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European Citizens' Worries and Self-Responsibility towards Climate Change

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Abstract: Attitudes and perceptions about climate change (CC) are crucial to public engagement and support in the promotion of mitigating actions and sustainable lifestyles embracing the United Nations' sustainable development goals. This study aimed to investigate how worried are European citizens about CC, and what is their willingness to assume self-responsibility in its mitigation. We used the European Social Survey, namely the answers to the questions "How worried are you about climate change?" and "To what extent do you feel a personal responsibility to try to CC?" and have related them with demography and individual perception of the society and its policies. We fit two statistical models to each of the questions studied and found the following: Model 1—people that trust in scientists are more worried about CC, people satisfied with the national government are more worried about CC, women are more worried about CC than men, and older and more educated people are also more worried about CC; Model 2—Women have higher levels of self-responsibility, people that trust in scientists feel more responsibility when satisfied with the economy and the health system of the country, and older people that trust in scientists also have more responsibility.

Keywords: climate change; culpability; anxiety; mitigation; willingness

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1. Introduction

Although citizens' perceptions about climate change (CC) have been extensively analysed by the literature over the past two to three decades [1–3], these studies focused mainly on environmental and agricultural aspects; only recently have studies into the challenges of CC and attempts at mitigation and involvement of the citizens became more effective.

Nevertheless, despite the relevance of the topic "attitudes about CC", the literature covers mostly the side of the demand. The majority of the literature considers the attitudes of citizens as consumers, which is considered a critical factor responsible for the deterioration of the environment [4–6]. Thus, environmental consumption has become a relevant area in the literature. Recent studies have focused mainly on environmental consumers associated with demographic and socioeconomic factors [7,8] and the association between attitude and actual consumption patterns [4,7]. Other studies reinforce the importance of economic factors on sustainable consumption just on the demand side [9].

The literature also focused on the contribution of education to sustainable practices [10,11] and conclude that the three main themes used to create CC awareness among school children were the effects of CC, the factors affecting CC, and mitigation plans in handling CC issues.

Nousheen and colleagues 10 analysed the factors that affect citizens' attitudes towards CC and how these attitudes affect national climate change policy in 26 countries of Europe.

The results showed that attitudes really matter in the implementation of public policies and that citizens' attitudes are conditioned not only by the way individuals react to the specific attributes of CC, but also by socio-economic factors, information, openness of society, and attitudes towards the reliability of the government.

Boto-García and Bucciol [11] analysed the public attitudes concerning CC and mitigation measures and how psychological factors, such as attitudes, norms, and willingness to pay, determine self-reported energy-efficient behaviour. The authors conclude that good public awareness of lifestyle change needs can facilitate the implementation of policies favouring environmentally friendly behaviours.

Other works [10,12] focus on the impact of the speech and ideas defused by public decisions makers and politicians to citizens. This is primarily related to the attitudes and impact of the populist parties in the dissemination of messages about CC, specifically, to the institutional trust and attitudes towards science. The authors note that populists tend to have more negative attitudes toward science and political institutions, and, consequently, the trend to reduce the importance of CC and the importance of mitigation measures.

The literature also refers to perceptions and attitudes concerning European citizens about CC based on the European Social Survey 2016 or ESS8 [2,13,14]. The authors [14] analysed people's attitudes towards welfare and the results of CC policies, concluding that four distinct attitude groups can be determined and that the probability of belonging to any of these groups is influenced by the individuals' socioeconomic and ideological status, together with the context of the country where they live.

Poortinga and colleagues [13] analysed the influence of key socio-political and demographic factors in CC perception across 22 European countries and Israel. The results also confirm the importance of socio-economic conditions, specifically, age, gender, and education. However, these authors consider that political ideology and age are more consistent across countries than gender and age concerning CC perceptions.

Hence, citizens across the world in general, and in Europe in particular, have become increasingly aware of CC and its impact on future social and economic conditions.

The recent challenge and crises (economic, social, environmental, institutional, epidemic, and energetic) affecting economies at the global level have drawn attention to the need for urgent and real implementation of structural changes towards a more sustainable world and society [5,15].

The EU has a long tradition and has a consolidated environmental policy framework [16], based on sustainability policies aiming to achieve economic, social, and environmental objectives aligned with the United Nations Agenda 2030 for Sustainable Development Goals (SDGs). The European environmental policy framework is based on the Treaty of the EU, specifically on Articles 11 and 191 to 193, with the measures to mitigate CC being an explicit goal referred to in Article 191 [16]. Financial support for the EU comes from a Multi-Annual Financial Framework implemented over recent decades to support and implement multilevel policies at economic, social, and environmental levels in the Member States. These aim to mitigate CC and promote general environmental efficiency in the different sectoral economies and countries [17].

Several studies [18–20] have evaluated the impact of EU regulations and directives, such as the Water Framework Directive and the Waste Framework Directive, on pollution levels and environmental quality. These studies have generally found that EU environmental policies have been effective in reducing pollution and protecting natural resources, although there is room for improvement in certain areas [21–23].

Another area of research is the relationship between EU environmental policies and economic development. Some studies suggest that environmental regulations can have negative effects on economic growth [23,24], while others argue that a more sustainable economy is more resilient and profitable in the long run [21,24,25]. There is also an ongoing debate about the role of market-based instruments, such as the emissions trading schemes, in achieving environmental objectives [26–29]. Some studies suggest that the system

has been successful in reducing emissions [30–32], while others argue that it needs to be strengthened in order to achieve the EU's climate goals [33,34].

Finally, many studies have evaluated the role of public participation in EU environmental policymaking [35–37]. The EU has established several mechanisms for involving stakeholders and the public in environmental decision-making [38], such as the Aarhus Convention and the European Citizens' Initiative in line with the Lisbon Treaty [39–41]. Studies have generally found that public participation can lead to more effective and legitimate environmental policies, although there are challenges to ensuring that all voices are heard and that the process is transparent [40,42].

According to Park and Lin [6] "When people sense that an issue poses a serious threat, they want to reduce the threat associated with the issue". That means citizens and public decision-makers taking action and supporting policies and measures to reduce the carbon footprint and greenhouse gas emissions, which reinforces the relevance of this paper. This paper assumes that attitudes and perceptions about CC are crucial for public engagement and support to promote mitigating actions and to promote a sustainable lifestyle accordingly to the SDGs. As such, the aim of this study is to investigate how worried are European citizens with CC and what is their willingness to assume self-responsibility in CC mitigation. We also test the hypothesis that gender, age, education level, level of trust in scientists, level of trust in the legal system, level of satisfaction with the economy, level of satisfaction with the government, satisfaction with the state of the health services, and satisfaction with the state of the education levels may affect both self-responsibility and worries about climate change.

2. Materials and Methods

2.1. Data

The data used were collected between the 25th of May 2022 and the 18th of September 2022, are freely available, and were retrieved from the European Social Survey [43]. The European Social Survey (ESS) is a cross-national survey that covered 25 European countries in its 10th edition [43]. This survey has three aims:

- "To monitor and interpret changing public attitudes and values within Europe and to investigate how they interact with Europe's changing institutions;
- To advance and consolidate improved methods of cross-national survey measurement in Europe and beyond;
- And, to develop a series of European social indicators, including attitudinal indicators. The survey involves strict random probability sampling, high response rate and rigorous translation protocols."

The data were collected through face-to-face interviews; however, due to the COVID-19 pandemic, some interviews were done via web or videoconference.

The survey covers several aspects of the Europeans' life, including social conditions and indicators, social behaviour and attitudes, general health and well-being, political behaviour and attitudes, political ideology, minorities, cultural and national identity, media, equality, inequality and social exclusion, language and linguistics, religion and values, and family life and marriage [44].

The represented universe in the sample includes persons aged 15 and over resident within private households, regardless of their nationality, citizenship, language, or legal status, in the following countries: Austria, Bulgaria, Switzerland, Czechia, Germany, Estonia, Spain, Finland, France, Greece, Croatia, Hungary, Iceland, Italy, Lithuania, Montenegro, North Macedonia, Netherlands, Norway, Poland, Portugal, Serbia, Sweden, Slovenia, and Slovakia. The survey contains a total of 18,060 entries.

2.2. Variables Included in the Present Study

With the aim of studying levels of worriedness and self-responsibility in European citizens to tackle CC, we have selected variables of interest from the ESS. The surveyed individuals were asked several questions, including two questions of interest for the present

study and herein used as the dependent variable: Question 1—"How worried are you about climate change?" Question 2—"To what extent do you feel a personal responsibility to try to reduce climate change?"

As independent variables (IV) to explain the chosen dependent variable, we have selected questions related with demography, and the individual perception of the society and its policies. The following were used as IV:

Demographic: age, gender, and years in education.

Individual perception of the society and its policies: trust in the legal system, trust in scientists, satisfaction with the state of the economy, satisfaction with the government, satisfaction with the democratic system, satisfaction with the state of the health services, and satisfaction with the state of the education services.

2.3. Statistical Analysis

The dependent variables (DV) were responded to on a five-point Likert scale (1 not at all worried, 2 not very worried, 3 somewhat worried, 4 very worried, and 5 extremely worried) for question 1, and on a 0 to 10 scale (from 'not at all' to 'a great deal') for question 2.

The IV were answered with a direct answer for the demographic and on a 0 to 10 scale (from 'not at all' to 'a great deal') for the others. All the questions resulting in the DV and IV variables had as answer options 'don't know', refused to answer, or did not give an answer. The models considered only interviewees with a scaled answer in all the significant variables.

The two dependent variables entered ordinal regressions with a cumulative logit link. In a first instance, single IV models were fitted to the DV to retrieve the individual influence of each of the IVs in the DV. In a second step, a factorial model was adjusted, using only the IV previously found to be significant. A backwards stepwise selection of variables was implemented. The two dependent variables entered two different ordinal regressions, with a cumulative logit link. The procedures were repeated with each of the DV.

The procedures were implemented via the generalized linear models routine of the statistical package IBM Corp. ®SPSS® Statistics, Armonk, NY, USA. Version: 28.0.1.1.

The predicted probabilities of the model were computed following the parameterization of the models as

$$log\left(\frac{P(Y \leq j)}{1 - P(Y \leq j)}\right) = \alpha_j + \beta_1 x_1 + \beta_2 x_2 \cdots \beta_n x_n \quad (1)$$

where the β_i are the parameters of the fitted model and x_i are the dummies associated with each of the variables when these are factors or the value of the variable if these are covariates. The number of parameters β_i reflects the number of significant IVs in the model and varies from 1 to n, and j varies between 1 and the number of total ordered levels in the DV minus one, once one of the levels is used as reference in the model. With the DPs in the present study, $5 - 1 = 4$. Therefore $j = 4$ (1 not at all worried, 2 not very worried, 3 somewhat worried, and 4 very worried), with 5 extremely worried being the reference level. The threshold is given by α, in each one of the j levels. From (1), the probabilities are calculated as

$$P(Y \leq j) = \frac{e^{\alpha_j + \beta_1 x_1 + \beta_2 x_2 \cdots \beta_n x_n}}{1 + e^{\alpha_j + \beta_1 x_1 + \beta_2 x_2 \cdots \beta_n x_n}} \quad (2)$$

For the levels 1 to 4 and for level 5 as

$$P(Y \leq 5) = \frac{1}{1 + e^{\beta_1 x_1 + \beta_2 x_2 \cdots \beta_n x_n}} \quad (3)$$

3. Results

3.1. Descriptive Statistics

The descriptive statistics of the variables used in this study are shown in Table 1.

Table 1. Descriptive statistics of the variables entered in the study.

		Variables §								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
N ǂ	Valid	17,765	11,845	17,641	17,640	17,598	17,201	17,916	17,466	17,723
	Omitted	295	6215	419	420	462	859	144	594	337
Mean		4.86	6.79	4.65	4.29	4.91	5.61	5.46	5.71	3.20
Median		5.00	7.00	5.00	4.00	5.00	6.00	6.00	6.00	3.00
Standard error		2.874	2.460	2.488	2.711	2.684	2.539	2.701	2.822	0.956
Minimum		0	0	0	0	0	0	0	0	1
Quartile	25	3.00	5.00	3.00	2.00	3.00	4.00	3.00	4.00	3.00
	50	5.00	7.00	5.00	4.00	5.00	6.00	6.00	6.00	3.00
	75	7.00	9.00	7.00	6.00	7.00	8.00	8.00	8.00	4.00
Maximum		10	10	10	10	10	10	10	10	5

§ All variables on a 0 to 10 scale (from 'not at all' to 'a great deal'), with the exception of variable 9 on a 1 to 5 scale (1 not at all worried, 2 not very worried, 3 somewhat worried, 4 very worried, and 5 extremely worried); Variables: 1—Trust in the legal system, 2—Trust in scientists, 3—Satisfaction with present state of the economy in the country, 4—Satisfaction with the national government, 5—Satisfaction with the way democracy works in the country, 6—State of the education in the country nowadays, 7—State of health services in the country nowadays, 8—To what extent do you feel personal responsibility to reduce climate change, 9—How worried are you about climate change; ǂValid answers were given within the scale, omitted answers relate to refusal to answer, not giving an answer or answering 'don't know'.

3.2. How Worried Are You about Climate Change?

3.2.1. Single Independent Variable Models

In these models, single independent variables were entered to facilitate the interpretation of results. The results are summarised in Table 2.

Table 2. Parameters of the models fitted to the dependent variable "How worried are you about climate change?", using single independent variables.

Dependent Variable		**Independent Variables**															
		1 NS	**2** ***		**3** NS	**4** ***		**5** NS	**6** NS	**7** NS	**§ 8** ***		**9** ***		**10** ***	
			β	e^{β}		β	e^{β}				β	e^{β}	β	e^{β}	β	e^{β}
How worried are you about climate change?	1		−2.67 ***	0.07		−3.1 ***	0.05				−3.42 ***	0.03	−2.91 ***	0.06	−2.75 ***	0.06
	2		−1.03 ***	0.36		−1.46 ***	0.23				−1.77 ***	0.17	−1.27 ***	0.28	−1.11 ***	0.33
	3		1.05 ***	2.87		0.61 ***	1.72				0.32 ***	1.38	0.80 ***	2.23	0.96 ***	2.61
	4		3.0 ***	20.0		2.55 ***	12.8				2.27 ***	9.67	2.74 ***	15.5	2.9 ***	18.14
IV parameter			0.08 ***	1.08		0.02 ***	1.02				−0.45 ***	0.64	0.006 ***	1.006	0.034 ***	1.034

Independent variables: 1—Trust in the legal system, 2—Trust in scientists, 3—Satisfaction with the present state of the economy in the country, 4—Satisfaction with the national government, 5—Satisfaction with the way democracy works in the country, 6—State of education in the country nowadays, 7—State of health services in the country nowadays, 8—Gender, 9—Age, 10—Years in full-time education; § Male is modelled, female is the reference ($\beta = 0$); Levels in how worried are you about climate change: 1 not at all worried, 2 not very worried, 3 somewhat worried, 4 very worried, and 5 extremely worried (used as reference, $\beta = 0$); NS $p > 0.05$, *** $p < 0.001$.

The results were not significant for the variables "trust in the legal system", "satisfaction with the economy of the country", "satisfaction with the way democracy works in the country", "state of education in the country", and "state of the health services in the country". Therefore, none of these variables impact how worried people are about climate change. We can use the odds ratio (e^{β}) for the interpretation of the significant results. Therefore:

- The odds of scoring higher, or being more worried about CC, increase as trust in scientists increases. The odds ratio is 1.08, meaning that the odds of scoring one point higher in the CC question increase by 8% with by each point rating higher trust in scientists.
- The odds of scoring higher, or being more worried about CC, increase as the satisfaction with the national government increases. The odds ratio is 1.02, meaning that the odds of scoring one point higher in the CC question increase by 2% with each point rating higher satisfaction with the national government.

- The odds of rating a lower score are 0.64 higher for men than women. The odds of a woman rating a higher score is 1/0.64 = 1.5625 higher than men. The odds are 56.25% higher for women than they are for men, and women are more worried about climate change than men.
- The odds of scoring higher, or being more worried about CC, increase with the age of the interviewees. The odds ratio is 1.006, meaning that the odds of scoring one point higher in the climate change question increase by 0.06% per year added to the age of the interviewee.
- The odds of scoring higher, or being more worried about CC, increase with the time spent on education by the interviewees. The odds ratio is 1.034, meaning that the odds of scoring one point higher in the climate change question increase by 3.4% per added year to the education of the interviewee.

3.2.2. Multiple Independent Variable Model

In the multiple independent variable model, all the independent variables (IV) previously found to be significant in the single IV models entered a factorial model. The model was found to be significant (−2 Log likelihood χ^2 = 364, 9 d.f., $p < 0.001$) and has an AIC = 28,181. The parameters and respective interactions found to be significant can be consulted in Table 3.

Table 3. Multiple independent variable model, modelling "How worried are you about climate change". From the 18,060 interviews, 11,282 were included in the model and 6778 were excluded.

			95% CI			95% CI	
Parameter	**β**	**Std Error**	**Lower**	**Upper**	**Exp(β)**	**Lower**	**Upper**
How worried 1	−2.080 ***	0.276	−2.620	−1.540	0.125	0.073	0.214
2	−0.416 ^{NS}	0.273	−0.959	0.119	0.660	0.387	1.126
3	1.706 ***	0.273	1.171	2.241	5.506	3.224	9.406
4	3.670 ***	0.275	3.130	4.209	39.238	22.879	67.294
Gender *** Male	−1.247 ***	0.152	−1.546	−0.949	0.287	0.213	0.387
T Sci ***	0.085 ***	0.025	0.035	0.135	1.089	1.036	1.144
Age ***	0.024 **	0.006	0.013	0.036	1.024	1.013	1.036
YE **	0.052 ***	0.017	0.019	0.084	1.053	1.019	1.088
T Sci × Gender ***, Male	0.055 ***	0.016	0.025	0.086	1.057	1.025	1.090
Gender × Age ***, Male	0.008 ***	0.002	0.004	0.012	1.008	1.004	1.012
T Sci. × Age ***	−0.002 ***	0.0006	−0.004	−0.001	0.998	0.996	0.999
Age × YE *	−0.001 **	0.0004	−0.002	−0.001	0.999	0.998	0.999
T Sci × Age × YE **	0.0001 ***	4.01^{-5}	5.03^{-5}	2.1^{-4}	1.0001	1.00005	1.0002

CI—Confidence interval, How worried—How worried are you about climate change, T Sci—Trust in Scientists, YE—Years in Education; Levels in how worried are you about climate change: 1—not at all worried, 2—not very worried, 3—somewhat worried, 4—very worried, 5—extremely worried (used as reference, $\beta = 0$); ^{NS} $p > 0.05$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Using the odds ratio to interpret the results, the independent variables "Gender", "Trust in scientists", "Age of the interviewee", and "Years in education" were found to be significant, and the same type of tendencies were found as per single variable models. The independent variable is also affected by two-way interactions and a three-way interaction, and the interpretation is more complex and cannot be made directly. Some results follow that may be useful in the interpretation:

- For the interaction between "Gender" and "Trust in Scientists" no significant differences are found between men and women relative to trusting in scientists (Mann–Whitney U-test Z = −0.330, $p = 0.742$).
- For the interaction "Gender Age", there is a significant difference between the age of the male and female interviewees (equal variances not assumed, Levene's Z = 4.387, $p = 0.036$; *T*-test $t = -7.227$, 17,938 d.f., $p < 0.001$), with mean age of females (51.78) slightly higher than males (49.78). Therefore the 8% addition in the odds ratio is

understandable as both the gender female and age have a positive impact on the score of the dependent variable.

- For the interaction "Trust in Scientists" with "Age", and also for the interaction "Age" with "Years in education", the same type of rationale used previously cannot be used, and the results do not have a direct interpretation. The results must be understood in the context of the main effects results and the three-way interaction.
- The three-way interaction has a direct interpretation, as the individual variables all impact positively the independent variable; therefore, when considered together, the result is augmented.

3.3. To What Extent Do You Feel a Personal Responsibility to Try to Reduce Climate Change?

3.3.1. Single Independent Variable Models

In these models, single independent variables were entered to facilitate the interpretation of results. The results are summarized in Table 4.

Table 4. Parameters of the models fitted to the dependent variable "To what extent do you feel a personal responsibility to try to reduce climate change?", using single independent variables.

Dependent Variable ‡		Independent Variables (IV)																			
		1 ***		2 ***		3 ***		4 ***		5 ***		6 ***		7 ***		§ 8 ***		9 ***		10 ***	
		β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}	β	e^{β}
To what extent do you feel a personal responsibility to try to reduce climate change?	0	−2.162 ***	0.115	−1.702 ***	0.182	−2.029 ***	0.132	−2.206 ***	0.110	−2.075 ***	0.126	−2.068 ***	0.126	−2.133 ***	0.118	−2.794 ***	0.061	−2.87 NS	0.057	−1.516 ***	0.220
	1	−1.810 ***	0.164	−1.351 ***	0.259	−1.675 ***	0.187	−1.855 ***	0.156	−1.723 ***	0.179	−1.719 ***	0.179	−1.783 ***	0.168	−2.446 ***	0.087	−2.52 NS	0.080	−1.165 ***	0.312
	2	−1.318 ***	0.268	−0.859 ***	0.423	−1.180 ***	0.307	−1.363 ***	0.256	−1.229 ***	0.293	−1.229 ***	0.293	−1.293 ***	0.274	−1.959 ***	0.141	−2.04 NS	0.130	−0.674 ***	0.510
	3	−0.857 ***	0.425	−0.399 ***	0.671	−0.716 ***	0.489	−0.902 ***	0.406	−0.766 ***	0.465	−0.770 ***	0.463	−0.833 ***	0.435	−1.503 ***	0.222	−1.58 NS	0.205	−0.214 ***	0.807
	4	−0.524 ***	0.592	−0.067 NS	0.935	−0.381 ***	0.683	−0.570 ***	0.565	−0.432 ***	0.649	−0.438	0.645	−0.501 ***	0.606	−1.176 ***	0.309	−1.26 NS	0.285	0.117 NS	1.124
	5	0.274 ***	1.315	0.732 ***	2.079	0.423 ***	1.527	0.226 ***	1.254	0.370 ***	1.448	0.355 ***	1.426	0.294 ***	1.341	−0.395 ***	0.674	−0.48 NS	0.621	0.911 ***	2.486
	6	0.765 ***	2.150	1.224 ***	3.401	0.917 ***	2.502	0.716 ***	2.046	0.863 ***	2.371	0.842 ***	2.322	0.781 ***	2.183	0.083 ***	1.087	0.001 NS	1.001	1.400 ***	4.054
	7	1.417 ***	4.125	1.878 ***	6.540	1.573 ***	4.819	1.366 ***	3.918	1.517 ***	4.557	1.491 ***	4.440	1.428 ***	4.170	0.720 ***	2.055	0.64 NS	1.889	2.050 ***	7.768
	8	2.276 ***	9.740	2.740 ***	15.48	2.434 ***	11.41	2.223 ***	9.236	2.377 ***	10.77	2.347 ***	10.45	2.283 ***	9.806	1.567 ***	4.794	1.48 NS	4.389	2.908 ***	18.33
	9	2.883 ***	17.87	3.350 ***	28.50	3.042 ***	20.95	2.830 ***	16.95	2.985 ***	19.79	2.953 ***	19.17	2.890 ***	17.99	2.172 ***	8.778	2.08 NS	8.017	3.516 ***	33.67
IV parameter		0.116 ***	1.123	0.146 ***	1.157	0.151 ***	1.164	0.116 ***	1.123	0.133 ***	1.142	0.114 ***	1.120	0.111 ***	1.117	−0.317 ***	0.728	−0.004 ***	0.996	0.0089 ***	1.093

Independent variables (IV): 1—Trust in the legal system, 2—Trust in scientists, 3—Satisfaction with the present state of the economy in the country, 4—Satisfaction with the national government, 5—Satisfaction with the way democracy works in the country, 6—State of education in the country nowadays, 7—State of health services in the country nowadays, 8—Gender, 9—Age, 10—Years in full-time education; § Male is modelled, female used as reference ($\beta = 0$); ‡ from 0 'not at all' to 10 'a great deal' (10 used as reference, $\beta = 0$); NS $p > 0.05$, *** $p < 0.001$.

All the independent variables were found to be significant, and therefore affect how the interviewees answered the question "To what extent do you feel a personal responsibility to try to reduce climate change?". Using the odds ratio (e^{β}) for the interpretation of the significant results:

- The odds of scoring higher or feeling more responsible to try to reduce CC increases as trust in the legal system increases. The odds ratio is 1.123, meaning that the odds of scoring one point higher in the climate change question increase by 12.3% with each point rating higher trust in the legal system.
- The same result is observed for "Trust in scientists". The odds ratio is 1.57, meaning that the odds of scoring one point higher in the CC question increase by 57% with each point rating higher trust in scientists.
- For satisfaction with the state of the economy in the country, the odds ratio is 1.164, a 16.4% increase.
- For satisfaction with the national government, the odds ratio is 1.123, a 12.3% increase.
- For satisfaction with the way democracy works, the odds ratio is 1.142, a 14.2% increase.

- For satisfaction with the state of education in the country, the odds ratio is 1.12, 12.0% increase.
- For satisfaction with the state of the health services in the country, the odds ratio is 1.117, an 11.7% increase.
- The odds of rating a lower score are 0.728 higher for men than women. The odds of women rating a higher score is 1/0.728 = 1.3736 higher than men. The odds are thus 37.36% higher for women than they are for men, and women feel more personal responsibility in trying to reduce climate change than men.
- For age, the odds ratio is 0.996, and (1/0.996 = 1.004); thus, responsibility decreases slightly with age (0.4% per year added to age).
- For time in education, the odds ratio is 1.093, a 9.3% increase per added year in full-time education.

3.3.2. Multiple Independent Variable Model

In the multiple independent variable model, all the independent variables (IV) previously found to be significant in the single IV models entered a single factorial model. Due to the very high number of significant variables, only two-way interactions were used. The model was found to be significant (−2 Log likelihood χ^2 = 1139, 8 d.f., $p < 0.001$) and has an AIC = 48,816. The results are summarized in Table 5.

Table 5. Parameters of the models fitted to the dependent variable "To what extent do you feel a personal responsibility to try to reduce climate change?", using a factorial model with independent variables and two-way interactions. From the 18,060 interviews, 11,017 were included in the model and 7043 were excluded.

			95% CI			95% CI	
Parameter	**β**	**Std Error**	**Lower**	**Upper**	**Exp(β)**	**Lower**	**Upper**
[§] Responsibility 0	−1.663 ***	0.1102	−1.879	−1.447	0.190	0.153	0.235
1	−1.304 ***	0.1087	−1.517	−1.091	0.271	0.219	0.336
2	−0.800 ***	0.1073	−1.011	−0.590	0.449	0.364	0.554
3	−0.325 **	0.1067	−0.534	−0.116	0.723	0.586	0.891
4	0.014 [NS]	0.1065	−0.194	0.223	1.015	0.823	1.250
5	0.865 ***	0.1067	0.656	1.074	2.374	1.926	2.927
6	1.373 ***	0.1072	1.163	1.583	3.949	3.201	4.872
7	2.057 ***	0.1083	1.845	2.269	7.822	6.326	9.671
8	2.949 ***	0.1104	2.733	3.165	19.087	15.375	23.697
9	3.559 ***	0.1125	3.339	3.780	35.138	28.186	43.806
Gender × Age ***, Male	0.007 ***	0.0025	0.003	0.012	1.007	1.003	1.012
T Sci × S Econ ***	0.013 ***	0.0011	0.011	0.015	1.013	1.011	1.015
T Sci × S Health ***	0.006 ***	0.0010	0.004	0.008	1.006	1.004	1.008
T Sci × Age ***	−0.001 ***	0.0003	−0.002	0.000	0.999	0.998	1.000
T Sci × YE ***	0.005 ***	0.0013	0.003	0.008	1.005	1.003	1.008
Gender *** Male	−0.696 ***	0.0997	−0.892	−0.501	0.498	0.410	0.606
YE ***	0.036 ***	0.0103	0.016	0.056	1.037	1.016	1.058

CI—Confidence interval, Responsibility—To what extent do you feel a personal responsibility to try to reduce climate change? T Sci—Trust in Scientists, YE—Years in Education, S Econ—Satisfaction with present state of economy in the country, S Health—State of health services in the country nowadays; In Gender, male is modelled, female is used as reference ($\beta = 0$); [§] Responses scaled from 0 'not at all' to 10 'a great deal' (10 is used as reference, $\beta = 0$); [NS] $p > 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Using the odds ratio to make the interpretation of the results, the independent variables "Gender" and "Years in education" were found to be significant, and the same type of tendencies were found as per the single variable models. The independent variable is also affected by two-way interactions, and the interpretation is more complex and cannot be made directly. One additional difficulty is the fact that some independent variables ("State of the economy", "State of the health system", and "Trust in scientists") are significant only in interaction. Some results follow that may be useful in the interpretation:

- For the interaction "Gender × Age", the previous findings of significant differences between males and females can, in this model, have the same explanation.
- To devise an explanation of the two-way interactions, the correlations between the variable "Trust in scientists" and the others involved in the interactions were obtained (Sperman's rho): "Satisfaction with the economy in the country" 0.298 ($p < 0.001$), "Satisfaction with the health system in the country" 0.306 ($p < 0.001$), "Age of the interviewee" 0.034 ($p < 0.001$), and "Years in education" 0.134 ($p < 0.001$). The positive correlation with "Trust in scientists" itself contributing to higher levels of self-responsibility in the single models can explain the results. The exception is age, but as age correlates negatively with "Time in education" (-0.204, $p < 0.001$), the negative parameter in the interaction with "Trust in scientists" may be in the model to compensate the positive parameter in the interaction "Trust in scientists × Years in education".

4. Discussion

As its name indicates, self-responsibility belongs to each individual; therefore, gender, age, degree of education, and individual beliefs are key factors in shaping perception. However, location-related factors are closely interacting with this individual perception, such as the trust in the country's government, the state of the economy or the degree to which the country is affected by climatic disturbances or ecological disasters. The use of a large and diverse dataset across Europe allowed us to explore these complex relationships, and despite the wide breadth and diversity of socio-economic constraints, we found clear and consistent factors affecting people's concern and self-responsibility around CC across the 25 European countries surveyed.

Gender was found to be the most important variable shaping CC responsibility and awareness. As it has been previously reported, we found that women perceive CC as a more concerning issue than men [45–47] and they also feel more responsible for it. The social involvement of women in care and parenting tasks appears to be one of the factors behind these gendered differences. Nevertheless, men who are fathers at the same time increase their individual worry about the impact of CC on their children's life [46,47]. Women tend to underestimate their CC knowledge [48], despite being found to be better informed than men [49].

For this capacity of understanding CC, the awareness of its causes, impacts, and solutions has paramount importance. In fact, the complexity of CC makes it harder to understand for children [50,51]. Thus, as we found, CC awareness increases with age, which is indirectly related to education and exposure to information [52]. Despite this, we could be currently facing a social change, as different studies show how younger people realize the severity of CC and are more proactive in environmental issues [53], in agreement with our results that point to more responsibility in youth. For example, a recent study targeting Finnish children's perception showed how they think CC is important and they feel responsible for it [50]. In fact, young Swedish climate activist Greta Thunberg started a protest with global impacts at the age of 15 which is the paradigm of young Europeans' perception of CC. The decrease in the responsibility towards CC with age could be also related to a transfer of the problem from older adults to the youth with the idea that CC issues will be solved by a future generation of well-educated and climate-conscious children [54] that will be undoubtedly more affected by a failure to deal with CC [52].

Individual knowledge about the global climate threat is a key factor in shaping awareness. In the present study, we found that each year of education is a factor that increases the level of awareness of CC, which tallies with what was previously reported by Ekholm and Olofsson [47]. When people are confused about pivotal points related to CC, for example, between the concepts of climate and weather [55], this leads to a decrease in their perception of the severity of the issue. Otherwise, when there is an understanding of how climate change operates, people are more likely to take effective action and be advocates for climate change mitigation policies [56].

The intrinsic characteristics of CC as a systematic change in average weather conditions make it a phenomenon that cannot be perceived or evaluated with a personal perspective without the statistical tools that scientists offer [55]. Nevertheless, when processes are experienced in a personal way, they tend to raise both awareness and proactive action; multiple studies have found a correlation between natural disasters and climate change preoccupation [57]. In this context of an intangible and slow process, the capacity of scientists to inform society through mass media and educators about the importance of CC mitigation is key to raising awareness and thus making collective decisions towards sustainable action [55].

People concerned with CC modify their willingness to support mitigation policies when they have low levels of social trust [56]. Thus, this perception is highly affected by the country's socioeconomic and political conditions [58,59]. There are multiple variables that can inform how people transfer the level of awareness into active day-to-day decisions to mitigate CC. Governments encouraging energetic saving as a mitigation policy can positively affect social perception and action against CC [11]. Moreover, incentives such as financial subsidies or fines are considered useful for increasing environmental awareness [11,60]; however, their utility on climate unconscious people varies depending on individuals' economic status.

Although the data analysed in this study present robust evidence with a large number of samples from multiple countries and a well-diversified spectrum, some limitations were found that should be considered and could be addressed in future works. For example, the use of large datasets is prone to obtain significant results despite the size of the effects found [61], and the interpretation of results should always consider the magnitude of the effects and previous knowledge. Here, we obtained a combination of factors that show high effects and low ones, and even when the effect sizes were small, the consistency across countries and the majority of consensus with previous studies increase our confidence in these results [62]. We also must consider that multiple other factors could be also affecting and interacting with these self-perceptions; for example, when studying the effort to save energy as a climate mitigation tool, Boto-Garcia and Bucciol [11] found evidence that income and religious belief were positively associated with responsibility but negatively with mitigation behaviour. The moment in which the 10th European Social Survey was carried out may also be affecting the results obtained as it took place during the COVID-19 pandemic in 2022. This could potentially modulate the degree of concern about CC and the perception of its threat. In a Swedish study to understand the worries behind reproductive decisions within climate crises across multiple age groups and gender, the ongoing pandemic was often seen as a much more tangible and important threat than climate change [54].

5. Conclusions

How to mitigate and decrease the impact of CC is still an ongoing debate that requires a combination of multiple social, economic, and political strategies. However, for CC to achieve central concern status in governments and in their actions, a strong sense of people's concern about CC must also be present. We identified multiple key factors for raising awareness and concern and incrementing the degree of individual responsibility. As such, it is pivotal to educate from childhood to adulthood about CC, its causes, and mitigation measures, as evidenced by science. This would also allow effective policies that can be perceived as good indicators of government reliability and social justice to match governments' statements. We need to tackle gender discrepancies with direct policies towards equality and a balance of roles between men and women, to be able to share the perspective that a better future depends on a shift in today's actions against CC.

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