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Effects of perceived social norms on support for renewable energy transition: Moderation by national culture and environmental risks

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Abstract

Transition from fossil fuel to renewable energy sources is indispensable to the achievement of carbon-neutral targets in climate change mitigation. Such transition not only requires policy changes and technological advances but also hinges on individuals' actions and support. Accordingly, there is a pressing need to engage the public in renewable energy transition. In this pre-registered study, we examined the effects of perceived descriptive norms and injunctive norms on people's support for renewable energy transition among 31 European countries. Importantly, we compared how the strength of such effects varied between the countries with different cultures and levels of environmental risks. With data from the ECHOES international survey, we found that the two perceived social norms were positively related to support for renewable energy transition, and these positive associations were stronger among countries with higher levels of individualism and cultural tightness, or lower levels of air pollution and vulnerability to climate change risks. Overall, although these observations are contrary to our hypotheses developed based on the cross-cultural psychology literature, they speak of the imperative for researchers and practitioners to acknowledge that the behavioral influence of social norms in the energy domain is sensitive to contextual factors.

Keywords: Perceived descriptive norms, perceived injunctive norms, renewable energy, cultures, environmental risks, cross-national comparisons

1. Introduction

Tackling global climate change requires substantial reduction of carbon emissions. Some states have pledged commitment in this regard. For example, the European Union recently submitted a more ambitious Nationally Determined Contribution (NDC) to the UNFCCC, aiming at "at least 55%" net reduction of domestic emissions below 1990 levels by 2030. Similarly, China proposed to update its NDC and commit to a net-zero "before 2060" target. Japan also aims to become carbon-neutral by 2050.

To meet the reduction targets, transition from fossil fuel to renewable energy sources is key, and such transition requires policy changes and technological advances. Notably, its effectiveness also hinges on individuals' actions, such as their own way of using energy and support for energy policies (Creutzig et al., 2016; Gram-Hanseen, 2013; Stern, 2020). How to motivate members of the public to support renewable energy transition is therefore a pressing issue.

From the studies crossing various social science disciplines, social norms are known to be one of the strongest predictors of pro-environmental behavior (Farrow et al., 2017; Thøgersen, 2006). Research has also shown that social norm-based messages and interventions in general generate positive results (Cialdini & Jacobson, 2021; for meta-analyses, see Abrahamse & Steg, 2013; Bergquist et al., 2019; Farrow et al., 2017). Similar findings have been obtained in the energy domain (e.g., Allcott, 2011; Bonan et al., 2020).

Remarkably, recent studies have shown that the predictive power of many known antecedents of pro-environmental behavior, values (Chan, 2020), environmental concern (e.g., Chan & Tam, 2021; Eom et al., 2016; Tam & Chan, 2017), or social dominance orientation (Milfont et al., 2018) significantly vary across social and cultural contexts (Milfont & Markowitz, 2016; for reviews, see Tam et al., 2021; Tam & Milfont, 2020). These studies

together have called for a comparative, person-context approach to the study of human responses to environmental problems. That is, to answer the question as to how energy-related behavioral change can be promoted in the general public, scientists must explicitly recognize the possibility of cross-national or cross-cultural variability of pathways to these behaviors. This recognition has yet to be fully achieved in the study of the behavioral effects of social norms, however, mainly due to the lack of large-scale international data in this respect (Bamberg & Möser, 2007; Eom et al., 2016; Tam & Milfont, 2020). Addressing this void, the present investigation offers the direly needed comparison of the effects of social norms on energy-related behavior across 31 societies. In particular, we adopted the data from the ECHOES project – a cross-national research project aimed to provide in-depth insights into individual and collective energy-related choices among European countries (Reichl et al., 2019).

1.1 The Role of Social Norms on Energy-Related Behavior

Social norms impact a wide range of behavior (Cialdini et al., 1991), including behaviors that can address environmental problems (Farrow et al., 2017; Thøgersen, 2006). Researchers have theorized two distinct types of social norms--descriptive social norms and injunctive social norms—that serve different motivations (Cialdini et al., 1991; Thøgersen, 2006). This distinction is widely accepted both in the study of pro-environmental behavior in general, and in energy-related behavior specifically. The two types of norms are usually operationalized in terms of people's subjective perceptions and expectations.

The role of descriptive and injunctive social norms on human behavior is elaborated in the focus theory of normative conduct (Cialdini et al., 1990, 1991). Descriptive norms shape behavior by informing individuals which action is deemed to be prevalent (and thus adaptive) in a situation. In the environmental domain, research has consistently shown that

individuals who perceive a pro-environmental behavior to be prevalent among others, compared to those who do not, are more likely to engage in the behavior. For example, in a recent meta-analysis based on over 30 effect sizes, Geiger et al. (2019) found a large effect in the association between descriptive norms and recycling. In terms of energy-related behavior, Chen et al. (2016) found that stronger perceived descriptive norms of sustainable behavior were related to university students' stronger intention to adopt solar water heaters and drive alternative fuel vehicles in the future. Wang et al. (2019) also found a positive relationship between perceived descriptive norms and electricity conservation behavior in the workplace. Other studies revealed that perceived descriptive norms were related to stronger perceived energy-saving responsibility, which in turn was related to stronger intention to save energy (e.g., Fornara et al., 2016). Notably, interventions that highlight the prevalence of a pro-environmental behavior are generally effective in bringing positive behavioral change in the audience (for meta-analysis studies, see Abrahamse & Steg, 2013; Bergquist et al., 2019; Farrow et al., 2017), including energy-related behavior (e.g., Dwyer et al., 2015; Schultz et al., 2008).

Injunctive norms refer to the perception of what other people approve or disapprove (Cialdini et al., 1990). Injunctive norms motivate behavior by suggesting the prospect of rewards or sanctions by other people. In the environmental domain, individuals who perceive more social approval towards a pro-environmental behavior are more likely to adopt it. For example, Barth et al. (2016) found that injunctive norms, independently from descriptive norms, significantly predicted individuals' acceptance of electric vehicles. Chen and Knight (2014) also found a positive relationship between perceived injunctive norms and energy-saving behavior intention in the workplace. In terms of behavioral interventions, researchers have observed that a combination of injunctive and descriptive norm messages effectively reduce people's energy consumption (Allcott, 2011; Bonan et al., 2020; Schultz et al., 2008).

Meta-analysis studies also suggest that injunctive norms-based interventions are effective in inducing pro-environmental behavior change (e.g., Bergquist et al., 2019).

1.2 Research Gap: Comparison of the Effects of Social Norms across Societies

As noted earlier, recent studies have shown that the predictive power of factors behind pro-environmental behavior typically varies across societies (Chan, 2020; Chan & Tam, 2021; Milfont & Markowitz, 2016; Tam & Chan, 2017; Tam & Milfont, 2020). These findings together call for a comparative approach that takes into account both the role of persons and the role of contexts for the study of human responses to environmental problems. A comparison of effects of social norms across countries or cultures, which we attempt to offer in the present study, should fittingly echo this call.

In the study of pro-environmental behavior, the possibility that the predictive power of the two types of norms varies across societies has rarely been tested, however. Most studies on the association between social norms and pro-environmental behavior were single-country (Bamberg & Möser, 2007). In only a few exceptions, a comparison between two or a small number of countries was conducted. Ando et al. (2007) compared the effects of subjective norms (a specific form of social norms that refers to perceptions of a behavior's prevalence and approval by close and significant others) and descriptive norms on three behaviors between Japan and the United States. Another study by Ando and colleagues (Ando et al., 2010) compared the effects of subjective norms on individual and collective pro-environmental behaviors between Japanese and Germans. Arvola et al. (2008) compared the effects of subjective norms on organic food consumption across Finland, Italy, and the United Kingdom. Eom et al. (2016) compared the effect of descriptive norms between a Japanese sample and an American sample. Most recently, Joanes et al. (2020) tested the effects of

subjective norms on personal clothing consumption in five developed countries (Germany, Poland, Sweden, the United States, and the United Kingdom).

These exceptional studies have documented some significant but inconsistent cross-national differences in the predictive power of social norms. However, it is challenging, if not impossible, to pinpoint the exact driver(s) behind any observed differences. Although the countries in most of these studies were carefully selected by the authors on some conceptual grounds (e.g., individualistic culture versus collectivistic culture), the effect of culture on the observed cross-national differences can only be assumed rather than empirically demonstrated, as culture was not explicitly measured (Norenzayan & Heine, 2005).

To truly compare the strength of association between social norms and pro-environmental behavior across countries, first of all, a dataset with a standardized set of variables (including the two types of social norms and behaviors), as well as representative samples of respondents from a sizable number of countries, is required. In addition, indicators of the hypothesized contextual factors (e.g., individualism-collectivism) are needed. With these data, multilevel analysis can be performed, wherein the effects of the various contextual factors on the between-country variability of the norms-behavior associations can be modeled (Tam & Milfont, 2020; Tam & Chan, 2017). The present investigation follows this suggested approach. More specifically, using a combined dataset with country-level indicators and individual-level responses from a 31-country survey, the present study empirically examines the extent to which the strength of the associations between the two types of norms and people's support for the renewable energy transition varies across the countries, and explains the observed variations, if any, with reference to theoretically derived contextual factors.

1.3 Hypotheses

That the strength of social normative influence varies across situations and contexts has been widely recognized in social psychology and cross-cultural psychology (Gelfand et al., 2017). The focus theory of normative conduct (Cialdini et al., 1990; 1991) states that social norms are influential only when they fall into or are brought into one's attentional focus, which, in turn, is situation and context dependent. Savani et al. (2015) put forward the same norms-different adherence motivation account, which states that even when the content of social norms is similar across two cultures, there could still be cultural differences in behavior because of cultural differences in the strength of people's motivation to conform to social norms. In the domain of pro-environmental behavior, there have been some preliminary findings showing between-country variations in the association between social norms and behavior (e.g., Ando et al., 2007; Eom et al., 2016). We thus have the two following hypotheses.

H1: Perceived descriptive norms has a positive association with support for renewable energy transition, and the strength of this association varies across countries.

H2: Perceived injunctive norms has a positive association with support for renewable energy transition, and the strength of this association varies across countries.

We propose to explain the hypothesized cross-national variations through two perspectives: cultural emphasis of norm-compliance, and exposure of environmental risks.

1.3.1 Culture: Individualism-collectivism and tightness-looseness

The first perspective concerns the influence of culture on norm compliance. Specifically, the individualism-collectivism dimension is relevant to the understanding of normative influence as it represents how members in a culture see their relationship with other people (Hofstede et al., 2010). In individualist cultures, there is a clear boundary between the self and others (Markus & Kitayama, 1991). Individuals are encouraged to

pursue personal agency and goals. Consistency between one's personal views and behavior is also expected and valued. On the contrary, in collectivistic cultures, there is a more permeable boundary between the self and others. Behavior is largely determined by shared goals, social roles, and social obligations. It is desirable to prioritize collective goals over personal goals. People are also expected to behave according to context; thus, inconsistency between one's personal views and behaviors, and inconsistency across situations, is acceptable (Suh et al., 2002).

Empirical studies have found support for the role of individualism-collectivism. For example, the seminal meta-analysis by Bond and Smith (1996) demonstrated that conformity to group norms was stronger among countries with higher levels of collectivism (or lower levels of individualism). Savani et al. (2015) found that individuals from India, a supposedly collectivistic society, were more responsive to normative cues than Americans, whose culture is supposedly individualistic. Similarly, Eom et al. (2016) found that perceived prevalence of environmentally friendly behaviors among members of society was predictive of the pro-environmental choice of products only among Japanese participants (supposedly collectivistic) but not American participants.

Another possible cultural factor that determines the emphasis of norm compliance in a society is cultural tightness-looseness. The recent works by Gelfand and colleagues (Gelfand et al., 2011; Gelfand et al., 2017) showed that due to different socio-ecological features (e.g., ecological threat, population density), societies differ in terms of the strength of social norms and sanctioning of deviant behavior. Tight cultures are characterized by strong, pervasive social norms, and afford a restricted range of appropriate behavior. In these cultures, individuals tend to enact behavior that is characteristics of conformity. By contrast, loose cultures have weak norms and afford a high tolerance of individuals' discretion (Gelfand et al., 2006). Cultural tightness-looseness thus is expected to influence how much people adhere

to social norms when making behavioral decisions. Supporting this view, Siemens et al. (2020) found that their Korean participants adhered more to descriptive norm messages on donation requests than their American counterparts did. The authors attributed such observed differences to the higher cultural tightness in Korea than in the United States. Also, in tight cultures, variations in personalities and innovation are smaller, whereas conformity and sanctions of deviance are stronger (Uz, 2015).

Based on the above discussion, we expect the strength of the association between social norms and support for renewable energy transition to be stronger among countries with a stronger cultural emphasis on norm-compliance (i.e., higher collectivism and tightness). We thus have the following two hypotheses.

H3: The relationship between perceived descriptive norms and pro-environmental behavior is stronger among societies with a higher cultural emphasis on norm compliance.

H4: The relationship between perceived injunctive norms and pro-environmental behavior is stronger among societies with a higher cultural emphasis on norm compliance.

It is noteworthy that these hypothesized effects are not consistent with some recent meta-analytic findings. In their meta-analysis of social norms-based field experiments, Bergquist et al. (2019) observed that normative interventions actually had a stronger effect on behavioral change in more individualistic countries, which was contrary to their expectation. In a meta-analysis on theory of planned behavior in the environmental domain, Morren and Grinstein (2016) hypothesized that subjective norms would have a stronger association with pro-environmental intention and behavior in collectivistic countries; yet, they did not observe such an effect. It remains doubtful as to how reliable these meta-analytic findings are, as both

groups of authors cautioned that their meta-analytic findings are limited because the studies meta-analyzed came from a concentrated range of countries. For example, in Morren and Grinstein's (2016) analysis on the subjective norms-behavioral intention link, only three of the nineteen countries compared were collectivistic.

1.3.2 Environmental risks

Our second perspective focuses on the role of environmental risks. The impacts of environmental problems such as climate change are unevenly distributed across geographical regions (Althor et al., 2016; Arnell et al., 2016). Some countries are more exposed to such impacts than other countries. For example, the Global Climate Risk Index (Greenwatch, 2018) revealed that death tolls and economic losses attributable to extreme weather events vary hugely across continents and countries. Even within Europe, some countries (e.g., France) face stronger climate risks than do others (e.g., Sweden). Because of differences in coping and adaptive capacities (e.g., environmental governance, public health infrastructure), countries facing similar levels of risks may be vulnerable to the impacts of environmental problems to different degrees (Adger et al., 2005). However, it is yet to be understood whether the level of environmental risks a country faces has any implications on its citizens' compliance with social norms when they respond to environmental problems.

We refer to the threat management function of social norms to address this issue. Conformity to social norms helps individuals cope with existential threats (Fritsche et al., 2010; Gelfand et al., 2011). When a group faces a threat, be it ecological (e.g., natural disasters) and human-made (e.g., wars and conflicts), social coordination is essential in the service of individual and collective survival. For example, when there is an outbreak of infectious disease, the risk of infection can be reduced when all members of the society follow the suggested disease-preventive practices shared in the group. Similarly, to survive a

natural disaster, people must cooperate with each other in terms of sharing coping resources (e.g., food, shelter) and recovering from the aftermaths (e.g., rebuilding a community). Norm compliance by individual group members should be able to facilitate such social coordination in the group (Baumeister, 2005). Research findings have indeed shown that when a threat is brought to people's attention, stronger emphasis on norm compliance and more negative evaluations of social deviants typically result (Gelfand et al., 2017). Also, cross-nationally, cultural emphasis on conformity to norms and intolerance of deviance is stronger in countries facing more natural disasters (e.g., Oishi & Komiya, 2017), prevalence of diseases or pathogens (e.g., Murray et al., 2011), harsh climate (e.g., Van de Vliert, 2013), or territorial conflicts with neighboring countries (e.g., Gelfand et al., 2011).

Undeniably, environmental problems pose an existential threat to individuals and groups (Fritsche et al., 2012). For example, pollution and resource depletion could put a strain on food, water, or energy security in some countries. With respect to climate change, continuing sea-level rise threatens coastal communities and islandic countries around the world. In some extreme cases, such as Kiribati, an entire country is going to disappear (Weiss, 2015). Environmental problems (e.g., air pollution) can cause severe health problems and premature deaths. A recent paper by Parncutt (2019) estimated that every 1,000 tonnes of carbon burned would result in one future premature death. Based on the threat management function of social norms, we hypothesize that the association between social norms and support for the renewable energy transition would be stronger in countries facing higher risks of environmental problems. We refer to climate change risks and air pollution in the present study, as these issues are closely relevant to the burning of fossil fuels (versus the use of green energy).

H5: The relationship between perceived descriptive norms and pro-pro-environmental behavior is stronger among societies with higher levels of environmental risks.

H6: The relationship between perceived injunctive norms and pro-pro-environmental behavior is stronger among societies with higher levels of environmental risks.

We acknowledge that the two types of social norms are distinct from each other and influence pro-environmental behavioral decisions via different psychological mechanisms. However, few studies have compared whether the behavioral influences of the two types of social norms are similar or different between societal and cultural contexts. For example, cross-cultural psychology studies have elaborately investigated the influence of cultural factors (e.g., individualism-collectivism) on normative considerations; yet, these studies seldom differentiate the role of perceived descriptive norms from that of perceived injunctive norms. We contend that the theories and findings discussed earlier apply to both types of normative influence; that is, perceived descriptive norms (normative information) and perceived injunctive norms (normative approval) could both be important in guiding behavioral decisions in societal contexts with stronger cultural emphasis on norm-compliance and environmental risks. We thus derive a similar set of hypotheses for the two types of social norms.

1.4 Overview of the Present Study

To test the above hypotheses, we referred to two levels of data. The first level involved individual-level data that had a representative sample of participant collective from multiple countries. We adopted the ECHOES International Survey (Reichl et al., 2019), which covered 31 European countries. The second level involved country-level data that captured the characteristics of a country in terms of individualism-collectivism, cultural tightness-looseness, and exposure of environmental risks associated with climate change and air pollution. We compiled this country-level data from the cross-cultural psychology literature (e.g., Hofstede et al., 2010; Uz, 2015) and multiple public databases (e.g., Greenwatch, World Bank).

2. Method

2.1 Individual-level data

2.1.1 Participants

We adopted the ECHOES International Survey data (Reichl et al., 2019). This survey was administered in 2018 and aimed to recruit nationally representative samples. In total, the data consisted of 18,037 participants from 31 European countries. In the original design of the survey, participants were randomly assigned to respond to group-based questions that referred to either the municipality (N = 5,919), the country (N = 6,007), or Europe (N = 6,111). As we did not have an apriori assumption about how the effect of social norms would differ between the three levels, we used the pooled sample in all our analyses.

2.1.2 Measures

Support for renewable energy transition. We identified two items that captured people's support for renewable energy transition. The first item captured people's intention to use energy in a way that would benefit the transition ("I intend to use energy in a way that helps bringing the transition to a renewable energy"). The second item captured people's support for energy policies that would encourage the transition ("I would accept energy policies that protect the environment even when these induce higher costs (e.g., policies that increase the prices of fossil fuels)"). Respondents reported on a 5-point scale for each item. We created an average score based on the two items to capture people's overall support for renewable energy transition (Spearman-Brown's *rho* = .52; standardized Cronbach's α = .68).

Perceived descriptive norms. We identified two items that captured perceived descriptive norms of supporting renewable energy transition. The first item captured perceived descriptive norms of energy-saving behavior: "A growing number of people in [group] try to save energy (e.g., using public transport instead of a personal car, turning off

lights when leaving the room, using technical appliances which help to save energy)." The second item captured perceived descriptive norms of support for renewable energy transition policy: "A growing number of people in [group] favor energy policies that support the energy transition." For each item, the [group] would be replaced by either "my municipality," "the country I live in," or "the EU." Respondents reported on a 5-point scale for each item (1 = strongly disagree to 5 = strongly agree). We computed an average score of perceived descriptive norms based on the two items (Spearman-Brown's *rho* = .57; standardized Cronbach's $\alpha = .74$).

Perceived injunctive norms. We identified two items that captured perceived injunctive norms. The first item captured perceived injunctive norms of energy-saving behavior: "Many people in [group] would support it if I used less energy." The second item captured perceived injunctive norms of support for renewable energy transition policy: "Man people in [group] would support it if I favored energy policies that support the energy transition." For each item, the [group] would be replaced by either "my municipality," "the country I live in," or "the EU." Respondents reported on a 5-point scale for each item (1 = strongly disagree to 5 = strongly agree). We computed an average score of perceived injunctive norms based on the two items (Spearman-Brown's *rho* = .47; standardized Cronbach's $\alpha = .66$).

Demographic variables. We included demographic variables as the covariates in our analyses. These variables include gender, age (1 = 18-34 years, 2 = 35-44 years, 3 = 45-54 years, and 4 = 55 years or above), education level: 1 = elementary or secondary school, 2 = professional training (practical skills), 3 = A-levels (qualification for university), and 4 = university or college degree, and household's monthly net income (1 = less than 1st quartile-income threshold, 2 = between 1st quartile and the median, 3 = between median and the 3rd quartile, 4 = between 3rd quartile and 90th percentile, 5 = higher than 90th percentile).

2.2 Societal-level data

2.2.1 Measures

Individualism-collectivism. We adopted the cultural individualism-collectivism index from Hofstede et al. (2010). This index has been widely used in previous studies that compared the cross-national differences in the relationship between environment-related constructs (e.g., Chan, 2020; Eom et al., 2016). A higher score represented a higher level of individualism (or lower level of collectivism).

Cultural tightness-looseness. We adopted the cultural tightness-looseness index from Uz's (2015) 68-country study. This index has been used in past studies in the cross-cultural environmental psychology literature as well (e.g., Tam & Chan, 2017). A higher score indicated a higher level of cultural looseness (or lower level of tightness).

Air pollution. We adopted the level of $PM_{2.5}$ exposure (mg per cubic meter) as a proxy of air pollution exposure to individuals (World Bank, 2020), as previous studies on air pollution revealed that $PM_{2.5}$ was related to reduced physical health (e.g., Burnett et al., 2018). Studies also estimated that around 74% to 81% of the European urban population was exposed to $PM_{2.5}$ at a level that exceeds the World Health Organization air quality guideline (Sicard et al., 2021). The European Environmental Agency also reported that in 2015, about 83% of air pollution-related death was attributable to $PM_{2.5}$ (European Environmental Agency, 2018). We thus considered $PM_{2.5}$ as an appropriate proxy of air pollution. We log-transformed the original index to reduce the level of skewness and kurtosis of the data, with higher scores indicating higher levels of air pollution exposure.

Climate risk. We identified multiple climate risk indexes, including (1) the Climate Risk Index (CRI; Greenwatch, 2018), (2) the World Risk Index (WRI; World Risk Report, 2019), and the (3) Climate Vulnerability Index of the Notre-Dame Global Adaptation

Initiative (ND-GAIN; see Chen et al., 2015). CRI captured the impact of weather-related loss events (e.g., heatwaves, floods) on a country from 1998 to 2017, with higher scores indicating lower levels of climate risk. WRI involved two sub-dimensions of measure – vulnerability and exposure. The vulnerability dimension measured the extent to which a country had the capacity to cope with the harm bought by climate risks, including the susceptibility of suffering damage, capacities for adaptation, and capacities to reduce negative consequences. The exposure dimension measured the amount of exposure to natural hazards. For both sub-dimensions of WRI, higher scores indicated higher levels of climate risk. Lastly, the Climate Vulnerability Index of ND-GAIN measured levels of exposure, sensitivity, and capacity to adapt to the harmful effects of climate change in six sectors (e.g., food, water; for technical details, see Chen et al., 2015). To test the convergence between WRI and ND-GAIN index, we also extracted the exposure sub-scale for the ND-GAIN vulnerability index. Higher scores represented higher levels of vulnerability to climate risks.

2.3 Data Analysis Plan

We tested our hypotheses by conducting a series of multilevel linear regression analyses. We conducted two sets of analyses for the two predictor variables (i.e., perceived descriptive norms and perceived injunctive norms) separately. For each set of analysis, we first constructed the random-coefficient model to estimate the main effect of the predictor variable, the random effect of the intercept, and the random effect of the slope (i.e., the main effect of the predictor variable). Next, we constructed a series of slope-as-outcome models to test the hypothesized effect of the country-level predictor on the slope of the individual-level predictor (i.e., cross-level interaction; e.g., perceived descriptive norms × individualism-collectivism). In each model, we included the predictor separately, given that we have only a small sample size in the country-level (N = 31). For all individual-variables, we centered each variable by the mean within each country (except for gender). As the country-level variables

were measured in different units, we standardized them at the country level to allow easier interpretation. To examine the unique effect of the two social norms predictors, we also repeated the multi-level analyses with the two individual-level predictors included simultaneously. Our analysis plan has been pre-registered on the Open Science Framework: https://osf.io/bv52a/?view_only=18a0275662a74bb6b1c5993a04ea6dfc[1]. Table 1 shows the descriptive statistics of the variables included in the analysis. Supplementary Figures S1 and S2 illustrate the relationship between the two perceived social norms and support for renewable energy transition across the 31 countries. Supplementary Table S1 presents the zero-order correlations between the country-level variables.

3. Results

3.1 Perceived Descriptive Norms

We first included perceived descriptive norms as the individual-level predictor of the random-coefficient model. As expected, perceived descriptive norms were a positive and significant predictor of support for renewable energy transition. The variance of the slope at the country-level was .010 (*SE* = .003), with a *Wald-Z* = 3.33, $p < .01$. We also conducted the likelihood ratio test to compare the model with the random effect of the slope versus the model with a fixed effect of the slope. The finding also supported a random slope model (χ^2 = 157.89, *df* = 2, $p < .001$). Together, these findings support the notion that the strength of the perceived descriptive norms-support for renewable energy transition link varied between countries (Hypothesis 1) (see also Figure S1).

Next, we constructed a series of slope-as-outcome models to examine the effect of each country-level predictor on the random intercept of support for renewable energy transition and the slope of perceived descriptive norms. Table 2 shows the results. As for the main effect of each country-level predictor, individualism and cultural looseness were

negatively related to support for renewable energy transition, and $PM_{2.5}$ exposure and vulnerability sub-index of WRI were positively related to it. It implies that people, on average, showed stronger support for renewable energy transition in countries with higher levels of collectivism, cultural tightness, air pollution exposure, and vulnerability to environmental risks. Unexpectedly, individualism and cultural looseness were a positive and significant predictor of the slope of perceived descriptive norms. It indicates that perceived descriptive norms had a stronger association with support for renewable energy transition among countries with higher levels of individualism or cultural looseness (See also Figures 1 and 2). These findings were inconsistent with Hypothesis 3. Also, $PM_{2.5}$ exposure, the vulnerability sub-index of WRI, and the vulnerability index of ND-GAIN were a negative and significant predictor of the slope of perceived descriptive norms. These findings suggest that perceived descriptive norms had a weaker association with support for renewable energy transition among countries with higher levels of air pollution or vulnerability to climate risks (See also Figures 3 and 4). Furthermore, the exposure sub-index of WRI, the exposure sub-index of ND-GAIN, and CRI were unrelated to the slope of perceived descriptive norms. Together, these findings were inconsistent with Hypothesis 5. We did not find evidence that the effect of perceived descriptive norms on support for renewable energy transition would be stronger in countries with higher levels of environmental risks.[2]

3.2 Perceived Injunctive Norms

Similar to the above, we first included perceived injunctive norms as the individual-level predictor of the random-coefficient model. As expected, perceived injunctive norms were a positive and significant predictor of support for renewable energy transition. The variance of the slope at the country-level was .008 (*SE* = .002), with a *Wald-Z* = 3.30, $p < .01$. We also conducted the likelihood ratio test to compare the model with the random effect of the slope versus the model with the fixed effect of slope. The finding also supported a

random slope model (χ^2 = 128.99, df = 2 , p < .001). Together, these findings support the notion that the strength of the perceived injunctive norms-support for renewable energy transition link varied between countries (Hypothesis 2) (see also Figure S2).

Next, we constructed a series of slope-as-outcome models to examine the effect of each country-level predictor on the random intercept of support for renewable energy transition and the slope of perceived injunctive norms. Table 3 shows the results. Unexpectedly, individualism and cultural looseness were a positive and significant predictor of the slope of perceived injunctive norms. It indicated that perceived injunctive norms had a stronger association with support for renewable energy transition among countries with higher levels of individualism or cultural looseness. These findings were inconsistent with Hypothesis 4. Also, $PM_{2.5}$ exposure, the vulnerability sub-index of WRI, and the vulnerability index of ND-GAIN were a negative and significant predictor of the slope of perceived injunctive norms. These findings suggested that perceived injunctive norms had a weaker association with support for renewable energy transition among countries with higher levels of air pollution or vulnerability to climate risks. Furthermore, the exposure sub-index of WRI, the exposure sub-index of ND-GAIN, and CRI were unrelated to the slope of perceived injunctive norms. Together, these findings were inconsistent with Hypothesis 6. We did not find evidence that the effect of perceived injunctive norms on support for renewable energy transition would be stronger in countries with higher levels of environmental risks.[2]

3.3 Including Both Social Norms Predictors Simultaneously

Lastly, we simultaneously included the two individual-level predictors into the slope-as-outcome models. Same as the above, we included each country-level predictor variable separately. Table 4 shows the results. Individualism was a positive and significant predictor of the slope of perceived descriptive norms only, while cultural looseness was positively

related to the slope of perceived injunctive norms only. As for environmental risks, the level of $PM_{2.5}$ exposure and the vulnerability index of WRI were a negative and significant predictor of the slope of perceived descriptive and injunctive norms. The vulnerability index of ND-GAIN was negatively related to the slope of perceived injunctive norms but not perceived descriptive norms (though still in the same direction). It appears that some indexes of environmental risks had a unique effect on the relationship between the two perceived social norms and support for renewable energy transition.

3.4 Supplementary Analysis – Including All Societal-level Predictors Simultaneously

In the previous analyses, we considered the societal-level predictors individually and separately; that is, their moderating effects were tested one at a time in separate models. Considering the moderate to strong correlations between these country-level predictors, these models do not necessarily speak of the independent effect of each country-level predictor.

To address this issue, we additionally constructed two slope-as-outcome models to examine the unique effects of the country-level predictors by simultaneously including all eight country-level factors as the predictors of the intercept of support for renewable energy transition and the slope of perceived descriptive norms or perceived injunctive norms. We also included national wealth (measured by gross domestic income (GDP) per capita) as the societal-level covariate for the intercept. Supplementary Tables S2 and S3 show the results. Only individualism-collectivism remained to be a negative and significant predictor of support for renewable energy transition. It indicates that European countries with higher levels of collectivism, on average, showed stronger support for renewable energy transition. None of the remaining cross-level interactions were significant.

These findings also need to be interpreted with caution, however. First, given the small number of countries involved, the analysis may not have enough statistical power to

detect the unique effects of the eight country-level predictors when considered simultaneously. Second, given the conceptual overlap between some of these predictors, including them simultaneously in the statistical model may unwantedly partial out the very variance of these predictors that explains the cross-national variation of the effect of the two perceived social norms. In this case, the results may not reflect the true meaning of the country-level predictors in their original form and make the results difficult to interpret (e.g., Becker et al., 2014; Carlson & Wu, 2012). We thus opted to base our conclusions on the models reported in the earlier sections (i.e., the ones that considered the societal-level predictors individually and separately).

4. General Discussion

The present study examined the relationship between perceived social norms and support for renewable energy transition and explored how this link varied between 31 European countries. There are three sets of observations that are worth attention.

First, we observed a robust positive link between perceived descriptive norms or perceived injunctive norms and support for renewable energy transition. Perceived social norms inform people what behaviors are adaptive and socially desirable. People are thus more likely to behave in ways consistent with social norms. That is, overall, individuals who perceive support for transition to green energy sources to be widely adopted and approved of in the society are themselves more supportive of such transition. This observation confirms the significant role of normative influences in pro-environmental behavior (Cialdini & Jacobson, 2021). Our findings imply that garnering public support for renewable energy transition can be facilitated by social norms-based behavioral interventions. Notably, previous research has also suggested the possibility of changing social norms via policies and facilitative infrastructures (Nyborg et al., 2016). For example, the increase in electric vehicle

chargers may signal the increase in the prevalence of electric vehicles. Arguably, the implementation of carbon taxes, for instance, may signal the widespread disapproval of carbon emissions from both industries and individuals, and thereby encourage people to transit to green energy sources.

Second, we observed that the strength of the norms-behavior link varied significantly across countries. These findings are novel and singular. As noted earlier, large-scale multi-country comparisons of the strength of normative influences in pro-environmental behavior have been lacking in the literature. It is relatively unknown whether social norms are more predictive of pro-environmental behavior in some societies than others and, if so, what explain such cross-national variability. Taking advantage of the 31-country survey dataset in ECHOES, we were able to address this issue empirically. Our findings are consistent with previous ones in two ways. First, it has been documented that the effects of individual-level dispositional factors (e.g., values, attitudes) on pro-environmental behaviors typically vary between countries (e.g., Chan, 2020; for reviews, see Tam et al., 2021, Tam & Milfont, 2020). The present findings extend these studies by demonstrating that the cross-national variation was applies to not only dispositional factors but also perceptual social factors (in this case, social norms). Second, meta-analytic research has also revealed between-country heterogeneity of the efficacy of social norms-based behavioral interventions (e.g., Bergquist et al., 2019). Our findings thus attest that the effects of social norms on pro-environmental behaviors vary between countries, regardless of whether they are subjectively perceived or experimentally induced or reminded. From these findings, we put forward that researchers and practitioners should acknowledge that social norms have different levels of efficacy as a driver of pro-environmental behavior in different socio-ecological contexts. Although social norms as an intervention or nudge are effective in general, there could be boundaries for such effectiveness residing in the socio-ecological context. That is, social norms would be less

effective to induce change in intention or actual behavior in some contexts than in other contexts. Overall, our findings also suggest that other predictors of PEB that have recently attracted research attention (e.g., identity, Udall et al., 2020; Udall et al., 2021; connectedness to nature, Mayer & Frantz, 2004; Tam, 2013) may show similar between-country variability. This notion is worth testing in future research.

Third, when trying to explain the cross-national variability of the effects of social norms, we found that perceived social norms (both descriptive and injunctive ones) were more predictive (rather than less predictive) of support for renewable energy transition in countries with a higher level of individualism and cultural looseness or a lower level of air pollution and vulnerability to climate risk. The effects appear small (|*b*|*s* ranged from .04 to .07; see Tables 2 and 3), and this pattern is opposite to what we hypothesized based on cross-cultural psychological theories. That is, these findings stand in stark contrast with the notions that norm compliance is less emphasized in individualistic or loose cultures and that conformity is more adaptive in societies facing impending existential threats. Nevertheless, our findings are in line with what Bergquist et al.'s (2019) meta-analysis showed. Their meta-analysis included a comparison of effect sizes associated with social norms-based behavioral interventions from 18 countries. They observed that the effect sizes were positively related to individualism: Norms-based interventions have stronger effects in encouraging pro-environmental behavior in individualistic countries than collectivistic ones. Considering together Bergquist et al.'s (2019) meta-analytic findings and our 31-country findings, social norms appears to have a stronger influence on pro-environmental behavior in countries with a weaker emphasis on norm-compliance and a lower level of environmental risks. That being said, it is crucial to note that the differences in the behavioral influence of perceived social norms among countries with different cultural and environmental risk factors are small in

effect size. Perceived social norms remain to be a robust predictor of pro-environmental behavior cross-nationally.

We can only speculate the reasons behind this unexpected but persistent pattern in a post-hoc manner. First, we conjecture that conforming to social norms is not necessarily in conflict with the exercise of personal agency prioritized by people from individualistic cultures. Descriptive social norms can signal what behaviors are most instrumental to the achievement of certain personally relevant goals (Davis et al., 2018). For example, the popularity of energy-efficient appliances may indicate that such appliances are better products than alternative ones. Thus, following the norms by choosing energy-efficient appliances may therefore represent an effective way to fulfill one's goal of making a wise or correct purchase. Similarly, compliance with injunctive norms can represent a way to boost one's self-image, as the behavior prescribed by such norms implies high social desirability and approval. Arguably, this goal-fulfillment function of social norms could be less salient in collectivistic or tight cultures, wherein people are inherently expected to follow or even internalize social norms, regardless of their personal goals (Bergquist et al., 2019). Future studies would benefit from considering the various motivations underlying people's norm adherence and how these motivations play out differently in different socio-ecological contexts.

Second, with respect to our findings regarding environmental risks, we speculate that high levels of air pollution and vulnerability to climate risk could be taken as an indication of poor environmental performance and hence ineffective governance in a country (Thomas et al., 2019). It follows that support of renewable energy transition would be seen by individuals living in such a political context to be inefficacious in driving meaningful societal changes, despite perceived prevalence support of such transition. For this reason, in countries that are vulnerable to climate and other environmental risks, pro-environmental social norms are

associated with behavior to a smaller extent. Future studies could scrutinize this speculative account by systematically manipulating research participants' perception of governance quality and hence probability of systemic societal changes and observing how the influence of social norms on pro-environmental behavior varies subsequently.

Third, it is possible that individuals living in countries with exposure to high levels of environmental risks are already highly supportive of renewable energy transition; as a result, in these countries, the role of perceived social norms becomes less prominent. This interpretation is consistent with the notion that people become environmental conscious and support environmental actions because they objectively face serious environmental problems (e.g., Inglehart, 1995). Similarly, individuals living in countries with high levels of collectivism and cultural tightness may already have a strong preference on promoting the wellness of the group and therefore be readier to support renewable energy transition (e.g., Parboteeah et al., 2012), hence the weaker effect of perceived social norms. This interpretation implies that certain societal conditions (high collectivism, cultural tightness, and environmental risks) can foster support for renewable energy transition even when a supportive social norm is lacking. This possibility warrants future research attention.

We also argue for the need to consider the difference between prescriptive and proscriptive social norms (Farrow et al., 2017). Prescriptive social norms refer to perceptions of what other people do or approve of doing, whereas proscriptive norms are prohibitive, referring to what other people do not do or disapprove of doing. It is speculated that our hypothesized effects (that is, the behavioral influence of social norms is stronger in collectivistic and tight cultures) are more applicable to proscriptive norms than prescriptive norms. Given their prohibitive nature, proscriptive social norms could be more important for successful adaptation in socio-ecological contexts that emphasize norm-compliance, as deviance from social norms is likely to be considered to be a serious social offense there. Put

it differently, individuals from collectivistic or tight cultures could be more sensitive to proscriptive social norms than prescriptive social norms, as the former type of norms is more potent in guiding them to avoid social sanctions. Indeed, recent studies showed that respondents from tight cultures (e.g., Germany) tended to exhibit stronger defensive reactions than did their counterparts from loose cultures (e.g., Russia) after they had recalled an event of violation of social norms (e.g., Eriksson et al., 2021; Prentice et al., 2020). It seems reasonable to expect that in contexts with a strong emphasis on norm compliance, proscriptive social norms rather than prescriptive social norms are more important in determining people's pro-environmental behavior. Furthermore, a recent meta-analysis study on disease-preventive behaviors during the coronavirus-2019 pandemic revealed that subjective norms had a stronger effect on behavioral intention and behavior among countries with higher levels of collectivism and cultural tightness (Fisher & Karl, 2021). Their findings once again highlight the potential influence of the type of social norms in the understanding of cross-national variability of behavioral influences of social norms. The present research only measured prescriptive social norms. It is therefore crucial for future studies to test the effects of culture and environmental risks on the relationship between proscriptive social norms, subjective norms, and pro-environmental behavior.

Lastly, as the purpose of the present study is to examine the cross-national variations in the influence of social norms, we focused on the societal-level variables. It is noteworthy that the influence of culture can also be mediated through individual-level psychological characteristics (Markus & Kitayama, 1991). Individuals may develop a self-construal that reflects their internalized cultural values and beliefs (e.g., independent versus interdependent self; Markus & Kitayama, 1991). They may also form their own perceptions of normative cultural practices (perceived descriptive norms of culture; Chiu et al., 2010). Future studies

can thus inquire into how these individual-level, culturally shaped or informed factors relate to the link between social norms and pro-environmental behavioral decisions.

The present study has several limitations. First, we only included European countries. It is thus uncertain to what extent our findings are generalizable to non-European countries. Nevertheless, we believe that our results are still informative, as we observed that the European countries are not as similar to each other as often assumed. Our national-level indicators showed that these European countries have meaningful variations in individualism-collectivism, cultural looseness, and environmental risks. For example, in terms of individualism-collectivism, the scores of our countries ranged from collectivistic (e.g., score = 27, Slovenia) to medium (e.g., score = 55, Austria) to individualistic (score = 89, the United Kingdom). This range is comparable to that among the widely used countries in cross-cultural comparisons (e.g., score = 20 for China; score = 46 for Japan; score = 91 for the United States). That said, future studies would benefit from sampling countries in different continents. Second, although we have included multiple measures to capture cultural and environmental risk factors, these measures do not capture all types of cultures and socio-ecological contexts. For example, recent studies have shown that there are seven forms of independence versus interdependence, and their correlation with individualism-collectivism varies (Vignoles et al., 2016). Some of these forms (e.g., self-direction versus receptiveness to influence) are strongly related to individualism-collectivism and could exert a similar influence on the effect of perceived social norms. Other forms, however, are barely related to individualism-collectivism (e.g., self-reliance versus dependence on others); their effects on the behavioral effect of perceived social norms are uncertain. Future studies will benefit from considering this multitude of cultural factors. Third, support for renewable energy transition was captured by intention items only. It is well-established that intention may not translate into actual behavior. It would be crucial for future studies to demonstrate the observed cross-

national differences on the social norms-actual behavior link. Lastly, all our findings are correlational in nature and primarily based on models that include one country-level predictor at a time. As noted earlier, because of the small sample size at the country level (N = 31), our data did not have sufficient statistical power for testing the unique effect of each country-level predictor. As a result, our findings should be interpreted with caution. We suggest that future studies would benefit from including a larger number of countries, although this suggestion is subject to data availability. We also argue that an experimental design wherein the socio-ecological context is manipulated or simulated will be useful. Such a design would allow researchers to examine the independent causal effects of the country-level factors on the link between social norms and pro-environmental behavior.

5. Conclusion

Social norms are known to be one of the strongest driving factors behind pro-environmental behavior. With data from 31 European countries, we replicated this effect in the domain of transition to renewable energy. Most importantly, riding on this large-scale cross-national dataset, we observed significant between-country variability in terms of the social norms effect. We further found that this effect was stronger in socio-ecological contexts with higher levels of individualism and cultural looseness or lower levels of air pollution and vulnerability to climate risks. Although these observed effects appear small and contrary to our pre-registered hypotheses developed based on the cross-cultural psychology literature, they speak of the imperative for researchers and practitioners to acknowledge that the behavioral influence of social norms is sensitive to contextual factors. We hope this research can help draw theorists' attention to the intricacy of the social norms-related processes behind pro-environmental behavior.

Endnote

1. In our pre-registration, we also mentioned the analysis that would explore the relationship between personal norms and pro-environmental behavior. We are not reporting results from this analysis in the present main text, as they are outside the scope. In brief, we observed that personal norms were positively related to support for renewable energy transition. We also observed that this relationship was weaker in societies with higher levels of air pollution and vulnerability to climate risks.

2. Our findings remained consistent when we included national wealth (GDP per capita) as a covariate variable in predicting the intercept of support for renewable energy transition, except for the main effect of the vulnerability sub-index of WRI, which became non-significant (b = .12, SE = .06, p = .055, 95% CI = [-.002, .24]), while GDP per capita was also a non-significant predictor of support for renewable energy transition (b = .03, SE = .06, p = .613, 95% CI = [-.09, .15]). Given that GDP per capita was unrelated to the outcome variable, we opted to report the findings without controlling GDP per capita in the main text.

References

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change, 23*(6), 1773-1785. https://doi.org/10.1016/j.gloenvcha.2013.07.029

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change, 15*(2), 77-86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics, 95*(9-10), 1082-1095. https://doi.org/10.1016/j.jpubeco.2011.03.003

Althor, G., Watson, J. E., & Fuller, R. A. (2016). Global mismatch between greenhouse gas emissions and the burden of climate change. *Scientific Reports, 6*, 20281. https://doi.org/10.1038/srep20281

Ando, K., Ohnuma, S., & Chang, E. C. (2007). Comparing normative influences as determinants of environmentally conscious behaviours between the USA and Japan. *Asian journal of Social Psychology, 10*(3), 171-178. https://doi.org/10.1111/j.1467-839X.2007.00223.x

Ando, K., Ohnuma, S., Blöbaum, A., Matthies, E., & Sugiura, J. (2010). Determinants of individual and collective pro-environmental behaviors: Comparing Germany and Japan. *Journal of Environmental Information Science, 38*(5), 21-32. Retrieved from: http://hdl.handle.net/2115/44021

Arnell, N. W., Brown, S., Gosling, S. N., Gottschalk, P., Hinkel, J., Huntingford, C., Lloyd-Hughes, B., Lowe, J. A., Nicholls, R. J., Osborn, T. J., Osborne, T. M., Rose, G. A., Smith, P., Weeler, T. R., & Zelazowski, P. (2016). The impacts of climate change across the globe: A multi-sectoral assessment. *Climatic Change, 134*, 457-474. https://doi.org/10.1007/s10584-014-1281-2

Arvola, A., Vassallo, M., Dean, M., Lampila, P., Saba, A., Lähteenmäki, L., & Shepherd, R. (2008). Predicting intentions to purchase organic food: The role of affective and moral attitudes in the theory of planned behaviour. *Appetite, 50*(2-3), 443-454. https://doi.org/10.1016/j.appet.2007.09.010

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14-25. https://doi.org/10.1016/j.jenvp.2006.12.002

Barth, M., Jugert, P., & Fritsche, I. (2016). Still underdetected – social norms and collective efficacy predict the acceptance of electric vehicles in Germany. *Transportation Research Part F: Traffic Psychology and Behaviour, 37*, 64-77. https://doi.org/10.1016/j.trf.2015.11.011

Baumeister, R. F. (2005). The cultural animal: Human nature, meaning, and social life. New York, NY: Oxford University Press.

Bergquist, M., Nilsson, A., & Schultz, W. P. (2019). A meta-analysis of field-experiments using social norms to promote pro-environmental behaviors. *Global Environmental Change, 59*, 101941. https://doi.org/10.1016/j.gloenvcha.2019.101941

Bonan, J., Cattaneo, C., d'Adda, G., & Tavoni, M. (2020). The interaction of descriptive and injunctive social norms in promoting energy conservation. *Nature Energy, 5*, 900-909. https://doi.org/10.1038/s41560-020-00719-z

Bond, R., & Smith, P. B. (1996). Culture and conformity: A meta-analysis of studies using Asch's (1952b, 1956) line judgment task. *Psychological Bulletin, 119*(1), 111-137. https://doi.org/10.1037/0033-2909.119.1.111

Burnett, R., Chen, H., Szyszkowicz, M., Fann, N., Hubbell, B., Pope, C. A. III, Apte, J. S., Brauer, M., Cohen, A., Weichenthal, S., Coggins, J., Di, Q., Brunekreef, B., Frostad, J., Lim, S. S., Kan, H., Walker, K. D., Thurston, G. D., Hayes, R. B., … Spadaro, J. V. (2018). Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter. *PNAS, 115*(38), 9592-9597. https://doi.org/10.1073/pnas.1803222115

Chan, H.-W. (2020). When do values promote pro-environmental behaviors? Multilevel evidence on the self-expression hypothesis. *Journal of Environmental Psychology, 71*, 101361. https://doi.org/10.1016/j.jenvp.2019.101361

Chan, H.-W., & Tam, K.-P. (2021). Exploring the association between climate change concern and mitigation behaviour between societies: A person-context interaction approach. *Asian Journal of Social Psychology, 24*, 184-197. https://doi.org/10.1111/ajsp.12430

Chen, C. F., Xu, X., & Frey, S. (2016). Who wants solar water heaters and alternative fuel vehicles? Assessing social–psychological predictors of adoption intention and policy support in China. *Energy Research & Social Science, 15*, 1-11. https://doi.org/10.1016/j.erss.2016.02.006

Chen, C., & Knight, K. (2014). Energy at work: Social psychological factors affecting energy conservation intentions within Chinese electric power companies. *Energy Research & Social Science, 4*, 23-31. https://doi.org/10.1016/j.erss.2014.08.004

Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M., & Chawla, N. (2015). University of Notre Dame Global Adaptation Index. Country index technical report. Retrieved from: https://gain.nd.edu/assets/254377/nd_gain_technical_document_2015.pdf

Chiu, C. Y., Gelfand, M. J., Yamagishi, T., Shteynberg, G., & Wan, C. (2010). Intersubjective culture: The role of intersubjective perceptions in cross-cultural research. *Perspectives on Psychological Science, 5*, 482-493. https://doi.org/10.1177/1745691610375562

Cialdini, R. B., & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences, 42*, 1-8. https://doi.org/10.1016/j.cobeha.2021.01.005

Cialdini, R. B., Kallgren, C. A., & Reno, R. R. (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation of the role of norms in human behavior. *Advances in Experimental Social Psychology, 24*, 201-234. https://doi.org/10.1016/S0065-2601(08)60330-5

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015-1026. https://doi.org/10.1037/0022-3514.58.6.1015

Creutzig, F., Fernandez, B., Haberl, H., Khosla, R., Mulugetta, Y., & Seto, K. C. (2016). Beyond technology: demand-side solutions for climate change mitigation. *Annual Review of Environment and Resources, 41*, 173-198. https://doi.org/10.1146/annurev-environ-110615-085428

Davis, T., Hennes, E. P., & Raymond, L. (2018). Cultural evolution of normative motivations for sustainable behaviour. *Nature Sustainability, 1*, 218-224. https://doi.org/10.1038/s41893-018-0061-9

Dwyer, P. C., Maki, A., & Rothman, A. J. (2015). Promoting energy conservation behavior in public settings: The influence of social norms and personal responsibility. *Journal of Environmental Psychology, 41*, 30-34. http://doi.org/10.1016/j.jenvp.2014.11.002

Eom, K., Kim, H. S., Sherman, D. K., & Ishii, K. (2016). Cultural variability in the link between environmental concern and support for environmental action. *Psychological Science, 27*(10), 1331-1339. https://doi.org/10.1177/0956797616660078

Eriksson, K., Strimling, P., Gelfand, M., Wu, J., Abernathy, J., Akotia, C. S., Aldashev, A., Andersson, P. A., Andrighetto, G., Anum, A., Arikan, G., Aycan, Z., Bagherian, F., Barrera, D., Basnight-Brown, D., Batkeyev, B., Belaus, A., Berezina, E., Björnstjerna, M., … Van Lange, P. A. M. (2021). Perceptions of the appropriate response to norm violation in 57 societies. *Nature Communications, 12*, 1481. https://doi.org/10.1038/s41467-021-21602-9

European Environmental Agency (2018). Air Quality in Europe. Available: https://www.eea.europa.eu//publications/air-quality-in-europe-2018

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social norms and pro-environmental behavior: A review of the evidence. *Ecological Economics, 140*, 1-13. https://doi.org/10.1016/j.ecolecon.2017.04.017

Fischer, R., & Karl, J. A. (2021). Predicting behavioral intentions to prevent or mitigate COVID-19: A cross-cultural meta-analysis of attitudes, norms, and perceived behavioral control effects. *Social Psychological and Personality Science*, 19485506211019844. https://doi.org/10.1177/19485506211019844

Fornara, F., Pattitoni, P., Mura, M., & Strazzera, E. (2016). Predicting intention to improve household energy efficiency: The role of value-belief-norm theory, normative and informational influence, and specific attitude. *Journal of Environmental Psychology, 45*, 1-10. http://doi.org/10.1016/j.jenvp.2015.11.001

Fritsche, I., Cohrs, J. C., Kessler, T., & Bauer, J. (2012). Global warming is breeding social conflict: The subtle impact of climate change threat on authoritarian tendencies. *Journal of Environmental Psychology, 32*(1), 1-10. https://doi.org/10.1016/j.jenvp.2011.10.002

Fritsche, I., Jonas, E., Kayser, D. N., & Koranyi, N. (2010). Existential threat and compliance with pro-environmental norms. *Journal of Environmental Psychology, 30*(1), 67-79. https://doi.org/10.1016/j.jenvp.2009.08.007

Geiger, J. L., Steg, L., van der Werff, E., & Ünal, A. B. (2019). A meta-analysis of factors related to recycling. *Journal of Environmental Psychology, 64*, 78-97. https://doi.org/10.1016/j.jenvp.2019.05.004

Gelfand, M. J., Harrington, J. R., & Jackson, J. C. (2017). The strength of social norms across human groups. *Perspectives on Psychological Science, 12*(5), 800-809. https://doi.org/10.1177/1745691617708631

Gelfand, M. J., Nishii, L. H., & Raver, J. L. (2006). On the nature and importance of cultural tightness-looseness. *Journal of Applied Psychology, 91*(6), 1225-1244. https://doi.org/10.1037/0021-9010.91.6.1225

Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., Duan, L., Almaliach, A., Ang, S., Arnadottir, J., Aycan, Z., Boehnke, K., Boski, P., Cabecinhas, R., Chan, D., Chhokar, J., D'Amato, A., Ferrer, M., Fischlmayr, I. C., Fischer, R., …, Yamagishi S. (2011). Differences between tight and loose cultures: A 33-nation study. *Science, 332*(6033), 1100-1104. https://doi.org/10.1126/science.1197754

Gram-Hanssen, K. (2013). Efficient technologies or user behaviour, which is the more important when reducing households' energy consumption?. *Energy Efficiency, 6*(3), 447-457. https://doi.org/10.1007/s12053-012-9184-4

Greenwatch (2018). Global climate risk index 2019. Retrieved from: https://germanwatch.org/sites/default/files/Global%20Climate%20Risk%20Index%202019_2.pdf

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). Culture and organization: Software for the mind. (3rd ed.). New York, NY: McGraw-Hill.

Inglehart, R. (1995). Public support for environmental protection: Objective problems and subjective values in 43 societies. *PS: Political Science & Politic, 28*, 57-72. https://doi.org/10.2307/420583

Joanes, T., Gwozdz, W., & Klöckner, C. A. (2020). Reducing personal clothing consumption: A cross-cultural validation of the comprehensive action determination model. *Journal of Environmental Psychology, 71*, 101396. https://doi.org/10.1016/j.jenvp.2020.101396

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224–253. https://doi.org/10.1037/0033-295X.98.2.224

Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*(4), 503-515. doi.org/10.1016/j.jenvp.2004.10.001

Milfont, T. L., & Markowitz, E. (2016). Sustainable consumer behavior: A multilevel perspective. *Current Opinion in Psychology, 10*, 112-117. https://doi.org/10.1016/j.copsyc.2015.12.016

Milfont, T. L., Bain, P. G., Kashima, Y., Corral-Verdugo, V., Pasquali, C., Johansson, L.-O., Guan, Y., Gouveia, V. V., Garðarsdóttir, R. B., Doron, G., Bilewicz, M., Utsugi, A., Aragones, J. I., Steg, L., Soland, M., Park, J., Otto, S., Demarque, C., Wagner, C., … Einarsdóttir, G. (2018). On the relation between social dominance orientation and environmentalism: A 25-nation study. *Social Psychological and Personality Science, 9*(7), 802-814. https://doi.org/10.1177/1948550617722832

Morren, M., & Grinstein, A. (2016). Explaining environmental behavior across borders: A meta-analysis. *Journal of Environmental Psychology, 47*, 91-106. doi.org/10.1016/j.jenvp.2016.05.003

Murray, D. R., Trudeau, R., & Schaller, M. (2011). On the origins of cultural differences in conformity: Four tests of the pathogen prevalence hypothesis. *Personality and Social Psychology Bulletin, 37*(3), 318-329. https://doi.org/10.1177/0146167210394451

Norenzayan, A., & Heine, S. J. (2005). Psychological universals: What are they and how can we know?. *Psychological Bulletin, 131*(5), 763-784. https://doi.org/10.1037/0033-2909.131.5.763

Nyborg, K., Anderies, J. M., Dannenberg, A., Lindahl, T., Schill, C., Schlüter, M., Adger, W. N., Arrow, K. J., Barret, S., Carpenter, S., Chapin, F. S. III, Crépin, A.-S., Daily, G., Ehrlich, P., Folke, C., Jager, W., Nautsky, N., Levin, S. A., Madsen, O.J., … de Zeeuw, A. (2016). Social norms as solution. *Science, 354*(6308), 42-43. https://doi.org/10.1126/science.aaf8317

Oishi, S., & Komiya, A. (2017). Natural disaster risk and collectivism. *Journal of Cross-Cultural Psychology, 48*(8), 1263-1270. https://doi.org/10.1177/0022022117719496

Parboteeah, K. P., Addae, H. M., & Cullen, J. B. (2012). Propensity to support sustainability initiatives: A cross-national model. *Journal of Business Ethics, 105*, 403-413. https://doi.org/10.1007/s10551-011-0979-6

Parncutt, R. (2019). The human cost of anthropogenic global warming: Semi-quantitative prediction and the 1,000-Tonne rule. *Frontiers in Psychology, 10*, 2323. https://doi.org/10.3389/fpsyg.2019.02323

Prentice, L., Klackl, J., Agroskin, D., Grossmann, I., Alexandrov, Y., Apanovich, V., Bezdenezhnykh, B., & Jonas, E. (2020). Reaction to norm transgressions and islamization threat in culturally tight and loose contexts: a cross-cultural comparison of Germany versus Russia. *Culture and Brain, 8*, 46-69. https://doi.org/10.1007/s40167-018-0073-3

Reichl, J., Cohen, J., Kollmann, A., Azarova, V., Klöckner, C., Royrvik, J., Vesely, S., Carrus, G., Panno, A., Tiberio, L., Fritsche, I., Masson, T., Chokrai, P., Lettmayer, G., Schwarzinger, S., & Bird, N. (2019). International survey of the ECHOES project [Dataset]. Zenodo. http://doi.org/10.5281/zenodo.3524917

Savani, K., Wadhwa, M., Uchida, Y., Ding, Y., & Naidu, N.V.R. (2015). When norms loom larger than the self: Susceptibility of preference-choice consistency to normative influence across cultures. *Organizational Behavior and Human Decision Processes, 129*, 70-79. https://doi.org/10.1016/j.obhdp.2014.09.001

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). The constructive, destructive, and reconstructive power of social norms. *Psychological Science, 18*(5), 429-434. https://doi.org/10.1111/j.1467-9280.2007.01917.x

Sicard, P., Agathokleous, E., De Marco, A., Paoletti, E., & Calatayud, V. (2021). Urban population exposure to air pollution in Europe over the last decades. *Environmental Sciences Europe, 33*(28). https://doi.org/10.1186/s12302-020-00450-2

Siemens, J. C., Raymond, M. A., Choi, Y., & Choi, J. (2020). The influence of message appeal, social norms and donation social context on charitable giving: investigating the role of cultural tightness-looseness. *Journal of Marketing Theory and Practice, 28*(2), 187-195. https://doi.org/10.1080/10696679.2020.1717968

Stern, P. C. (2020). A reexamination on how behavioral interventions can promote household action to limit climate change. *Nature communications, 11*(1), 1-3. https://doi.org/10.1038/s41467-020-14653-x

Suh, E. M. (2002). Culture, identity consistency, and subjective well-being. *Journal of Personality and Social Psychology, 83*, 1378-1391. https://doi.org/10.1037/0022-3514.83.6.1378

Tam, K. P. (2013). Concepts and measures related to connection to nature: Similarities and differences. *Journal of environmental psychology, 34*, 64-78. doi.org/10.1016/j.jenvp.2013.01.004

Tam, K.-P., & Milfont, T. L. (2020). Towards cross-cultural environmental psychology: A state-of-the-art review and recommendations. *Journal of Environmental Psychology, 71*, 101474. https://doi.org/10.1016/j.jenvp.2020.101474

Tam, K.-P., Leung, A. K.-Y., & Clayton, S. (2021). Research on climate change in social psychology publications: A systematic review. *Asian Journal of Social Psychology, 24*(2), 117-143. https://doi.org/10.1111/ajsp.12477

Tam, K-P., & Chan, H-W. (2017). Environmental concern has a weaker association with pro-environmental behavior in some societies than others: A cross-cultural psychology perspective. *Journal of Environmental Psychology, 53*, 213-223. doi.org/10.1016/j.jenvp.2017.09.001

Thøgersen, J. (2006). Norms for environmentally responsible behaviour: An extended taxonomy. *Journal of Environmental Psychology, 26*(4), 247-261. https://doi.org/10.1016/j.jenvp.2006.09.004

Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B.P., & Winthrop, R. (2019). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change, 10*(2), e565. https://doi.org/10.1002/wcc.565

Udall, A. M., De Groot, J. I. M., De Jong, S. B., & Shankar, A. (2020). How Do I See Myself? A Systematic Review of Identities in Pro-Environmental Behavior Research. *Journal of Consumer Behaviour, 19*(2), 108-141. https://doi.org/10.1002/cb.1798

Udall, A. M., De Groot, J. I. M., De Jong, S. B., & Shankar, A. (2021). How I See Me – A Meta-Analysis Investigating the Association between Identities and Pro-Environmental Behaviour. *Frontiers in Psychology - Environmental Psychology, 12*, 642-1-50. https://doi.org/10.3389/fpsyg.2021.582421

Uz, I. (2015). The index of cultural tightness and looseness among 68 countries. *Journal of Cross-Cultural Psychology, 46*(3), 319-335. https://doi.org/10.1177/0022022114563611

Van de Vliert, E. (2013). Climato-economic habitats support patterns of human needs, stresses, and freedoms. *Behavioral and Brain Sciences, 36*(5), 465-521. https://doi.org/10.1017/S0140525X12002828

Vignoles, V. L., Owe, E., Becker, M., Smith, P. B., Easterbrook, M. J., Brown, R., ... & Bond, M. H. (2016). Beyond the 'east-west'dichotomy: Global variation in cultural models of selfhood. *Journal of Experimental Psychology: General, 145*, 966-1000. https://doi.org/10.1037/xge0000175

Wang, S., Wang, J., Ru, X., Li, J., & Zhao, D. (2019). Understanding employee's electricity conservation behavior in workplace: Do normative, emotional and habitual factors matter?. *Journal of Cleaner Production, 215*, 1070-1077. https://doi.org/10.1016/j.jclepro.2019.01.173

Weiss, K. R. (2015). Before we drown we may die of thirst. *Nature, 526*, 624-627. https://doi.org/10.1038/526624a

World Bank (2020). PM2.5 air pollution, mean annual exposure (micrograms per cubic meter). Retrieved from: https://data.worldbank.org/indicator/EN.ATM.PM25.MC.M3

World Risk Report (2019). World Risk Report 2019. Retrieved from: https://weltrisikobericht.de/wp-content/uploads/2019/09/WorldRiskReport-2019_Online_english.pdf

Table 1. Descriptive statistics

	N	Mean	SD	Range
Individual-level variables				
Perceived descriptive norms	18037	3.37	0.86	1-5
Perceived injunctive norms	18037	3.38	0.88	1-5
Support for renewable energy transition	18037	3.52	0.87	1-5
Age	18037	3.30	1.17	2-5
Education	17670	3.08	1.06	1-4
Income	18037	3.68	1.39	1-5
Gender				
Male	8930	-	-	-
Female	9099	-	-	-
Country-level variables				
Individualism-Collectivism	30	58.57	17.56	5-110
Cultural looseness-tightness	28	66.68	24.27	12.50-119.8
Air pollution (level of $PM_{2.5}$ exposed) (log transformed)	31	2.53	0.41	1.77-3.79
Climate risk (climate risk index 98-17)	31	85.11	36.86	38.00-155.67
Climate vulnerability (ND-vulnerability Index)	31	0.33	0.04	0.27-0.41
Climate exposure (ND-exposure index)	31	0.37	0.05	0.27-0.45
Vulnerability to environmental risk (World risk - vulnerability index)	31	27.79	4.48	20.97-40.33
Exposure to environmental risk (World risk - exposure index)	31	11.85	5.11	1.84-31.86

Note. Higher values of the societal-level factors indicate higher levels of individualism, higher levels of cultural looseness, higher levels of $PM_{2.5}$ exposed, lower levels of climate risk (indexed by climate risk index 98-17), higher levels of climate vulnerability (indexed by ND-vulnerability index and world risk - vulnerability index), and higher levels of climate risk exposure (indexed by ND-exposure index and world risk - exposure index).

Table 2. Results of the multilevel analyses on the relationship between perceived descriptive norms and support for renewable energy transition

	Effect on intercept			Effect on slope of perceived descriptive norms		
DV: Support for renewable energy transition	b (SE)	p-value	95% CI	b (SE)	p-value	95% CI
Main effect of perceived descriptive norms	.38 (.02)	.000	[.34, .42]	-	-	-
Culture						
Individualism-collectivism	-.12 (.03)	.000	[-.18, -.06]	.06 (.02)	.000	[.03, .08]
Cultural looseness-tightness	-.08 (.04)	.039	[-.15, -.00]	.05 (.02)	.006	[.01, .08]
Environmental risk						
Air pollution (level of $PM_{2.5}$ exposed)	.09 (.03)	.010	[.02, .15]	-.06 (.02)	.000	[-.09, -.03]
Climate risk (climate risk index 98-17)	-.04 (.03)	.284	[-.11, .03]	.02 (.02)	.366	[-.02, .05]
Climate vulnerability (ND-vulnerability Index)	.03 (.04)	.435	[-.04, .10]	-.05 (.02)	.004	[-.09, -.02]
Climate exposure (ND-exposure index)	.04 (.04)	.292	[-.03, .11]	.01 (.02)	.772	[-.03, .04]
Vulnerability to environmental risk (World risk - vulnerability index)	.09 (.03)	.006	[.03, .15]	-.07 (.01)	.000	[-.10, -.05]
Exposure to environmental risk (World risk - exposure index)	.02 (.04)	.651	[-.05, .09]	.01 (.02)	.697	[-.03, .05]

Note. Variance of the slope effect = .010, SE = .003, 95% CI = [.006, 019]. Each societal-level factor was included separately in the slope-as-outcome model. Higher values of the societal-level factors indicate higher levels of individualism, higher levels of cultural looseness, higher levels of $PM_{2.5}$ exposed, lower levels of climate risk (indexed by climate risk index 98-17), higher levels of climate vulnerability (indexed by ND-vulnerability index and world risk - vulnerability index), and higher levels of climate risk exposure (indexed by ND-exposure index and world risk - exposure index).

Table 3. Results of the multilevel analyses on the relationship between perceived injunctive norms and support for renewable energy transition.

	Effect on intercept			Effect on slope of perceived injunctive norms		
DV: Support for renewable energy transition	b (SE)	p-value	95% CI	b (SE)	p-value	95% CI
Main effect of perceived injunctive norms	.45 (.02)	.000	[.41, .48]	-	-	-
Culture						
Individualism-collectivism	-.12 (.03)	.000	[-.18, -.06]	.04 (.02)	.013	[-.01, .07]
Cultural looseness-tightness	-.08 (.04)	.039	[-.15, -.00]	.04 (.01)	.006	[.01, .07]
Environmental risk						
Air pollution(level of $PM_{2.5}$ exposed)	.09 (.03)	.010	[.02, .15]	-.06 (.01)	.000	[-.09, -.04]
Climate risk (climate risk index 98-17)	-.04 (.04)	.282	[-.11, .03]	.01 (.02)	.557	[-.02, .04]
Climate vulnerability (ND-vulnerability Index)	.03 (.04)	.433	[-.04, .10]	-.04 (.02)	.004	[-.07, .01]
Climate exposure (ND-exposure index)	.04 (.04)	.294	[-.03, .11]	.02 (.02)	.226	[-.01, .05]
Vulnerability to environmental risk (World risk - vulnerability index)	.09 (.03)	.005	[.03, .16]	-.06 (.01)	.000	[-.09, -.03]
Exposure to environmental risk (World risk - exposure index)	.02 (.04)	.647	[-.05, .09]	.00 (.02)	.778	[-.03, .04]

Note. Variance of the slope effect = .008, SE = .002, 95% CI = [.004, 014]. Each societal-level factor was included separately in the slope-as-outcome model. Higher values of the societal-level factors indicate higher levels of individualism, higher levels of cultural looseness, higher levels of $PM_{2.5}$ exposed, lower levels of climate risk (indexed by climate risk index 98-17), higher levels of climate vulnerability (indexed by ND-vulnerability index and world risk - vulnerability index), and higher levels of climate risk exposure (indexed by ND-exposure index and world risk - exposure index).

Table 4. Results of the multilevel analyses on the relationship between perceived descriptive norms, perceived injunctive norms and support for renewable energy transition.

	Effect on Intercept			Effect on slope of perceived descriptive norms			Effect on slope of perceived injunctive norms		
DV: Support for renewable energy transition	b (SE)	p-value	95% CI	b (SE)	p-value	95% CI	b (SE)	p-value	95% CI
Main effect of perceived descriptive norms	.19 (.01)	.000	[.16, .21]	-	-	-	-	-	-
Main effect of perceived injunctive norms	.35 (.01)	.000	[.32, .38]	-	-	-	-	-	-
Culture									
Individualism-collectivism	-.12 (.03)	.000	[-.18, -.06]	.03 (.01)	.005	[.01, .06]	.02 (.01)	.137	[-.01, .05]
Cultural looseness-tightness	-.08 (.04)	.039	[-.15, -.00]	.02 (.01)	.072	[-.00, .05]	.03 (.01)	.010	[.01, .06]
Environmental risk									
Air pollution (level of $PM_{2.5}$ exposed)	.09 (.03)	.010	[.02, .15]	-.03 (.01)	.011	[-.06, -.01]	-.05 (.01)	.000	[-.07, -.02]
Climate risk (climate risk index 98-17)	-.04 (.04)	.279	[-.11, .03]	.01 (.01)	.576	[-.02, .04]	.00 (.01)	.773	[-.02, .03]
Climate vulnerability (ND-vulnerability Index)	.03 (.04)	.434	[-.04, .10]	-.02 (.01)	.155	[-.05, .01]	-.03 (.01)	.013	[-.06, -.01]
Climate exposure (ND-exposure index)	.04 (.04)	.290	[-.03, .11]	-.00 (.01)	.801	[-.03, .03]	.02 (.01)	.155	[-.01, .05]
Vulnerability to environmental risk (World risk - vulnerability index)	.09 (.03)	.006	[.03, .15]	-.04 (.01)	.001	[-.06, -.02]	-.04 (.01)	.001	[-.06, -.02]
Exposure to environmental risk (World risk - exposure index)	.02 (.04)	.643	[-.05, .09]	.00 (.01)	.910	[-.03, .03]	.00 (.01)	.762	[-.02, .03]

Note. Variance of the slope effect of perceived descriptive norms = .005, SE = .002, 95% CI = [.002, 010]. Variance of the slope effect of perceived injunctive norms = .005, SE = .002, 95% CI = [.002,.010]. Each societal-level factor was included separately in the slope-as-outcome model. Higher values of the societal-level factors indicate higher levels of individualism, higher levels of cultural looseness, higher levels of $PM_{2.5}$ exposed, lower levels of climate risk (indexed by climate risk index 98-17), higher levels of climate vulnerability (indexed by ND-vulnerability index and world risk - vulnerability index), and higher levels of climate risk exposure (indexed by ND-exposure index and world risk - exposure index).