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

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17 **Key words:** climate change; perceptions; European Social Survey; cross-national analysis.

18

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21 coordination costs of the ESS ERIC as well as covering the costs of their own fieldwork and

22 national coordination.

23

24

25

26 **Abstract**

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

45

46 **1. Introduction**

47 **1.1 Background**

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

58 The now extensive literature on climate change perceptions has contributed to a better
59 insight into how different individuals perceive and engage with climate change. Many studies
60 on the topic have focused on individual-level factors in people’s beliefs and concerns about
61 climate change. This research appears to show a consistent pattern across different
62 demographic groups. In particular, the research shows that men, older age groups, and those
63 with fewer years of formal education tend to be more doubtful about the reality and
64 anthropogenic nature of climate change, reflecting trend and attribution scepticism,
65 respectively (Milfont, Milojev, Greaves, & Sibley, 2015; Poortinga, Spence, Whitmarsh,
66 Capstick, & Pidgeon, 2011), and that they are less concerned about the impacts of climate
67 change (Shi, Visschers, Siegrist, & Arvai, 2016; Whitmarsh, 2011). Explanations for this
68 patterning include the ‘*white male effect*’, showing that Caucasian men are generally more
69 accepting of a range of environmental and technological risks – with a pattern that is distinct
70 from almost any other demographic group (Finucane, Slovic, Mertz, Flynn, & Satterfield,
71 2000). This may reflect societal inequalities, as well as differences in the subjective experience
72 of vulnerability in relation to these risks (Satterfield, Mertz, & Slovic, 2004). The effects may
73 however be contingent on the particular type of environmental risk concern (Hayes, 2001), and
74 gender differences may not exist in relation to generic environmental concern (Echavarren,
75 2017). Some scholars have pointed to the role of conservative values (the ‘*conservative male*
76 *effect*’) in combination with identity-protective cognition (Kahan, Braman, Gastil, Slovic, &
77 Mertz, 2007; McCright & Dunlap, 2013), whereby lower levels of risk perception, including
78 those for climate change, indicate a motivation to maintain prevailing social structures (Jylhä
79 & Akrami, 2015; Jylhä, Cantal, Akrami, & Milfont, 2016). Climate scepticism appears to be
80 particularly common among politically conservative men in a number of countries (McCright
81 & Dunlap, 2011; Milfont et al., 2015; Whitmarsh, 2011); and there is evidence that gender
82 difference are only modest when key beliefs and values are taken into account (McCright,
83 2010).

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

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

96 Education effects, i.e. of people with longer formal education expressing higher levels
97 of concern about the environment in general and climate change in particular (Marquart-Pyatt,
98 2008; O'Connor, Bord, & Fisher, 1999), are interpreted in multiple ways. It is often implicitly
99 assumed that education is a proxy for knowledge or a better understanding of the scientific
100 underpinnings of climate change. However, climate change and/or scientific knowledge itself
101 tends to be a poor predictor of climate change beliefs (Whitmarsh, 2011), with climate sceptics
102 being generally as knowledgeable as non-sceptics (Hornsey, Harris, Bain, & Fielding, 2016).
103 Knowledge may even have diverging effects depending on people's political orientation
104 (Kahan et al., 2012; Lee, Markowitz, Howe, Ko, & Leiserowitz, 2015; Malka, Krosnick, &
105 Langer, 2009), suggesting that a lack of belief or concern about climate change may not be due
106 to a deficit in knowledge (Snow & Dibners, 2016). Socio-economic effects are further
107 interpreted in reference to post-materialism theory (Inglehart, 1990). Individuals who have
108 satisfied their basic material needs may shift their attention to more postmaterialist ones, such
109 as freedom, quality of life and environmental protection (Fransson & Garling, 1999; Knight,
110 2016). While, overall, there are clear indications that the demographics of gender, age, and
111 education are all important factors in climate change perceptions, it is not known whether these
112 effects are universal or that they vary across countries.

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

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

123 Jenkins-Smith, & Braman, 2011; Poortinga, Steg, & Vlek, 2004). Values are understood as
124 guiding principles in life, and are considered an important part of what forms our beliefs and
125 attitudes towards social issues, including climate change (Milfont et al., 2015). This helps to
126 shape the way we behave in relation to the environment (De Groot & Steg, 2008; Poortinga et
127 al., 2004; Stern, 2000). Values' associations with climate-relevant attitudes and behaviour have
128 mostly been studied using either Schwartz' theory of basic human values, which arranges ten
129 distinct clusters across the two axes of *conservation versus openness-to-change* and self-
130 *transcendence versus self-enhancement* (Schwartz, 1992), or the *altruistic, egoistic, and*
131 *biospheric* trio of values derived from the Value-Belief-Norm (VBN) model (Dietz, Dan, &
132 Shwom, 2007; Stern, 2000). Research has consistently shown that people who endorse self-
133 transcending (or: altruistic) values have higher levels of concern and are less likely to be
134 sceptical about anthropogenic climate change (Brown & Kasser, 2005; Corner et al., 2014; De
135 Groot & Steg, 2007; Poortinga et al., 2004), while the opposite is generally (if not always) true
136 for self-enhancement (or: egoistic) values (Steg & De Groot, 2012). While multiple studies
137 have focused on the self-transcendence and self-enhancement value dimension, the role of the
138 conservation and openness-to-change value dimensions in climate change perceptions has been
139 explored less. There are indications that individuals who hold openness-to-change values have
140 stronger beliefs in the reality of climate change and its human cause (Milfont et al., 2015), and
141 that those endorsing conservation values are less likely to be concerned about or willing to
142 make changes for the environment (Schultz & Zelezny, 1999; Stern, Dietz, & Guagnano,
143 1998). Overall, the effects for openness-to-change and conservation values appear weaker than
144 for self-transcendence and self-enhancement values, and a few studies found non-significant
145 relationships with these dimensions (Milfont et al., 2015; Poortinga et al., 2004; Steg & De
146 Groot, 2012).

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

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

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

187 **1.2 Aims of this Paper**

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

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

213 **2. Methods**

214 **2.1 The European Social Survey**

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

219 number of methodological standards regarding questionnaire design, translation and data
220 collection. The questionnaire was developed in English through a two-year design process,
221 which included extensive testing, piloting and translation by national teams (European Social
222 Survey, 2015; Fitzgerald, 2015). Each country needed to achieve a minimum effective sample
223 size of 1,500 (or 800 in countries with populations smaller than 2 million), representative of
224 the resident population. Data collection involved strict random probability sampling to obtain
225 nationally-representative samples, and an extensive concept-based design process to ensure
226 measurement equivalence (Fitzgerald & Jowell, 2010). Interviews were conducted face-to-face
227 in respondents' own homes with people aged 15 years and over. The sample sizes for the 23
228 countries are provided in *Table 1*. In total, 44,387 participants were available for the analyses.
229 Data were collected, usually within three-month, in the period from August 2016 to December
230 2017. Post-stratification weight were used to take account of unequal probabilities of selection,
231 as well as of sampling and non-response error. The full questionnaire and the complete
232 European Social Survey Round 8 dataset can be downloaded from
233 <http://www.europeansocialsurvey.org>.

234 **2.2 Measures**

235 2.2.1 Dependent variables (climate change perceptions)

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

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

254 2.2.2. Independent variables (socio-political and demographic variables)

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

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

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

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

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

287 **2.3. Data analysis**

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

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

323 **3. Results**

324 **3.1 National differences in climate change perceptions**

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

341 **3.2 Individual-level effects of climate change perceptions**

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

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

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

370 **3.3. Cross-national differences in the strength of effects**

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

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

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

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

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

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

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

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

444 **3.4 Differences in the strength of effects between European regions**

445 We subsequently conducted a series of analyses to examine whether there are any
446 systematic differences between countries in different European regions. *Table 4* presents the
447 main (Model 3a) the interaction effects (Model 3b) of Central and Eastern, Southern, and
448 Northern European countries that took part in the ESS. It shows that trend (OR=2.05, 95%CI
449 1.26 to 3.25) and attribution (OR=1.56, 95%CI 1.06 to 2.29) scepticism are more common in
450 Central and Eastern Europe as compared to Western Europe; that the perceived impacts are
451 more negative and that concern about climate change is higher in Southern Europe; and that
452 there are no significant differences between Northern and Western Europe in any of the four
453 climate perception dimensions.

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

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

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

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

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

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

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

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

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

520 **4. Discussion**

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

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

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

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

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

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

577 General explanations for cross-national differences include differences in experiences
578 with extreme weather events (e.g. flooding and droughts) and vulnerability to the impacts of
579 climate change (Brody, Zahran, Vedlitz, & Grover, 2008; Demski, Capstick, Pidgeon, Sposato,
580 & Spence, 2017; Deryugina, 2013; Donner & McDaniels, 2013; Spence, Poortinga, Butler, &
581 Pidgeon, 2011), elite cues and media coverage (Carmichael & Brulle, 2017; Feldman, Hart,
582 Leiserowitz, Maibach, & Roser-Renouf, 2017), and current CO₂ emissions and dependence on
583 fossil fuels (Lee et al., 2015). While there are indications that all these factors are important for
584 climate-relevant environmental attitudes, they are less appropriate for explaining differences
585 in the size of individual-level effects. Here again we may need to look at possible historical
586 and political explanations. According to Rohrschneider and colleagues (2015), one reason as
587 to why left-right divisions are smaller in Central and Eastern Europe is because the
588 environment is less of an issue for party competition in these countries. If political parties do
589 not compete for the green vote, they are less likely to polarise the public in return (ibid).
590 Furthermore, if there is no platform for climate sceptical views, either as part of party politics
591 and/or the media, there is less opportunity for the public to become polarised through elite cues
592 (cf. Brulle et al., 2016; Carmichael & Brulle, 2017)

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

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

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

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

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

Country	Region	Sample size N	Trend	Attribution	Perceived impacts of	Concern about
			Scepticism ⁽¹⁾ %	scepticism ⁽²⁾ %	climate change ⁽³⁾ M (SD)	climate change ⁽⁴⁾ 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)

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

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

	Trend Scepticism <i>OR (95% CI)</i>	Attribution scepticism <i>OR (95% CI)</i>	Perceived impacts of climate change <i>B (95% CI)</i>	Concern about climate change <i>B (95% CI)</i>
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)***

886 *Note: *** p < 0.001; ^{n.s.} non-significant ; OR = odds ratio; CI = confidence interval.*

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888 **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 $\sigma^2 (SE)$	Attribution scepticism $\sigma^2 (SE)$	Perceived impacts of climate change $\sigma^2 (SE)$	Concern about climate change $\sigma^2 (SE)$
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.}

889 *Note: * p < 0.05; ** p < 0.01; ^{n.s.} non-significant.*

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

	Perceived impacts of climate			
	Trend scepticism <i>B</i> (95% <i>CI</i>)	Attribution scepticism <i>B</i> (95% <i>CI</i>)	change <i>B</i> (95% <i>CI</i>)	Concern about climate change <i>B</i> (95% <i>CI</i>)
<i>Model 3a (main effects)</i>				
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.}
<i>Model 3b (interactions)</i>				
Self-transcendence (vs. self-enhancement)				
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)				
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)				
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)				
Central and Eastern Europe	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.}
	-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.}

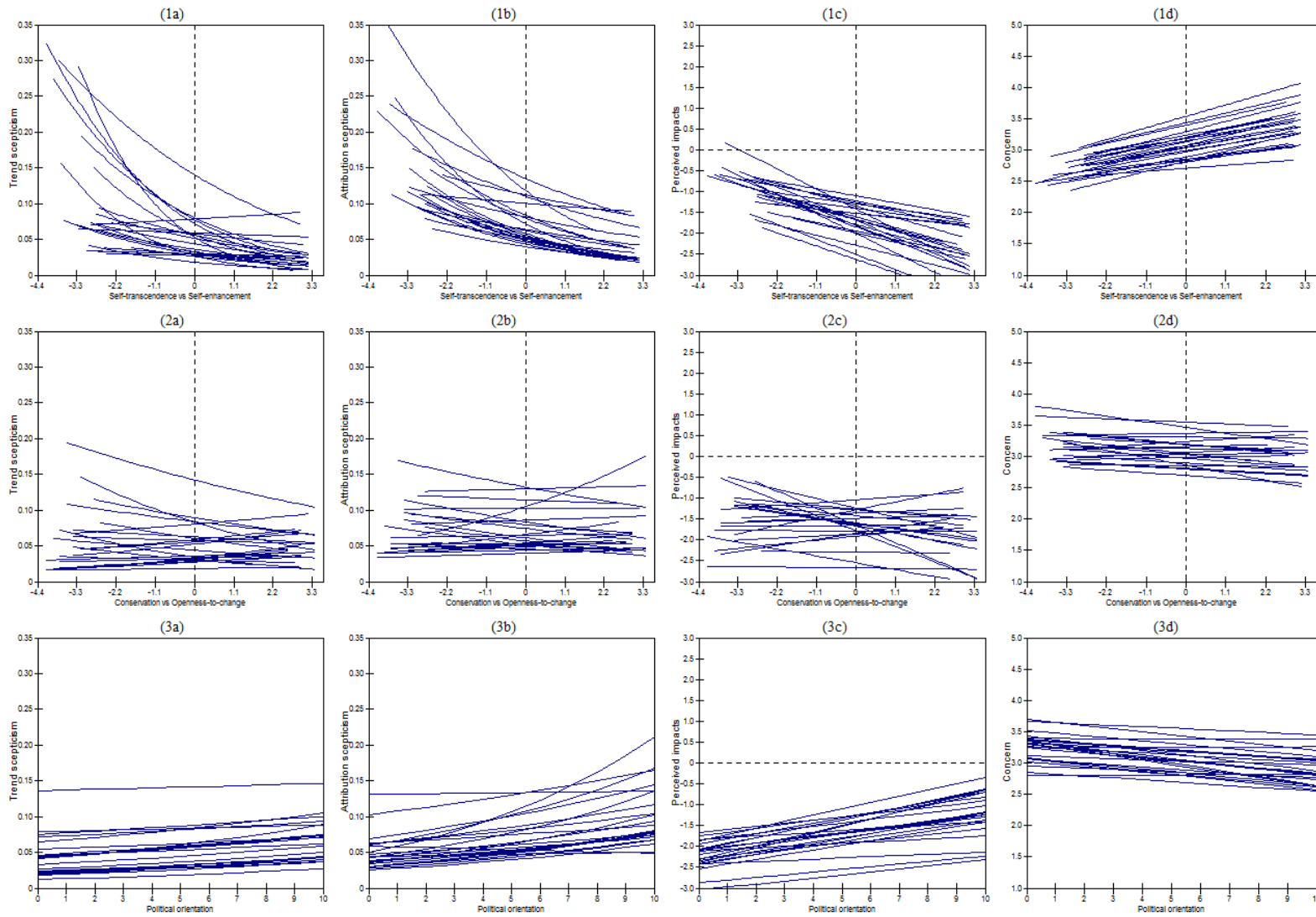
Note: Western Europe is the reference region; *** $p < 0.001$; ^{n.s.} non-significant ; CI = confidence interval; The odds ratios for trend and attribution scepticism can be calculated by EXP (B).

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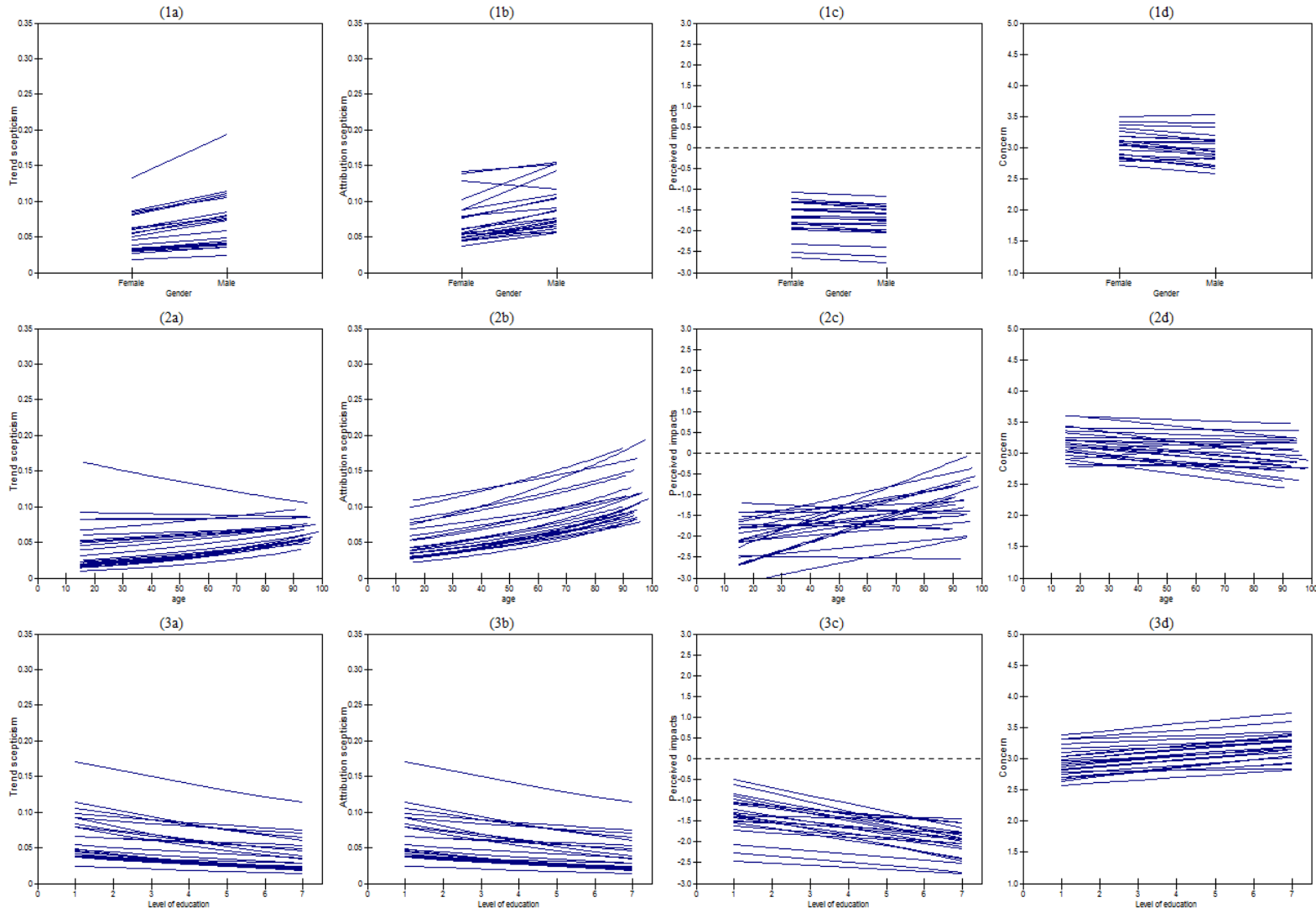
Figure 1. Associations of (1) self-transcendence versus self-enhancement, (2) conservation versus openness-to-change, and (3) political orientation, with (a) trend scepticism, (b) attribution scepticism, (c) perceived impacts of climate change, and (d) concern about climate change in 18 European countries



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



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