Climate change perceptions and their individual-level determinants: A cross-European analysis

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Abstract

There is now an extensive literature on the question of how individual-level factors affect climate change perceptions, showing that socio-political variables, notably values, worldviews and political orientation, are key factors alongside demographic variables. Yet little is known about cross-national differences in these effects, as most studies have been conducted in a single or small number of countries and cross-study comparisons are difficult due to different conceptualisations of key climate change dimensions. Using data from the European Social Survey Round 8 (n = 44,387), we examine how key socio-political and demographic factors are associated with climate change perception across 22 European countries and Israel. We show that human values and political orientation are important predictors of climate change beliefs and concern, as are the demographics of gender, age, and education. Certain associations with climate change perceptions, such as the ones for the self-transcendence versus self-enhancement value dimension, political orientation, and education, are more consistent across countries than for gender and age. However, even if the direction of the associations are to a large extent consistent, the sizes of the effects are not. We demonstrate that the sizes of the effects are generally smaller in Central and Eastern European countries, and that some demographic effects are larger in Northern European as compared to Western European countries. This suggests that findings from one country do not always generalize to other national contexts.

1. Introduction

1.1 Background

Public perceptions of climate change have been extensively studied over the past two to three decades (Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015). This research is conducted on the understanding that climate change perceptions are critical to public engagement and support for action on climate change (Bord, O'Connor, & Fisher, 2000; Corner, Markowitz, & Pidgeon, 2014). Ambitious targets, such as set out in the Paris agreement (UNFCCC, 2017) and the European Commission's 2030 energy strategy (European Commission, 2014), require fundamental shifts in the way energy is used and produced to mitigate climate change. However, policymakers may be reluctant to take meaningful action, if their electorate do not think that climate change is happening, anthropogenic, or a serious threat.

The now extensive literature on climate change perceptions has contributed to a better insight into how different individuals perceive and engage with climate change. Many studies on the topic have focused on individual-level factors in people's beliefs and concerns about climate change. This research appears to show a consistent pattern across different demographic groups. In particular, the research shows that men, older age groups, and those with fewer years of formal education tend to be more doubtful about the reality and anthropogenic nature of climate change, reflecting trend and attribution scepticism, respectively (Milfont, Milojev, Greaves, & Sibley, 2015; Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011), and that they are less concerned about the impacts of climate change (Shi, Visschers, Siegrist, & Arvai, 2016; Whitmarsh, 2011). Explanations for this patterning include the '*white male effect*', showing that Caucasian men are generally more accepting of a range of environmental and technological risks – with a pattern that is distinct from almost any other demographic group (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000). This may reflect societal inequalities, as well as differences in the subjective experience of vulnerability in relation to these risks (Satterfield, Mertz, & Slovic, 2004). The effects may however be contingent on the particular type of environmental risk concern (Hayes, 2001), and gender differences may not exist in relation to generic environmental concern (Echavarren, 2017). Some scholars have pointed to the role of conservative values (the '*conservative male effect*') in combination with identity-protective cognition (Kahan, Braman, Gastil, Slovic, & Mertz, 2007; McCright & Dunlap, 2013), whereby lower levels of risk perception, including those for climate change, indicate a motivation to maintain prevailing social structures (Jylhä & Akrami, 2015; Jylhä, Cantal, Akrami, & Milfont, 2016). Climate scepticism appears to be particularly common among politically conservative men in a number of countries (McCright & Dunlap, 2011; Milfont et al., 2015; Whitmarsh, 2011); and there is evidence that gender difference are only modest when key beliefs and values are taken into account (McCright, 2010).

Age effects in climate change perceptions have been found consistently across a large number of countries (e.g. Echavarren, 2017; McCright, 2010; Milfont et al., 2015; Poortinga et al., 2011). Age effects, just as gender effects, have been explained by differences in motivation to maintain prevailing social structures. Older people are more integrated into existing social orders, and therefore may have more to lose by changes that are needed to address environmental challenges such as climate change. Age differences may also be explained by climate change having been a threat and/or part of the formal education

(Stevenson et al., 2014) when older age cohorts were growing up. Furthermore, value orientations may change over the lifecourse, which may have implications for how one feels about climate change. There is evidence that people become more (politically) conservative as they age (Cornelis et al., 2009); and political values are among the strongest socio-political determinants of climate change perceptions (see below)

Education effects, i.e. of people with longer formal education expressing higher levels of concern about the environment in general and climate change in particular (Marquart-Pyatt, 2008; O'Connor, Bord, & Fisher, 1999), are interpreted in multiple ways. It is often implicitly assumed that education is a proxy for knowledge or a better understanding of the scientific underpinnings of climate change. However, climate change and/or scientific knowledge itself tends to be a poor predictor of climate change beliefs (Whitmarsh, 2011), with climate sceptics being generally as knowledgeable as non-sceptics (Hornsey, Harris, Bain, & Fielding, 2016). Knowledge may even have diverging effects depending on people's political orientation (Kahan et al., 2012; Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015; Malka, Krosnick, & Langer, 2009), suggesting that a lack of belief or concern about climate change may not be due to a deficit in knowledge (Snow & Dibners, 2016). Socio-economic effects are further interpreted in reference to post-materialism theory (Inglehart, 1990). Individuals who have satisfied their basic material needs may shift their attention to more postmaterialist ones, such as freedom, quality of life and environmental protection (Fransson & Garling, 1999; Knight, 2016). While, overall, there are clear indications that the demographics of gender, age, and education are all important factors in climate change perceptions, it is not known whether these effects are universal or that they vary across countries.

Strong associations of climate change perceptions have also been found with a range of socio-political variables, such as political orientation, human values and worldviews (Hornsey et al., 2016). It is well established that public views on climate change are divided along party-political lines in the US (Hoffman, 2011; McCright & Dunlap, 2011; McCright, Dunlap, & Xiao, 2014); and there are indications that political orientation may be an important factor in other countries as well, in particular in Anglophone countries (Fielding, Head, Laffan, Western, & Hoegh-Guldberg, 2012; Milfont et al., 2015; Poortinga et al., 2011). It is however not clear whether possible political divides in other countries are as pronounced as in the US.

The role of human values and cultural worldviews in climate change perceptions has also attracted widespread attention (Brown & Kasser, 2005; Corner et al., 2014; Kahan,

Jenkins-Smith, & Braman, 2011; Poortinga, Steg, & Vlek, 2004). Values are understood as guiding principles in life, and are considered an important part of what forms our beliefs and attitudes towards social issues, including climate change (Milfont et al., 2015). This helps to shape the way we behave in relation to the environment (De Groot & Steg, 2008; Poortinga et al., 2004; Stern, 2000). Values' associations with climate-relevant attitudes and behaviour have mostly been studied using either Schwartz' theory of basic human values, which arranges ten distinct clusters across the two axes of *conservation versus openness-to-change* and self-*transcendence versus self-enhancement* (Schwartz, 1992), or the *altruistic*, *egoistic*, and *biospheric* trio of values derived from the Value-Belief-Norm (VBN) model (Dietz, Dan, & Shwom, 2007; Stern, 2000). Research has consistently shown that people who endorse self-transcending (or: altruistic) values have higher levels of concern and are less likely to be sceptical about anthropogenic climate change (Brown & Kasser, 2005; Corner et al., 2014; De Groot & Steg, 2007; Poortinga et al., 2004), while the opposite is generally (if not always) true for self-enhancement (or: egoistic) values (Steg & De Groot, 2012). While multiple studies have focused on the self-transcendence and self-enhancement value dimension, the role of the conservation and openness-to-change value dimensions in climate change perceptions has been explored less. There are indications that individuals who hold openness-to-change values have stronger beliefs in the reality of climate change and its human cause (Milfont et al., 2015), and that those endorsing conservation values are less likely to be concerned about or willing to make changes for the environment (Schultz & Zelezny, 1999; Stern, Dietz, & Guagnano, 1998). Overall, the effects for openness-to-change and conservation values appear weaker than for self-transcendence and self-enhancement values, and a few studies found non-significant relationships with these dimensions (Milfont et al., 2015; Poortinga et al., 2004; Steg & De Groot, 2012).

The question remains whether these findings can be generalised to different countries or cultural contexts. Notably, most studies that have examined individual-level factors in relation to climate change perceptions have been conducted in a single or a small number of countries; and it is difficult to compare studies due to the use of different measures and conceptualisations of key climate change dimensions. A recent meta-analysis showed that individual-level effects were significantly moderated by the type of measure used (Hornsey et al., 2016). There are indications that the importance of different demographic and socio-political values in predicting climate change perceptions may vary cross-nationally independent of the type of measure. For example, Shi and colleagues found that gender, age

and education do not predict concern about climate change to the same extent in six different countries (Shi et al., 2016). Similarly, political ideology has been shown to predicts climate change beliefs in certain countries but not in others (Capstick et al., 2015). Whereas McCright and colleagues (2016) found that political ideology is associated with public views on climate change across multiple Western European countries, the effects are not as pronounced as in the US. Furthermore, non-significant effects were found for political affiliation in former communist countries (McCright, Dunlap, & Marquart-Pyatt, 2016). There are suggestions that climate scepticism in the media is predominantly an Anglophone phenomenon (Painter & Ashe, 2012), and it can be expected that polarisation is the greatest in countries where there is a political home for climate sceptical views through continued media attention and political representation (Dunlap & McCright, 2011; Engels, Hüther, Schäfer, & Held, 2013; Milfont et al., 2015; Poortinga et al., 2011; Tranter & Booth, 2015).

Marquart-Pyatt (2008) concluded that the individual-level sources for environmental concern, including demographics and knowledge, are largely consistent across nineteen industrialised countries; although there were some differences between them. In particular, a number of coefficients appeared different in former communist countries as compared to advanced industrialised countries (Marquart-Pyatt, 2008). The study focused on environmental concern, which may be less politicised than attitudes to climate change. A recent meta-analysis found high levels of variation in the strength of individual-level effects across studies (Hornsey et al., 2016), and particularly revealed significant differences in effect sizes between US and non-US samples. Yet, they did not explicitly examine cross-country variation. Moreover, the studies that were included in the meta-analysis were sourced from a large number of countries, and used data from diverse representative and non-representative samples that were collected at different time periods, making it difficult to draw firm conclusions about possible country differences. Furthermore, the studies included a wide variety of measures reflecting different aspects of climate change perceptions. It is therefore possible that the reported variation in individual-level effects is attributable to methodological (e.g. specific outcome measure or sampling strategy used) or contextual (e.g. country and period in which study was conducted) differences between the different studies. There is thus a clear need for systematic international comparisons to better understand the importance of individual factors for climate change perceptions in different national contexts (Hopkins, 2015).

1.2 Aims of this Paper

In this paper we make use of the *European Social Survey Round 8* (European Social Survey, 2016) to examine how individual-level demographic and socio-political factors are linked to climate change perceptions. In particular, we will examine levels of climate change perceptions and their determinants in 22 European countries and Israel. The focus of the paper is on four dimensions of *climate change perceptions*: public beliefs about the existence, causes, and consequences of climate change, and climate change concern. We distinguish between *climate change beliefs*, defined as propositional cognitions about the nature of climate change that may or may not correspond with reality (i.e. beliefs regarding the reality, causes, and impacts of climate change, which are often used to identify trend, attribution, and impact sceptical views; Poortinga et al., 2011), and *climate concern*, defined as affective evaluations of the seriousness of (the impacts of) climate change, indicated by personal feelings of worry about the issue (cf. Lo & Chow, 2015). We collectively refer to *climate change beliefs and concern* as *climate change perceptions*.

The paper has four aims. *First*, it will examine national differences in climate change perceptions across the 23 countries. *Second*, it will explore associations of different individual-level socio-political and demographic predictors with climate change perceptions across all countries. *Third*, it will assess cross-national differences in the strength of the relationships between these individual-level predictors and climate change perceptions, that is, whether the sizes of the regression coefficients of individual-level socio-political and demographic predictors differ between countries. *Fourth*, the paper will explore whether there are systematic differences in individual-level effects between different European regions, namely Western, Central and Eastern, Southern, and Northern European countries. By using high-quality, standardised measures of the key variables of interest, and coordinated data collection according to the highest methodological standards, the study is able to exclude methodological sources of variation.

2. Methods

2.1 The European Social Survey

The European Social Survey (ESS) is a biennial pan-European survey that has been conducted since 2002. Each round contains two modules on key social themes. Round 8 of the ESS (European Social Survey, 2016) included a module on Climate and Energy, designed by the authors together with ESS headquarters and national coordinating teams. The ESS has a

number of methodological standards regarding questionnaire design, translation and data collection. The questionnaire was developed in English through a two-year design process, which included extensive testing, piloting and translation by national teams (European Social Survey, 2015; Fitzgerald, 2015). Each country needed to achieve a minimum effective sample size of 1,500 (or 800 in countries with populations smaller than 2 million), representative of the resident population. Data collection involved strict random probability sampling to obtain nationally-representative samples, and an extensive concept-based design process to ensure measurement equivalence (Fitzgerald & Jowell, 2010). Interviews were conducted face-to-face in respondents' own homes with people aged 15 years and over. The sample sizes for the 23 countries are provided in *Table 1*. In total, 44,387 participants were available for the analyses. Data were collected, usually within three-month, in the period from August 2016 to December 2017. Post-stratification weight were used to take account of unequal probabilities of selection, as well as of sampling and non-response error. The full questionnaire and the complete European Social Survey Round 8 dataset can be downloaded from http://www.europeansocialsurvey.org.

2.2 Measures

2.2.1 Dependent variables (climate change perceptions)

Climate change beliefs. Three questions were asked to assess people's beliefs regarding the existence, causes, and consequences of climate change, respectively. *Trend scepticism* was determined by asking respondents "You may have heard the idea that the world's climate is changing due to increases in temperature over the past 100 years. What is your personal opinion on this? Do you think the world's climate is changing?" Respondents could use the options: definitely not changing, probably not changing, probably changing, and definitely changing. The 4-point response scale was dichotomised to 0 (probably/definitely changing) and 1 (probably/definitely not changing). *Attribution scepticism* was assessed with the question "Do you think that climate change is caused by natural processes, human activity, or both?" The responses were coded as 1 (entirely/mainly by natural processes) and 0 (entirely/mainly by human activity/about equally by natural processes and human activity). The non-prompted option of "I don't think climate change is happening" was coded as missing to avoid overlap with trend sceptical beliefs. *Perceived impacts of climate change*: respondents were asked to indicate how good or bad they thought the impact of climate change would be on people across the world, on a scale from -5 (extremely bad) and +5 (extremely good).

Climate concern was assessed by asking respondents "How worried are you about climate change?" with the response options of 1 (not at all worried), 2 (not very worried), 3 (somewhat worried), 4 (very worried), and 5 (extremely worried).

2.2.2. Independent variables (socio-political and demographic variables)

Human values. A modified 21-item version of the Portrait Values Questionnaire (PVQ) was used to measure peoples' values (Schwartz, 2003). Each item consists of a short two-sentence, gender-matched description of a person. Respondents then indicate on a 6-point scale from 1 (very much like me) to 6 (not like me at all) how similar this person is to themselves. The Schwartz (2015) approach was used to transform the items into 10 values. Universalism, Benevolence, Achievement (reversed) and Power (reversed) values were subsequently combined into an internally consistent *Self-transcendence vs. Self-enhancement* dimension (α=0.65), and Conformity, Security, Stimulation (reversed) and Hedonism (reversed) values into an internally consistent *Conservation vs. Openness-to-change* dimension (α=0.67). Higher positive values correspond to more self-transcendence and more openness-to-change values, relative to self enhancement and openness-to-change respectively. The two value scales were standardised by calculating the Z scores across all countries.

Political orientation involved self-placement on a 10-point scale ranging from 0 (left) to 10 (right). The question read: "In politics people sometimes talk of 'left' and 'right'. Using this card, where would you place yourself on this scale, where 0 means the left and 10 means the right?" The political orientation variable was standardised by calculating Z scores across all countries.

Demographics. Gender was indicated as 0 (female) and 1 (male). The age variable was centred on its grand mean of 47.64, and expressed in 10 year deviations from that mean. Level of education was indicated by the ESS version of the International Standard Classification of Education (ISCED). The level of education variable was centred on its grand mean of 4.14.

European regions. The European Regions included Western Europe (Austria, Belgium, Switzerland, Germany, France, United Kingdom, Ireland, and the Netherlands), Central and Eastern Europe (Czech Republic, Estonia, Hungary, Lithuania, Poland, the Russian Federation, and Slovenia), Southern Europe (Spain, Italy, and Portugal), and Northern Europe (Finland, Iceland, Norway, and Sweden). This distinction was made, as previous research has predominantly been conducted in Western and Northern European countries, and there are indications that differences in climate change perceptions across different socio-political and

demographic groups are smaller in former communist Central and Eastern European countries (Marquart-Pyatt, 2012; McCright, Dunlap, & Marquart-Pyatt, 2016). Israel was excluded from the region comparisons as the only non-European country involved in the ESS (Israel was included in all the other analyses).

2.3. Data analysis

Multilevel modelling was used to analyse the data, utilising the *MLwiN 2.36* software package, with individuals (level 1) nested within countries (level 2). Logistic models were constructed for trend and attribution scepticism, and linear models for the perceived impacts of climate change and concern about climate change. Three sets of analyses were conducted, in addition to the descriptive statistics to assess national differences in climate change perceptions. *First*, we constructed a series of *random intercept* multilevel regression models that included human values, political orientation, and demographics of gender, age, and level of education as predictors (Model 1). Only the fixed effects of the multilevel regression models are reported. Hence, these models were used to estimate the overall associations of the independent variables with the four climate change perception dimensions across the 23 countries, while allowing the countries to vary with respect to their average level on the dependent variable in the respective regression model. *Second*, a series of *random intercept, random slope* models were constructed for the four dependent climate change belief and concern variables. This means that Model 1 was extended by allowing the slopes of the independent variables to vary across countries (*Model 2*). Separate regression analyses were conducted for each of the six independent variables in their associations with the four climate change perception dimensions. That is, all independent variables were included, but only one slope was allowed to vary in each regression model. This approach was chosen, as the number of countries involved is insufficient to reliably estimate all parameters simultaneously. Only the random effects of the multilevel regression analyses are reported. The random effects indicate the cross-country variation in the strength of the association between the individual-level socio-political and demographic variables on the one hand and the climate change belief and concern variables on the other. *Third*, a series of analyses was conducted to examine whether there are any systematic differences between countries from different European regions. This was done by adding the regions as dummy variables (Model 3a), and subsequently their interactions with the socio-political and demographic variables (Model 3b). Separate regression analyses were conducted for each of the six independent variables in their associations with the four climate change perception dimensions. This means that each

multilevel regression model had three dummies indicating Central and Eastern European, Southern European, and Northern European countries, respectively (using Western European countries as the reference category), and three interaction terms of Central and Eastern European, Southern, and Northern European countries with the respective socio-political and demographic factors. Only the interaction effects are reported. The interaction effects indicate the extent to which the individual-level effects in those regions differ from the ones found in the Western European countries.

3. Results

3.1 National differences in climate change perceptions

In line with several other studies (e.g. Capstick et al., 2015), we find that levels of trend and attribution scepticism are low in most countries (see *Table 1*). This means that an overwhelming majority of the European population thinks that climate change is happening and is at least partly caused by human activity. However, there are substantial differences across the participating countries. Trend scepticism ranged from 2.3% in Iceland to 16.5% in the Russian Federation, and attribution scepticism from 4.0% in Spain to 15.4% in Lithuania. Attribution scepticism in Norway (12.0%) was surprisingly high, given that it has a middle-sized level of trend scepticism (7.1%) and a just-above average level of concern about climate change (see below). On average, the perceived impacts of climate change were seen to be negative in all participating countries, and ranged from -1.07 in Israel to -2.55 in Portugal, suggesting that most people think that the impacts of climate change around Europe (and Israel) will only be slightly negative. Average levels of concern ranged from 2.64 in Israel and 2.65 in Estonia to 3.42 in Spain and 3.48 in Portugal. This means that in all countries concern hovered around the scale midpoint of 3, which equates to "somewhat worried". These differing results show the importance of distinguishing between different types of climate change beliefs and concern.

3.2 Individual-level effects of climate change perceptions

We subsequently explored the associations of the individual-level socio-political and demographic factors with the four climate change perception dimensions across the 23 countries. This was done with a series of *random intercept* multilevel models, in which the individual-level factors were included as independent variables (*Model 1*). The models assumed the regression coefficients to be constant but allowed the intercepts to vary across the participating countries. This type of analysis allows us to explore the overall associations, while

taking into consideration that the countries differ with respect to their means. As can be seen in *Table 2*, the six socio-political and demographic variables were significant predictors of a number or all climate perception dimensions. Individuals who prioritise *self-transcendence* over *self-enhancing* values were less likely to have trend or attribution sceptical views (as is indicated by odds ratios below 1), perceived the impacts of climate change to be more negative, and had higher levels of concern. The *conservation* vs *openness-to-change* value dimension was non-significantly associated with trend and attribution scepticism, but individuals prioritising conservation over openness-to-change values tended to perceive the impacts of climate change as slightly less negative and to have slightly lower levels of concern. Individuals who placed themselves on the right hand side of the political spectrum were more likely to have trend or attribution sceptical views, perceived the impacts of climate change to be less negative, and had lower levels of concern.

The results demonstrate that men were more likely to have trend and attribution sceptical beliefs across the 23 countries, and generally had lower levels of concern about climate change than women. In contrast to these findings, men perceived the impacts of climate change to be more negative than women did. Furthermore, older respondents were more likely to have trend or attribution sceptical views, perceived the impacts of climate change to be less negative, and had lower levels of concern about climate change than younger respondents. Finally, the results show that level of education was negatively associated with trend and attribution sceptical beliefs. Respondents with higher levels of education also perceived the impacts of climate change to be more negative, and had higher levels of concern about climate change.

3.3. Cross-national differences in the strength of effects

In order to investigate cross-national variation in the strength of individual-level effects, we conducted a series of *random intercept, random slope* multilevel regression analyses, in which not only the intercepts but also slopes of the regression coefficients were allowed to vary across countries (*Model 2*). *Table 3* presents the cross-country variation (σ^2) in the strength of the associations between the individual-level socio-political and demographic variables on the one hand and the climate change perception dimensions on the other. It shows that the cross-country variation in the associations of the *self-transcendence vs self-enhancement* value dimension with trend scepticism, attribution scepticism and the perceived impacts of climate change were significant, but not with concern about climate change. All of the associations of the *conservation vs. openness-to-change* value dimension varied significantly across the 23

countries. For political orientation, the cross-country variation in the associations with attribution scepticism, perceived impacts of climate change and concern about climate change were significant, but not the one with trend scepticism. The associations of gender with attribution scepticism concern about climate change varied significantly across the 23 countries, as did the association of gender with concern about climate change. The associations of age with trend scepticism, attribution scepticism and the perceived impacts of climate change were significant, but not the one with concern about climate change. Similarly, the associations of education with trend scepticism, attribution scepticism and the perceived impacts of climate change were significant, but not the one with concern about climate change.

Figures 1 and 2 show the country-level regression lines for the socio-political and demographic variables, respectively. The figures visualise the degree to which the associations vary across the 23 countries. The raw regression coefficients and their confidence intervals are provided in the *Supplementary Information* document (see Tables A to F) to show the strength of the associations in the individual countries. The figures appear to show that certain associations are more consistent across countries than others, and that the cross-national variations in the strength of individual-level effects sometimes but not always lead to different conclusions regarding their importance. Table A in the supporting information shows that the *self-transcendence vs. self-enhancement* value dimension is consistently and positively associated with concern about climate change. It is also consistently associated with the perceived negative impacts of climate change, with only a few exceptions. While the self-transcendence vs. self-enhancement value dimension was generally negatively associated with trend and attribution scepticism, the associations were non-significant in twelve and five countries, respectively (Table A).

With regard to the *conservation vs. openness-to-change* value dimension, this factor was non-significantly associated with trend and attribution scepticism in the overwhelming majority of countries (Table B). It was only significantly associated with trend scepticism in the Czech Republic and with attribution scepticism in Israel. However, while the overall association of the factor with the perceived impacts of climate change was non-significant (Table 2), there were a number of countries in which the association was significantly negative and a number of countries where the association was significantly positive. Furthermore, whereas the overall association of the conservation vs. openness-to-change value dimension with concern about climate change was found to be significantly negative, the associations were non-significant in a majority of the individual countries, with only a few exceptions.

The associations of *political orientation* with the four climate perception dimensions were consistent across the 23 countries (Table C). Individuals with a right-leaning political orientation were less likely to perceive negative impacts and to be concerned about climate change in a majority of countries. While a right-leaning political orientation was generally positively associated with trend and attribution scepticism, the associations were non-significant in seven and nine countries, respectively.

The association of *gender* with trend scepticism was generally consistent across the 23 countries (Table D). The association was non-significant in five countries. The associations of gender with the other three climate perception dimensions were less consistent. While gender was positively associated with attribution scepticism overall (Table 2), the association was non-significant in ten out of the 23 countries. Similarly, while gender was negatively associated with concern about climate change overall, the association was non-significant in twelve out of the 23 countries. While men were found to perceive less negative impacts overall, the associations of gender with the perceived impacts of climate change were non-significant in all but two countries.

Age was consistently associated with attribution scepticism: in virtually all countries older respondents were more likely to have doubts about the anthropogenic nature of climate change (Table E). However, its association with the other three climate perceptions dimensions was more variable. In a majority of countries, older respondents were more likely to hold trend sceptical views, to perceive less negative impacts, and to be less concerned about climate change; but the associations were non-significant in ten countries for each of the three dimensions. The association between age and concern was even significantly positive in Lithuania.

Respondents with a higher *level of education* were generally less likely to hold trend and attribution sceptical beliefs, perceived more negative impacts, and were more concerned about climate change (Table F). These effects were consistent, in particular for attribution scepticism and concern about climate change. The associations were non-significant in four and three countries respectively. The results for trend scepticism and the perceived impacts of climate change were somewhat more variable. The associations were non-significant in nine and eight countries, respectively.

3.4 Differences in the strength of effects between European regions

We subsequently conducted a series of analyses to examine whether there are any systematic differences between countries in different European regions. *Table 4* presents the main (Model 3a) the interaction effects (Model 3b) of Central and Eastern, Southern, and Northern European countries that took part in the ESS. It shows that trend (OR=2.05, 95%CI 1.26 to 3.25) and attribution (OR=1.56, 95%CI 1.06 to 2.29) scepticism are more common in Central and Eastern Europe as compared to Western Europe; that the perceived impacts are more negative and that concern about climate change is higher in Southern Europe; and that there are no significant differences between Northern and Western Europe in any of the four climate perception dimensions.

The interaction effects (Model 3b) indicate the extent to which the individual-level effects in Central and Eastern, Southern and Northern European countries differ from the ones found in Western European countries. The interaction effects need to be compared to the regression coefficients of the different factors (see Table 4), which reflect their association with the respective climate perception dimensions in Western European countries. That is, where the overall regression coefficient is positive, a negative interaction term generally indicates a weaker effect and a positive interaction term a stronger effect for that factor in the region of interest. Reversely, where the overall regression coefficient is negative, a negative interaction term generally indicates a stronger effect and a positive interaction term a weaker effect. Where the overall regression coefficient is close to zero (e.g. for conservation vs openness-to-change), a negative interaction term may indicate a negative effect and a positive interaction term a positive effect for that factor in the region of interest.

Table 4 shows that the effects of the self-*transcendence vs. self-enhancement* value dimension were generally weaker in Central and Eastern European countries than in Western European countries, as indicated by the positive interaction terms for attribution scepticism and perceived impacts of climate change, and the negative interaction term for concern about climate change. The effects of self-transcendence vs. self-enhancement values were also weaker in Northern European countries as compared to Western European countries, although the interaction effects for attribution scepticism and concern about climate change were non-significant. No significant differences were found between Southern and Western Europe.

Individuals living in Southern European countries, who prioritise *conservation over openness-to-change values*, were more likely to hold attribution sceptical views and to perceive

less negative climate change impacts, as indicated by positive interaction terms. Individuals living in Northern European countries, who prioritise conservation over openness-to-change values, were more likely to hold trend and attribution sceptical views and to perceive less negative climate change impacts, as indicated by positive interaction terms. This is in contrast to Western Europe where the associations were non-significant. The only significant interaction of Central and Eastern Europe with the conservation vs. openness-to-change value dimension was found for the perceived impacts of climate change. The negative interaction term indicates that, on average, conservation vs. openness-to-change values are associated with more negative perceived climate change impacts in Eastern European countries.

The *political orientation* effects were generally weaker in Central and Eastern European countries as compared to Western European countries, as indicated by the negative interaction terms for trend scepticism and the perceived impacts of climate change, and by the negative interaction term for concern about climate change. In Southern Europe, political orientation effects were weaker for the perceived impacts and concern about climate change, as indicated by a positive and a negative interaction term, respectively. The only significant interaction effect of Northern Europe with political orientation was for attribution scepticism. This suggests that there is a bigger political divide with regard to attribution scepticism in Northern European countries as compared to Western European countries.

Table 4 further shows that there were only a small number of significant interaction effects for *gender*, suggesting that effects are relatively uniform across the different regions of Europe. In Central and Eastern and Northern European countries men were generally less concerned about climate change as compared to women in these regions, while the association of gender and climate concern was non-significant in Western European countries. The gender effects in relation to the perceived impacts of climate change were weaker in Central and Eastern European countries as compared to Western European countries. Gender effects were stronger in terms of attribution scepticism In Northern European countries as compared to Western European countries.The other interaction effects for gender were non-significant.

Age effects were generally weaker in Eastern European countries than in Western European countries, as indicated by negative interaction terms for trend scepticism, attribution scepticism and perceived impacts of climate change, and a positive interaction term for concern about climate change. Age effects for the perceived impacts and concern about climate change were generally stronger in Northern European countries, as indicated by a positive and a

negative interaction term, respectively. The only significant interaction for Southern Europe was found for the perceived impacts of climate change, indicating that, on average, the age effects for the perceived impacts of climate change were weaker in Southern European countries as compared to Western European countries.

The relationships between *level of education* on the one hand and the perceived impacts of climate change on the other appear stronger in Northern European countries, but weaker in Central and Eastern and Southern European countries (as indicated by negative and positive interactions, respectively). The link between education and attribution scepticism appears weaker in Eastern European countries as compared to Western European countries (as indicated by a positive interaction), while the link between education and trend scepticism appears stronger in Northern European as compared to Western European countries. The other interaction effects were non-significant.

4. Discussion

This paper examined the associations of climate change perceptions with a range of individual-level factors, and how the importance of these factors may vary cross-nationally. Building upon previous research on the individual-level determinants of climate change perceptions, we show that both socio-political and demographic factors are significant predictors of climate change beliefs and concern across 22 European countries and Israel (Capstick et al., 2015; Poortinga et al., 2011; Shi et al., 2016; Steentjes et al., 2017). This demonstrates that both socio-political and demographic factors are needed to understand public perceptions of climate change.

We show that some of the associations are remarkably consistent across the 23 countries that participated in the European Social Survey (cf. Marquart-Pyatt, 2008). In particular *political orientation*, *level of education* and the *self-transcendence vs. self-enhancement* values dimensions, were consistently linked to four different dimensions of climate change perceptions. That is, people who place themselves on the right-hand side of the political spectrum, have a lower level of education, and prioritise self-enhancement over self-transcendence values are more likely to hold climate sceptical views, perceive fewer negative impacts, and are less likely to be concerned about climate change in all or a great majority of countries. The other individual-level effects were more variable. For example, gender and age were significantly associated with climate change perceptions in some but non-significantly so in other countries; and whereas the conservation vs openness-to-change values dimension was

non-significantly associated with the four climate perception dimensions in most countries, there were a number of countries in which the association was significantly negative *and* a number of countries in which the association was significantly positive. Another interesting case is the association of gender with the perceived impacts of climate change. While the association is significant overall, it is only so in a small minority of individual countries (associations are non-significant in the other countries).

Even if the direction of the associations were to a large extent consistent, the sizes of the effects were not. This shows the importance of cross-cultural research, and the need to validate results in multiple countries and cultural contexts before assuming certain effects are universal. For example, while climate change perceptions are fairly consistently linked to political orientation, they are not equally polarised in every country. This not only applies to the socio-political factors but also to the demographic ones. Evidence was found that the effects for the demographic (e.g. age) and socio-political (e.g. political orientation) factors are generally weaker in Eastern as compared to Western European countries. Some of the demographic effects (e.g. gender and age) appeared stronger in Northern European countries. Demographics can reflect important socio-cultural categories, as illustrated by the 'conservative male effect' (cf. Jylhä & Akrami, 2015). The phenomenon that a specific demographic subgroup holds very distinct attitudes to a range of risk issues, from climate change and gun control to financial markets, emerged from and has mainly been found in the US (Dunlap & McCright, 2011; Finucane et al., 2000); and these socio-cultural categories may mean different things in different countries. That is, a conservative male in the US may socio-culturally not be the same as a conservative male in a different country.

The question of course is where the cross-national differences come from, and how they can be explained. The results of our study appear to confirm previous research showing systematic differences in individual-level effects between Central and Eastern European on the one hand and other European countries (McCright et al., 2016) and advanced industrialised countries (Marquart-Pyatt, 2008) on the other. Specifically, there appears to be less of a political divide in former communist countries. Several explanations have been offered for an East-West divide in environmental attitudes. These mostly focus on the legacy left by decades of communist rule as well as the profound impact of its collapse in the late 1980s. For example, it has been argued that the political and economic uncertainty following the collapse of communist regimes may have prioritised economic survival over environmental protection (cf. Inglehart, 1990). Others point to the speed of economic and social change, and a possibility of

a cultural lag in environmental attitudes (Brinkman & Brinkman, 1997; Balžekiene & Telešiene, 2017). Environmental attitudes may be 'sticky', in particular when they emerge from fundamental orientations and beliefs (Chaisty & Whitefield, 2015). This means that they may have to play catch-up in a fast changing world.

General explanations for cross-national differences include differences in experiences with extreme weather events (e.g. flooding and droughts) and vulnerability to the impacts of climate change (Brody, Zahran, Vedlitz, & Grover, 2008; Demski, Capstick, Pidgeon, Sposato, & Spence, 2017; Deryugina, 2013; Donner & McDaniels, 2013; Spence, Poortinga, Butler, & Pidgeon, 2011), elite cues and media coverage (Carmichael & Brulle, 2017; Feldman, Hart, Leiserowitz, Maibach, & Roser-Renouf, 2017), and current CO_2 emissions and dependence on fossil fuels (Lee et al., 2015). While there are indications that all these factors are important for climate-relevant environmental attitudes, they are less appropriate for explaining differences in the size of individual-level effects. Here again we may need to look at possible historical and political explanations. According to Rohrschneider and colleagues (2015), one reason as to why left-right divisions are smaller in Central and Eastern Europe is because the environment is less of an issue for party competition in these countries. If political parties do not compete for the green vote, they are less likely to polarise the public in return (ibid). Furthermore, if there is no platform for climate sceptical views, either as part of party politics and/or the media, there is less opportunity for the public to become polarised through elite cues (cf. Brulle et al., 2016; Carmichael & Brulle, 2017)

It is less clear as to why some of the demographic and value effects vary across countries and regions; and there is no coherent literature available to draw upon. Gender differences in environmental risk perception are often explained by social inequalities, and it could be argued that such effects are therefore less likely to emerge in more gender equal societies (Norgaard & York, 2005). This view is however not supported by the results of the current study. Gender effects appeared stronger in Northern European countries that tend to have higher levels of gender equality. Further research is needed to see wat may explain the effects.

There is a need to be cautious when interpreting the reported findings. The study involved a relatively small number of countries (n=23). This means that the models only have the statistical power to detect large national-level differences (Button et al., 2013). One criticism of current climate perception research is that the vast majority of empirical focus has

been on a small number of mainly affluent Western countries (Hopkins, 2015). A strength of our study is that there was a range of countries, including a number of Eastern European countries with smaller and mainly national literatures on climate change perceptions (Gwiazda & Kolbowska, 2009; Balžekienė et al., 2008; Vladyka, 2007; Soasepp, 2016). The inclusion of these, as well as other countries across the continent, allowed for systematic comparisons between countries from different European regions.

Most research on cross-national differences has predominantly been conducted using data from the International Social Survey Programme (ISSP) and the World Values Survey WVS), which contained question modules on more generic environmental attitudes and preferences for environmental protection. While others used Eurobarometer or international opinion poll data, Round 8 of the ESS was the first international survey with a dedicated and theory-driven module on climate change perceptions, allowing this study to explore associations with different aspects of climate change perceptions in a systematic way. Climate change perceptions can be understood to have different dimensions, and thus may be influenced by different sets of determinants. Results relating to cross-national variation may also depend on the specific combination of countries included in the analysis (Lo & Chow, 2015). The countries included in the ESS are a relatively coherent and affluent set of countries at the world stage. It can be assumed that differences in effects could be even greater when a more geographically, economically and culturally diverse set of countries is sampled and compared (Lee et al., 2015). Future research should attempt to expand the number of countries to improve the estimates of cross-national effects, and to explore the contextual factors that shape the differences in individual-level effects. This will be the focus of future analyses. The time and resources needed to conduct high-quality cross-national social research with valid, culturally equivalent measures should not be underestimated, and can only be delivered by substantial research infrastructures, such as the European Social Survey (ESS) or the International Social Survey Programme (ISSP) (Fitzgerald & Jowell, 2010; Haller, Jowell, & Smith, 2009). These international collaborations and investments help to improve our understanding of the cultural dependency of how climate change is perceived, as well as which policies and sustainable behaviours are considered acceptable.

5.0 References

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880 ***Table 1. Mean scores and standard deviations for the four climate change perception variables***.

Country	**Region**	**Sample size**	**Trend Scepticism [(1)]**	**Attribution scepticism[(2)]**	**Perceived impacts of climate change[(3)]**	**Concern about climate change[(4)]**
		N	%	%	M (SD)	M (SD)
Austria	W	2,010	7.3	7.9	-1.75 (2.21)	3.07 (0.90)
Belgium	W	1,766	3.6	5.9	-1.64 (2.34)	3.17 (0.86)
Czech Republic	CE	2,269	10.7	9.9	-1.57 (1.98)	2.77 (1.05)
Estonia	CE	2,019	8.6	10.8	-1.40 (2.07)	2.65 (0.95)
Finland	N	1,925	5.9	6.0	-1.49 (2.00)	3.05 (0.82)
France	W	2,070	3.7	6.1	-1.99 (2.21)	3.21 (0.93)
Germany	W	2,852	4.5	5.1	-2.04 (1.93)	3.36 (0.85)
Hungary	CE	1,614	8.2	6.9	-2.26 (2.06)	3.05 (0.85)
Iceland	N	880	2.3	5.3	-2.28 (1.96)	3.13 (0.92)
Ireland	W	2,757	3.8	8.4	-1.46 (2.37)	2.83 (0.92)
Israel	-	2,557	12.0	11.7	-1.07 (2.65)	2.64 (1.05)
Italy	S	2,626	5.0	6.1	-1.74 (2.34)	3.21 (0.84)
Lithuania	CE	2,122	11.0	15.4	-1.69 (2.04)	2.82 (0.91)
Netherlands	W	1,681	3.7	8.0	-1.13 (2.07)	3.01 (0.86)
Norway	N	1,545	7.1	12.0	-1.64 (1.97)	3.00 (0.83)
Poland	CE	1,694	7.1	9.7	-1.68 (2.06)	2.75 (0.86)
Portugal	S	1,270	3.0	6.2	-2.55 (2.32)	3.48 (0.92)
Russian Federation	CE	2,430	16.5	12.7	-1.42 (2.16)	2.75 (0.97)
Slovenia	CE	1,307	3.5	6.9	-1.69 (2.30)	3.17 (0.86)
Spain	S	1,958	4.1	4.0	-2.90 (2.00)	3.42 (0.88)
Sweden	N	1,551	3.2	7.5	-2.11 (1.93)	2.86 (0.87)
Switzerland	W	1,525	3.5	5.4	-1.80 (2.10)	3.12 (0.85)
United Kingdom	W	1,959	6.4	8.8	-1.46 (2.24)	2.96 (0.94)

Note: Post-stratification weights have been applied for country-level analysis; W = Western Europe; N = Northern Europe; CE = Central and Eastern Europe; S = Southern Europe [(1)] Coding: 0 probably/definitely changing, 1 probably/definitely not changing; [(2)] coding: 0 entirely/mainly by human activity/about equally by natural processes and human activity, 1 entirely/mainly by natural processes; [(3)] coding: scale from -5 extremely bad to +5 extremely good; [(4)] coding: scale from 1 not at all worried to 5 extremely worried.

Table 2. Associations of socio-political and demographic factors with the four climate change perception variables (Model 1).

	Trend Scepticism *OR (95% CI)*	**Attribution scepticism** *OR (95% CI)*	**Perceived impacts of climate change** *B (95% CI)*	**Concern about climate change** *B (95% CI)*
Self-transcendence (vs. self-enhancement)	0.78 (0.74 to 0.82) ***	0.79 (0.75 to 0.83)***	-0.25 (-0.27 to -0.22)***	0.11 (0.10 to 0.12)***
Conservation (vs. openness-to-change)	0.97 (0.92 to 1.01)[n.s.]	0.99 (0.95 to 1.03)[n.s.]	0.05 (0.02 to 0.07)***	-0.03 (-0.04 to -0.02)***
Political orientation: right (vs. left)	1.11 (1.06 to 1.16)***	1.18 (1.14 to 1.23)***	0.22 (0.19 to 0.24)***	-0.08 (-0.09 to -0.07)***
Gender: male (vs female)	1.37 (1.26 to 1.49)***	1.31 (1.22 to 1.42)***	-0.09 (-0.13 to -0.040)***	-0.09 (-0.10 to -0.07)***
Age	1.06 (1.03 to 1.08)***	1.12 (1.10 to 1.15)***	0.11 (0.09 to 0.12)***	-0.03 (-0.04 to -0.02)***
Level of education	0.91 (0.89 to 0.94)***	0.91 (0.89 to 0.93)***	-0.12 (-0.13 to -0.11)***	0.04 (0.04 to 0.05)***

*Note: *** $p < 0.001$; [n.s.] non-significant ; OR = odds ratio; CI = confidence interval.*

Table 3. Cross-country variation in the associations of the socio-political and demographic factors with the four climate change perception variables (Model 2).

	Trend scepticism σ^2 *(SE)*	**Attribution scepticism** σ^2 *(SE)*	**Perceived impacts of climate change** σ^2 *(SE)*	**Concern about climate change** σ^2 *(SE)*
Self-transcendence (vs. self-enhancement)	0.040 (0.020)*	0.016 (0.008)*	0.014 (0.006)*	0.001 (0.001) [n.s.]
Conservation (vs. openness-to-change)	0.024 (0.012)*	0.013 (0.006) *	0.024 (0.009)**	0.002 (0.001)*
Political orientation: right (vs. left)	0.007 (0.004) [n.s.]	0.017 (0.008)*	0.011 (0.005)*	0.003 (0.001)**
Gender: male (vs female)	0.021 (0.015) [n.s.]	0.060 (0.029)*	0.010 (0.006) [n.s.]	0.008 (0.003)**
Age	0.007 (0.003) *	0.002 (0.001)*	0.007 (0.003)*	0.001 (0.001) [n.s.]
Level of education	0.004 (0.002)*	0.004 (0.002)*	0.005 (0.002)*	0.000 (0.000) [n.s.]

*Note: * $p < 0.05$; ** $p < 0.01$; [n.s.] non-significant.*

892 ***Table 4. Interactions of European regions with the socio-political and demographic factors for the four climate change perception variables (Model 3a and 3b)***

	Trend scepticism *B (95% CI)*	**Attribution scepticism** *B (95% CI)*	**Perceived impacts of climate change** *B (95% CI)*	**Concern about climate change** *B (95% CI)*
Model 3a (main effects)				
Region				
Central and Eastern Europe	0.717 (0.235 to 1.179)**	0.446 (0.062 to 0.830)*	-0.126 (-0.444 to 0.192) n.s.	-0.165 (-0.357 to 0.027) n.s.
Southern Europe	-0.282 (-0.933 to 0.369) n.s.	-0.341 (-0.890 to 0.208) n.s.	-0.870 (-1.301 to -0.439)***	0.348 (0.117 to 0.579)**
Northern Europe	0.067 (-0.527 to 0.661) n.s.	0.143 (-0.384 to 0.670) n.s.	-0.115 (-0.515 to 0.285) n.s.	-0.152 (-0.338 to 0.034) n.s.
Model 3b (interactions)				
Self-transcendence (vs. self-enhancement)	-0.284 (-0.372 to -0.196)***	-0.281 (-0.354 to -0.208)***	-0.301 (-0.338 to -0.264)***	0.114 (0.098 to 0.130)***
Central and Eastern Europe	0.063 (-0.055 to 0.181) n.s.	0.097 (0.009 to 0.185)*	0.098 (0.035 to 0.161)**	-0.025 (-0.049 to -0.001)*
Southern Europe	-0.135 (-0.341 to 0.071) n.s.	0.041 (-0.131 to 0.213) n.s.	-0.059 (-0.141 to 0.023) n.s.	0.029 (0.004 to 0.062) n.s.
Northern Europe	0.183 (0.020 to 0.346)*	0.101 (-0.030 to 0.232) n.s.	0.194 (0.121 to 0.267)***	-0.027 (-0.056 to 0.002) n.s.
Conservation (vs. openness-to-change)	-0.034 (-0.017 to 0.085) n.s	-0.037 (-0.082 to 0.008) n.s	-0.011 (-0.046 to 0.024) n.s	-0.031 (-0.05 to -0.017)***
Central and Eastern Europe	-0.089 (-0.193 to 0.015) n.s.	0.036 (-0.058 to 0.130) n.s.	-0.167 (-0.224 to -0.110)***	0.023 (-0.001 to 0.047) n.s.
Southern Europe	-0.131 (-0.309 to 0.047) n.s.	0.197 (0.044 to 0.350)*	-0.153 (-0.224 to -0.082)***	-0.012 (-0.041 to 0.017) n.s.
Northern Europe	0.210 (0.059 to 0.361)**	0.193 (0.070 to 0.316)**	0.146 (0.079 to 0.213)***	-0.003 (-0.030 to 0.024) n.s.
Political orientation: right (vs. left)	0.204 (0.120 to 0.288)***	0.183 (0.110 to 0.256)***	0.266 (0.229 to 0.303)***	-0.099 (-0.11 to -0.08)***
Central and Eastern Europe	-0.191 (-0.297 to -0.085)**	-0.125 (-0.223 to -0.027)*	-0.132 (-0.189 to -0.075)***	0.067 (0.043 to 0.091)***
Southern Europe	-0.068 (-0.237 to 0.101) n.s.	-0.040 (-0.183 to 0.103) n.s.	-0.150 (-0.221 to -0.079)***	0.052 (0.025 to 0.079)***
Northern Europe	-0.085 (-0.242 to 0.072) n.s.	0.152 (0.023 to 0.281)*	0.029 (-0.038 to 0.096) n.s.	-0.024 (-0.051 to 0.003) n.s.
Gender: male (vs female)	0.360 (0.201 to 0.519)***	0.304 (0.173 to 0.435)***	-0.126 (-0.193 to -0.059)***	-0.030 (-0.06 to 0.00) n.s
Central and Eastern Europe	-0.083 (-0.287 to 0.121) n.s.	-0.031 (-0.209 to 0.147) n.s.	0.099 (0.001 to 0.197)*	-0.104 (-0.149 to -0.059)***

Southern Europe	-0.246 (-0.611 to 0.119) n.s.	-0.182 (-0.472 to 0.108) n.s.	-0.024 (-0.165 to 0.117) n.s.	0.028 (-0.031 to 0.087) n.s.
Northern Europe	0.136 (-0.168 to 0.440) n.s.	0.297 (0.054 to 0.540)*	0.052 (-0.073 to 0.177) n.s.	-0.183 (-0.238 to -0.128)***
Age	0.097 (0.056 to 0.138)***	0.149 (0.112 to 0.186)***	0.112 (0.092 to 0.132)***	-0.031 (-0.04 to -0.02)***
Central and Eastern Europe	-0.076 (-0.131 to -0.021)**	-0.078 (-0.129 to -0.027)**	-0.070 (-0.099 to -0.041)***	0.017 (0.003 to 0.031)*
Southern Europe	-0.027 (-0.121 to 0.067) n.s	0.025 (-0.059 to 0.109) n.s.	-0.046 (-0.085 to -0.007)*	0.008 (-0.008 to 0.024) n.s.
Northern Europe	0.008 (-0.068 to 0.084) n.s	0.014 (-0.049 to 0.077) n.s.	0.129 (0.094 to 0.164)***	-0.021 (-0.035 to -0.007)**
Level of education	-0.102 (-0.145 to -0.059)***	-0.127 (-0.162 to -0.092)***	-0.150 (-0.168 to -0.132)***	0.052 (0.040 to 0.060)
Central and Eastern Europe	0.055 (-0.004 to 0.114) n.s	0.090 (0.037 to 0.143)***	0.098 (0.067 to 0.129)***	-0.013 (-0.015 to 0.012) n.s.
Southern Europe	0.077 (-0.013 to 0.167) n.s	-0.066 (-0.152 to 0.020) n.s.	0.096 (0.061 to 0.131)***	-0.008 (-0.024 to 0.008) n.s.
Northern Europe	-0.100 (-0.180 to -0.020)*	0.006 (-0.061 to 0.073) n.s.	-0.056 (-0.091 to -0.021)**	-0.002 (-0.018 to 0.014) n.s.

*Note: Western Europe is the reference region;*** p < 0.001; n.s. non-significant ; CI = confidence interval; The odds ratios for trend and attribution scepticism can be calculated by EXP (B).*

Figure 1. Associations of (1) self-transcendence versus self-enhancement, (2) conservation versus openness-to-change, and (3) political orientation, with (a) trend scepticism, (b) attribution scepticism, (c) perceived impacts of climate change, and (d) concern about climate change in 18 European countries

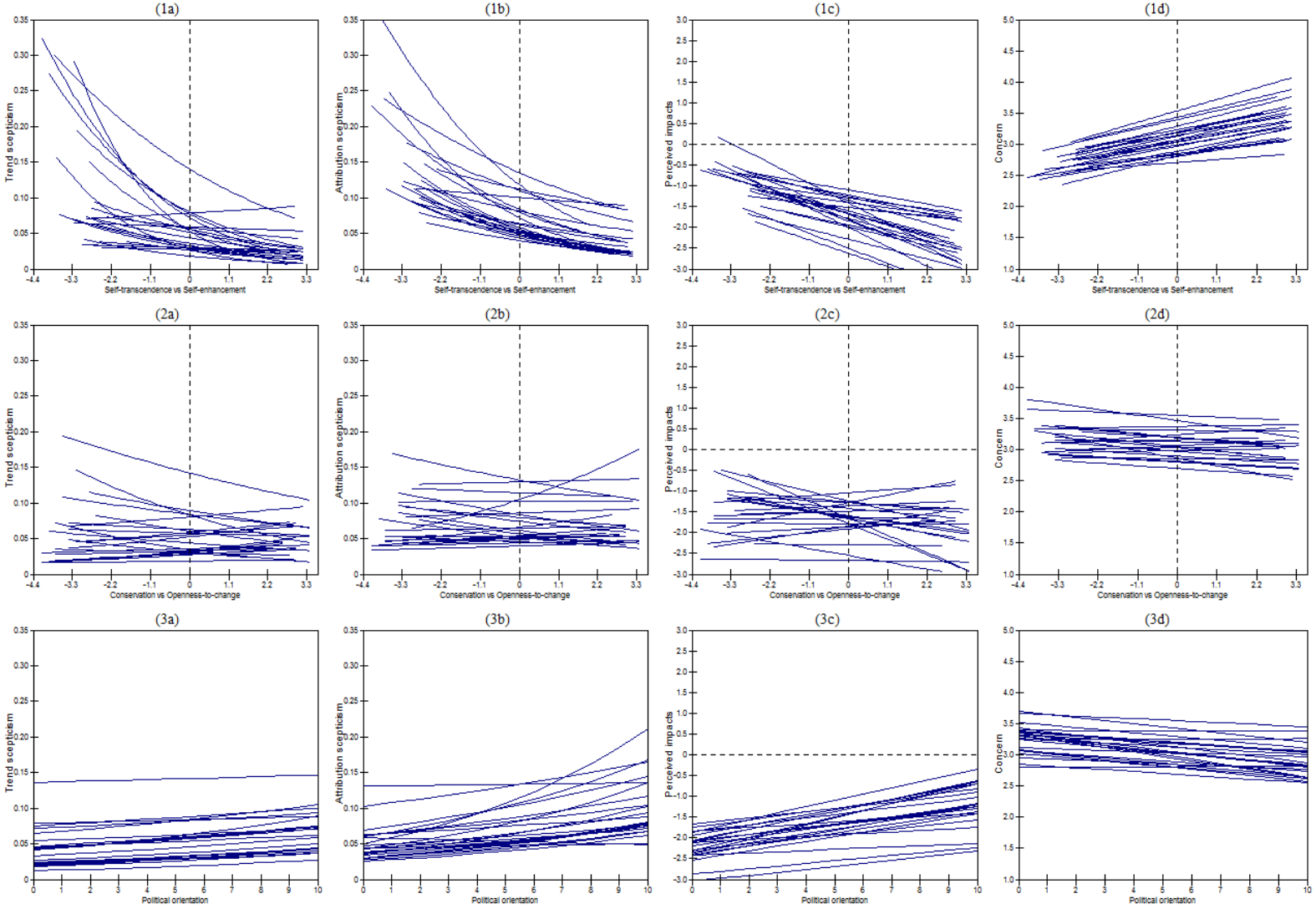

Figure 2. Associations of (1) gender, (2) age, and (3) level of education, with (a) trend scepticism, (b) attribution scepticism, (c) perceived impacts of climate change, and (d) concern about climate change in 18 European countries