	0.21%	0.84%	−1.08%	−0.14%	−0.92%	−3.45%	4.51%	0.07%	0.49%	1.99%	−2.54%
	EE—Estonia	0.21%**	1.44%**	5.69%**	−7.34%**	0.27%	1.81%	6.78%	−8.86%	0.17%	1.21%	4.96%	−6.34%
	HU − Hungary	−0.10%	−0.71%	−2.81%	3.63%	−0.14%	−0.92%	−3.46%	4.52%	−0.11%	−0.81%	−3.32%	4.25%
	LV—Latvia	0.26%***	1.81%***	7.13%***	−9.20%***	0.52%**	3.49%***	13.09%***	−17.10%***	0.15%	1.06%	4.31%	−5.51%
	LT—Lithuania	0.11%	0.78%	3.07%	−3.96%	0.13%	0.85%	3.21%	−4.19%	0.09%	0.64%	2.60%	−3.33%
	MT—Malta	−0.71%***	−4.92%***	−19.38%***	25.01%***	−0.92%***	−6.12%***	−22.96%***	30.00%***	−0.63%***	−4.55%***	−18.58%***	23.77%***
	PL—Poland	0.07%	0.45%	1.78%	−2.30%	0.23%	1.53%	5.74%	−7.50%	−0.03%	−0.23%	−0.92%	1.18%
	SK—Slovakia	−0.05%	−0.33%	−1.30%	1.68%	−0.27%	−1.83%	−6.85%	8.96%	0.00%	−0.02%	−0.08%	0.10%
	SI—Slovenia	−0.44%***	−3.06%***	−12.07%***	15.58%***	−0.46%**	−3.06%**	−11.49%**	15.01%**	−0.44%***	−3.16%***	−12.90%***	16.50%***
	BG—Bulgaria	−0.54%***	−3.74%***	−14.75%***	19.03%***	−0.65%***	−4.34%***	−16.30%***	21.30%***	−0.51%***	−3.66%***	−14.93%***	19.10%***
	RO—Romania	−0.09%	−0.65%	−2.56%	3.30%	−0.19%	−1.29%	−4.86%	6.35%	−0.08%	−0.59%	−2.42%	3.09%
	HR—Croatia	−0.01%	−0.06%	−0.23%	0.30%	−0.01%	−0.04%	−0.14%	0.18%	−0.04%	−0.29%	−1.18%	1.51%
	Other countries	Reference											

Table 5 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (Builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Generation	Born between 1946 and 1964 (Baby boomers)	0.01%	0.08%	0.30%	−0.39%					0.00%	0.01%	0.02%	−0.03%
	Born between 1965 and 1980 (Generation X)	0.15%***	1.01%***	4.00%***	−5.16%***					0.12%***	0.85%***	3.46%***	−4.42%***
	Born after 1980 (Millennials and Generation Z)	0.21%***	1.42%***	5.60%***	−7.23%***								
	Born between 1925 and 1945 (Builders)	Reference											
Gender	Man	0.22%***	1.48%***	5.85%***	−7.55%***	0.23%***	1.55%***	5.83%***	−7.61%***	0.20%***	1.44%***	5.86%***	−7.50%***
	Woman	Reference											
Household composition	Not living alone	0.04%*	0.27%*	1.05%*	−1.35%*	0.05%	0.32%	1.18%	−1.55%	0.03%	0.25%	1.01%	−1.29%
	Living alone	Reference											
Place of living	Cities/ large urban area	−0.02%	−0.13%	−0.51%	0.66%	−0.06%	−0.39%	−1.48%	1.93%	0.00%	−0.02%	−0.08%	0.10%
	Rural area/ Towns and suburbs/ small urban area	Reference											

Table 5 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (Builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Social class	The lower middle class	0.03%	0.19%	0.73%	−0.94%	0.01%	0.08%	0.32%	−0.42%	0.03%	0.20%	0.83%	−1.06%
	The middle class	−0.08%***	−0.53%***	−2.08%***	2.69%***	−0.03%	−0.18%	−0.67%	0.88%	−0.09%***	−0.65%***	−2.67%***	3.42%***
	The upper middle class	−0.14%***	−0.98%***	−3.86%***	4.98%***	−0.03%	−0.22%	−0.84%	1.10%	−0.18%***	−1.32%***	−5.37%***	6.87%***
	The higher class	−0.40%***	−2.77%***	−10.93%***	14.10%***	0.03%	0.20%	0.77%	−1.00%	−0.58%***	−4.13%***	−16.87%***	21.58%***
	Another answer	0.01%	0.08%	0.30%	−0.39%	−0.08%	−0.56%	−2.08%	2.72%	0.07%	0.50%	2.06%	−2.63%
	The working class of society	Reference											
Income (economic difficulties)	Most of the time	0.16%***	1.08%***	4.28%***	−5.52%***	0.29%***	1.90%***	7.14%***	−9.33%***	0.12%***	0.83%***	3.37%***	−4.32%***
	From time to time or almost never/never	Reference											
Life satisfaction	Very satisfied	−0.65%***	−4.45%***	−17.56%***	22.66%***	−0.50%***	−3.32%***	−12.45%***	16.27%***	−0.66%***	−4.75%***	−19.40%***	24.81%***
	Fairly satisfied	−0.22%***	−1.50%***	−5.90%***	7.62%***	−0.08%	−0.55%	−2.08%	2.72%	−0.24%***	−1.71%***	−6.97%***	8.92%***
	Not very or not at all satisfied	Reference											

Table 5 (continued)

Variable		Marginal effects (%)											
		Full sample				Born after 1980 (millennials and generation Z)				Born in 1980 or before (Builders, baby boomers and generation X)			
		y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4	y = 1	y = 2	y = 3	y = 4
Environmental information sources	Newspapers or magazines	−0.18%***	−1.25%***	−4.93%***	6.37%***	−0.16%***	−1.05%***	−3.96%***	5.17%***	−0.18%***	−1.26%***	−5.16%***	6.60%***
	Television news or radio or films/doc	−0.50%***	−3.48%***	−13.71%***	17.69%***	−0.41%***	−2.72%***	−10.20%***	13.33%***	−0.55%***	−3.95%***	−16.13%***	20.63%***
	Family/friends/etc	−0.19%***	−1.28%***	−5.04%***	6.51%***	−0.19%***	−1.29%***	−4.83%***	6.32%***	−0.18%***	−1.29%***	−5.28%***	6.75%***
	Books/scientific lit or brochures or events or museums	−0.39%***	−2.66%***	−10.47%***	13.51%***	−0.47%***	−3.13%***	−11.75%***	15.35%***	−0.34%***	−2.46%***	−10.06%***	12.87%***
	Online social networks or internet	−0.39%***	−2.68%***	−10.57%***	13.64%***	−0.53%***	−3.50%***	−13.13%***	17.15%***	−0.34%***	−2.41%***	−9.83%***	12.57%***
	Other	Reference											

Significancy codes: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Author's contribution JC: conceptualization, methodology, analysis, writing—original draft, review and editing, validation. LA: conceptualization, methodology, analysis, writing—original draft, review and editing, validation. AT: conceptualization, methodology, analysis, writing—original draft, review and editing, validation.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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