Title

(Mis)matched direct and moderating relationships among pro-environmental attitudes, environmental efficacy, and pro-environmental behaviors across and within 11 countries

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Abstract

Pro-environmental behaviors are influenced by individuals' pro-environmental attitudes and environmental efficacy, among many other factors. However, attitude-behavior models are inconsistent on whether and how attitudes, efficacy, and behaviors should match in specificity or generality, and on the moderation effect of efficacy. This study first tests a simple model including direct and moderating relationships between pro-environmental attitudes, environmental efficacy, and pro-environmental behaviors. Then it examines relationships among subscales matched or mismatched in their respective specific or general domain of environmental attitudes (concern, values), environmental efficacy (self, collective), and pro-environmental behaviors (private, public). Secondary data come from an overall sample of 11,000 respondents across 11 countries, with n=1,000 from each country. Pro-environmental attitudes and efficacy have direct relationships with pro-environmental behavior, but efficacy has little moderation effect. Different combinations of (mis)matched measures produce slightly different results, with the most variance explained, counter to hypotheses, by two mismatched models. Results are generally consistent across countries.

1 Introduction

As issues of environmental degradation become increasingly pressing and publicized [1,2], it is imperative that scholars have a clear understanding of the forces that can lead individuals to engage in pro-environmental behaviors. Gifford [3] underscores that "understanding behavior at the psychological level of analysis… is essential, given that the cumulative impact of individuals' decisions and behaviors is the key factor driving climate change" (p. 554). Two such antecedents that have been widely studied are pro-environmental attitudes and efficacy. Although ample research has explored the relationships among pro-environmental attitudes, efficacy, and behavior [e.g., 4], the field lacks a coherent understanding of the many subdimensions of these constructs and the relationships among them. Furthermore, there is little research that explores how these relationships may persist or vary across countries—an understanding of which is vital to combat such global phenomena.

Copious research has examined the association of pro-environmental attitudes with pro-environmental behaviors. Across behavior types, ages, and nationalities, people's pro-environmental attitudes are positively related to their intended and enacted pro-environmental behaviors [e.g., 5–14]. However, other studies report weak or non-significant relationships [5,15,16]. These inconsistent findings suggest that the environmental attitude-pro-environmental behaviors relationship is complicated by at least two conceptual issues.

The first issue is the extent to which the pro-environmental attitude-behavior relationship is conditioned by additional influences. One such influence is *efficacy*. When individuals perceive that they cannot perform a given action, or that their performance of that action is not likely to succeed, intentions and behavior weaken [17–19]. Requiring further clarification is whether efficacy operates as a direct effect on (is associated with) pro-environmental behavior and/or as a moderator of the pro-environmental attitude-behavior relationship.

The second issue is the extent to which measures of pro-environmental attitudes, environmental efficacy, and pro-environmental behaviors should be *specific, general, or combined*. Previous research suggests that large discrepancies occur when the specificity of attitude measurement does not match the specificity of the respective behavior [20–22]. For example, Kaiser [23] notes inconsistent results when using ecological behavior measures that do not explicitly consider the nature of the behaviors, or their correspondence to measured attitudes. Thus "an often-recommended means to increase consistency is *measurement correspondence*, that is, measuring both attitude and behavior on the same level of specificity" (p. 398). The theory of planned behavior (TPB) and related research argues that stronger relationships occur when measures of both attitudes and behaviors are specific [17, see also 24, concerning green purchases]. Similarly, Heeren et al. [15] analyzed the relationships between attitudes, knowledge, norms, and perceived behavioral control on each of 10 sustainability behaviors, finding much more variance was explained when the behaviors were analyzed separately (more specific) than when combined into one scale (more general). Indeed, some specific pro-environmental attitude variables seem to be associated with or affect only specific pro-environmental behaviors [25, p. 416].

However, Kaiser [23] and Kaiser et al. [26] argued that both pro-environmental attitudes and pro-environmental behaviors should be measured generally, partially because so many specific influences and challenges vary across individuals and contexts. Many researchers follow this approach by using measures of global environmental attitudes in their research [e.g., 23,27] (see Sections 2.1, 6.2).

Further, this unidimensional measurement of pro-environmental attitudes and pro-environmental behaviors from specific to general only takes into account the range from high specificity ("specific") to low specificity ("general"). However, in colloquial language, the term "general" is typically considered to be a counterpart to the term "specific." In this sense, specific and general are relative, so that any given measure can vary both on the level of specificity and on the level of generality. Measurements of both attitudes and behaviors can benefit from this conceptualization; even matching on single items (previously considered "specific") can be phrased in a specific domain (e.g., "how likely are you to ride your bike to work on Monday mornings") or a general domain (e.g., "how likely are you to take alternative modes of transportation"). Thus, to clarify this literature, we consider the *domains* of both "general" and "specific." We refer to scales that combine both domains of general and specific as "combined." Similarly, measures of efficacy can be more specific (e.g., "to what extent do you feel that you can ride your bike to work on Monday mornings") or more general (e.g., "to what extent do you feel that you can take alternative modes of transportation").

Based on a succinct interpretation of the literature, we define measures in the *combined* domain as involving items relevant to both specific and general domains (or, in the literature, that do not distinguish between the domains); *specific* measures as focused on a particular object or action that is typically immediate, individual, and/or direct; and *general* measures as including a broad range of objects or actions that are typically delayed, social, and/or indirect. Here, *combined* measures include pro-environmental attitudes (EA), environmental efficacy (EFF), and pro-environmental behaviors (PEBs). Measures in the *specific* domain include environmental concern (EAC), environmental self-efficacy (EFFS), and private sphere PEBs (PEBPr). Measures in the *general* domain include environmental values (EAV), environmental collective efficacy (EFFC), and public sphere PEBs (PEBPu). Respective sections below provide rationales

for each of these categorizations and their relationships. Section S6 in the S0 File provides definitions and abbreviations for all relevant terms used in this text.

We label analyses *simple* if the combined measures are used, as they do not distinguish specific from general domains. We consider analyses *matched* if the relationships among attitudes, efficacy, and behavior involve all specific or all general measures. Finally, *mismatched* analyses involve relationships with a mix of specific and general measures. We raise three research questions involving these (mis)matches: (a) whether the matching of measures itself (all are specific or all are general) outperforms mismatched measures (at least one is general and at least one is specific), (b) whether the measurement domain drives stronger results (matching on specific measures out- or under-performs matching on general measures), and (c) whether either matched or mismatched measures outperform combined measures (which include all relevant specific and general measures).

We test these relationships using secondary data both across and within 11 countries. We are not proposing to test a particular environmentally-oriented macro or meso theory (a wide range of which Stern [25], and Gifford [3], summarize), but instead are only considering primary direct and moderating relationships among combined, specific, or general domains of three central components of the TPB—attitudes, control (here, efficacy), and behavior—and among matched or mismatched domains of their subscales. Nor are we proposing or testing specific differences across the countries, but instead are seeking only to identify the extent to which the overall analyses are similar across countries, and thus support more generalizability.

Thus the paper hones in on several research gaps, associated with the theory of reasoned action, in the context of environmental attitudes, efficacy, and pro-environmental behaviors, and the extent to which such concepts should be tested and implemented specifically, generally, or in combined form. The *general research question* motivated by those gaps is: How do environmental attitudes and efficacy associate with pro-environmental behaviors, considering direct or moderated models, and simple or (mis)matched models, overall or in different countries? This framing question is analyzed through direct effect moderated effect analyses of combined as well as specific or general measures, tested overall across 11 countries and 11,000 respondents, and within each of the 11 countries. Thus this study helps clarify the theoretical roles of efficacy, and specific or general measures, concerning pro-environmental behaviors across and within a large multi-country sample. The study is unique by explicitly testing two possible roles of environmental efficacy, by conceptually and empirically distinguishing specific, general, and combined measures, and by finding fairly consistent results across diverse countries.

The following sections review relevant literature on the concepts of and relationships among environmental attitudes, environmental efficacy, and pro-environmental behaviors. The next section presents the respective models (direct and moderation, simple and general, matching and mismatching) hypotheses, and a specific research question (considering results overall and by country). The methodology section describes the sample and the measures. The results section provides analytical results for each of the models, hypotheses, and specific research question. The discussion section considers interpretations of relevant results, and provides limitations and possibilities for future research, followed by a conclusion section.

2 Literature review

2.1 Environmental attitudes: Concern and values

Environmental attitudes (EA) can be defined as “a psychological tendency expressed by evaluating the natural environment with some degree of favour or disfavour” [28, p. 80]. These evaluative tendencies influence “beliefs, affects, and behaviours regarding human-environment

relations" (p. 81). Gifford and Sussman [29] define EA broadly as concern for the environment or related issues. Two concepts that have shown considerable utility as indicators of EA are *environmental concern* (EAC) (more specific) and *environmental values* (EAV) (more general). In a multi-level study of secondary data from an international survey across 31 countries in 2009-2011, Tam [30] found both environmental concern and postmaterialist values and as psychological motivations associated with environmental activism engagement.

Many researchers view environmental concern (EAC) as an essential aspect of EA [31,32]. For instance, Schultz and colleagues [33,34] have referred to EAC as the affect associated with an EA [see also 35, p. 370], and Bamberg [36] concluded that "environmental concern" seems to be a specific part of a general environmental attitude. AlMenhali et al. [37] stated that "environmental attitudes are more of an individual concern for the physical environment, which is related to the degree of cognitive, affective, and behavioral concerns toward the environmental problems" (p. I). Environmental concern typically refers to an individual's concern about a specific environmental condition, such as air pollution. Thus, EAC can be considered a *specific* domain of EA [38].

"Values are trans-situational goals that guide people's evaluation of entities (e.g., person, object, social events) and selection of behaviors," but have varying influence depending on the relevance of the value to the situation [39, pp. 1,2], among other factors. Many studies have found strong associations between environmental values (EAV) and EA [e.g., 40–42]. Some scholars have argued that EAV causally precede EA (valenced evaluations of a specific object or topic) [28,41]. However, other researchers conceptualize EAV as one component of EA [25,29,43]. For example, Stern [25, p. 146] includes (perhaps inadvertently given his theory) norms, beliefs, and values as attitudinal factors influencing behaviors. Banerjee and McKeage's [43] Environmentalism Scale has three subscales, one of which is internal environmentalism, or "attitudes about one's own connection to nature and personally relevant issues," similar to our values measure [29, p. 67]. Environmental values typically refers to a basic orientation toward nature or the environment in general. Thus, EAV can be considered a *general* domain of EA.

Schultz et al. [34] note that much pro-environmental attitudes research focuses on environmental values, which provide a foundation for beliefs, EAC, and PEBs. In addition, Gifford [3] includes results from several studies that demonstrate direct relationships between EAV and PEB intentions. For example, Vesely et al.'s [14] extensive meta-analyses reported a medium to strong relationship between personal connectedness to nature and pro-environmental intentions and behaviors. Chan [39] reported a positive association between self-transcendence values and PEB.

2.2 Pro-environmental behaviors: Private and public sphere

Pro-environmental behavior (PEB) is "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world (e.g., minimize resource and energy consumption, use of non-toxic substances, reduce waste production)" [19,22, p. 240]. To some extent, environmental problems arise from the moral hazard issue and associated negative externalities: performing PEBs often requires individuals to prioritize the long-term collective health of others, a region, or the planet, over their own individual interests, while focusing on their own benefits may generate externalities such as pollution [44]. Furthermore, an individual's PEBs are difficult to associate with larger outcomes (both perceived as well as actual) [45]. Therefore, messages promoting PEBs can highlight, or frame, benefits to either or both the individual and society [46].

Measures of PEBs are diverse, including actions that directly benefit the environment, influencing others, supporting environmental policies, and lifestyle changes. Some studies do not attempt to conceptualize distinctions among PEBs, using measures that combine different aspects of PEB [5,10,12,15,16,20,27,47–50]. However, because environmental issues are public and increasingly global, PEBs involve both individual- and societal-level actions. Stern [25] distinguishes among environmental activism, nonactivist behaviors in the public sphere, private sphere environmentalism, and other (especially organizational). The third is in the private sphere, while the others are in the public sphere.

Following Milfont et al.'s [51] differentiation between public and private sphere PEBs, we identify two domains of PEBs: *private sphere pro-environmental behaviors* (PEBPr) (more specific) and *public sphere pro-environmental behaviors* (PEBPu) (more general).

Some scholars consider PEBPr as behaviors that are direct and impact-oriented (e.g., recycling) [52–54]. Other conceptualizations of PEBPr refer to the individual benefits that people accrue from performing green behaviors (termed "shallow green behavior" by Feng and Reisner [55]). However, this conceptualization does not apply equally to all private PEBs: while socially beneficial behaviors such as reducing electricity consumption can also lower an individual's utilities cost, other behaviors such as recycling often require individuals to devote effort to separating recyclables and paying for the bin and collection, without obvious or direct individual benefit. Therefore, we define *private PEBPrs* as behaviors that single individuals can take to benefit the environment (e.g., recycling, shopping with reusable bags), and the impact of these behaviors may be direct and specific to the individual [52–54]. Thus, PEBPr is a *specific* domain of PEBs.

PEBPu are often indirect in that they can signal the intention to enact PEBs through advocating for or commitment to environmental efforts (e.g., voting for an environmental policy) [52]. Some researchers consider "influencing others" as a separate facet of PEB [56]; based on the above conceptualization, however, influencing others can be considered an indirect and a public sphere behavior. Piyapong [53] further distinguishes public sphere (intent-oriented) behaviors into activist and non-activist. Homburg and Stolberg [57] consider nonactivist behaviors as a form of social commitment, such as engaging in environmental protection actions. Chen [58] measures public nonactivist behavior as "specific social commitments" such as planting trees and picking up litter on the beach (p. 70). We define PEBPu as behaviors that require some kind of group organization to benefit the environment either directly (e.g., volunteering to plant trees) or indirectly (e.g., signing a petition to support an environmental cause). Further, the impact of these behaviors may be diffuse and collective, requiring other engaged individuals [e.g., 52]. Thus, PEBPu is a *general* domain of PEBs.

2.3 Efficacy: Self and collective

Scholars have pointed to the role of efficacy (EFF) in enabling or motivating individuals to translate attitudes into concrete action [19]. EFF, or the belief that one has capabilities to "organize and execute the courses of action required to produce given attainments," allows individuals to feel that their actions are worthwhile and achievable [18, p. 3]. EFF both "motivates and sustains" behavior change [59, p. 2] by focusing attention [60], affecting perception of goal difficulty and goal commitment [61], helping assign resources to the goal [62], and fostering searching for better strategies [63,64; see 64, pp. 660-661 for a review].

Researchers have conceptualized EFF in both *specific* and *general* forms. Wang and Richarde [65] concluded that task-specific and global measures of EFF were relatively distinct. In the context of work motivation, Eden [66] referred to the concept of "total subjective efficacy"

as including both specific (e.g., tools, supervisory leadership) and general (e.g., the organization or team) subjective efficacy. Schwarzer [67] validated across 14 cultures and 13 languages a measure of generalized self-efficacy (ability to manage a variety of stressors) that differentiated task-specific from general efficacy. This scale was further validated in three and then in five countries and languages [68,69, respectively].

Other studies have reported varying relationships between self-efficacy and general efficacy. For example, Hanss and Böhm [56] concluded that dimensions of sustainable development (domain-specific) self-efficacy were variously associated with three kinds of sustainable behavior, while general self-efficacy was not. Smith et al. [70] also separately measured task-specific and general self-efficacy, showing that engaging in an unsolvable problem negatively affected the former but not the latter.

We refer to the concept as *environmental efficacy*, the combined scale as *EFF*, and the two domains as *self-efficacy* (EFFS) (more specific) and *collective efficacy* (EFFC) (more general). In the context of explaining PEBs, distinguishing between EFFS and EFFC is especially relevant because individual actions are insufficient for most environmental problems. For example, Hamann and Reese [71] reported that EFFS predicted PEBPr, although the relationship between EFFC and PEBPu remained unclear. Section S1 in the S0 File provides an extended review and justification of self- and collective efficacy.

EFFS typically consists of two aspects: whether the person believes that (a) that they can perform a given action, and (b) that the given action will have the intended effect [18,64,71]. EFFS also includes the ability to overcome some barriers in performing a behavior [9], and is conceptually similar to perceived behavioral control in the TPB [9,17,72]. Generally considered domain-specific [18], EFFS strengthens motivation and behavioral intentions [27,47,64]. EFFS, through increasing a sense of empowerment and effectiveness, should motivate relevant environmental behavior [72]. We note that, like PEBPr, EFFS is specific to the individual [18]. Therefore, we consider EFFS a *specific* domain of EFF.

Bandura [18] conceptualized EFFC as "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments" (p. 477). Collective efficacy also includes two aspects: (a) whether a group believes that they collectively can perform a certain behavior, and (b) whether the behavior has the desired effect. Perceived collective efficacy can allow individuals to believe that group efforts may matter even though individual efforts are insufficient [73]; see also the social identity model of collective action [74]. Chen [58] further clarifies that collective efficacy is an "emergent group-level property and not merely the sum of the efficacy beliefs of the individual members" (p. 69), and that the group must rely on collective rather than individual resources [see also 75]. For sustainable development issues, Hanss and Böhm [56] found that "in this country" and "around the world" did not represent different facets of geographical collectivity. Similar to PEBPu, EFFC is general in the sense that it involves an assessment of the group rather than of the individual [18]. Therefore, EFFC is a *general* domain of efficacy.

3 Relationships among EA, EFF, and PEBs — Simple direct or moderation effects, (mis)match direct or moderation effects — with controls/covariates and by country; Models, hypotheses, and research question

3.1 Simple model (direct and moderation; ignoring specific-general distinctions)

We have already noted the familiar direct EA-PEBs model, and we use that as the basic model to which we add EFF. EFF could play at least three roles related to PEBs: as a direct association with behaviors, as a moderator of the attitude-behavior relationship, or as a mediator between attitudes and behaviors. Section S2 in the S0 File discusses why this study does not consider the mediation role. As a central goal of this study is to clarify the relationships between these constructs, we will test both the direct role of EFF and the less-examined moderation role of EFF in the EA-PEB relationships. Thus, the direct and moderation models will first be tested using the three combined concepts (EA, EFF, PEBs; we refer to these as *simple* models), and then the direct and moderation models will be tested using the combinations of matches and mismatches of the concepts' domain subscales (we refer to these as *[mis]match* models, discussed in Section 3.2).

Studies consistently find that higher levels of EFF are directly associated with more engagement in a wide range of PEBs [e.g., 47,58,71,76]. This direct effect approach is grounded in the TPB [12,15,77,78], social cognitive theory (SCT) [71,79], and protection motivation theory (PMT) [9,78].

There are far fewer studies proposing or testing a moderation effect of efficacy. Although several studies do not find a moderating role of self-efficacy on the relationship between attitudes and PEBs [7,11,24,45,80], a few studies have shown significant moderation effects. For example, Berger and Corbin [20] demonstrated that both individuals' own perceived consumer effectiveness (EFFS) and their faith in the efficacy of others (EFFC) moderated the relationship between participants' EA and environmentally responsible purchasing behaviors (PEBs).

3.2 (Mis)matching models (direct and moderation, including specific-general distinctions)

One implication of the reviews in Section 2 is that more subtle approaches to the relationships among EA, EFF, and PEBs would take into account the specific and general domains within EA (i.e., EAC, EAV), within EFF (EFFS, EFFC), and within PEBs (PEBPr, PEBPu). Thus, more domain-specific EAs are more likely to be related to more domain-specific PEBs, more domain-general EAs are more likely to be related to more domain-general PEBs, and EFF domains might also be more effective, either directly or as a moderator, when matched with specific or general domains of EA and PEBs [81]. Nonetheless, even mismatched domains are likely to be significantly associated; for example, a generalized conservation attitude may be associated with multiple specific forms of conservation [29].

3.3 Controls

Both the simple and (mis)match models will control for relevant demographics. Research has identified a wide variety of other influences, here conceptualized as control variables, on environmental attitudes and behaviors. Among others, these include age, gender, education, geographic location, income, social class, and environmental social norms [9,19,53,82,83]. For example, Gifford [3] notes that rural and urban residents have different knowledge of and experience with environmental issues, place attachment, and beliefs in nature as a consumption resource or as deserving preservation for its own sake. Studies have found differences in concerns about and attitudes toward environmental problems across the rural-urban continuum [84], though other results are mixed [3,29].

3.4 A multi-country perspective

Although the basic relationships among EA, EFF, and PEBs may be an enduring framework, the levels and relationships among these constructs may also differ somewhat across countries. For example, in Brazil and Australia, deep histories of environmentalism have led voters to prioritize the environment as a central political issue, while in Indonesia, the multi-billion-dollar palm oil industry has led to incentivized deforestation [85,86]. Variations in countries' infrastructure, policies, assumptions, ideology, cultural history, and economic availability regarding environmental issues can all influence individuals' attitudes and abilities to translate those attitudes into action.

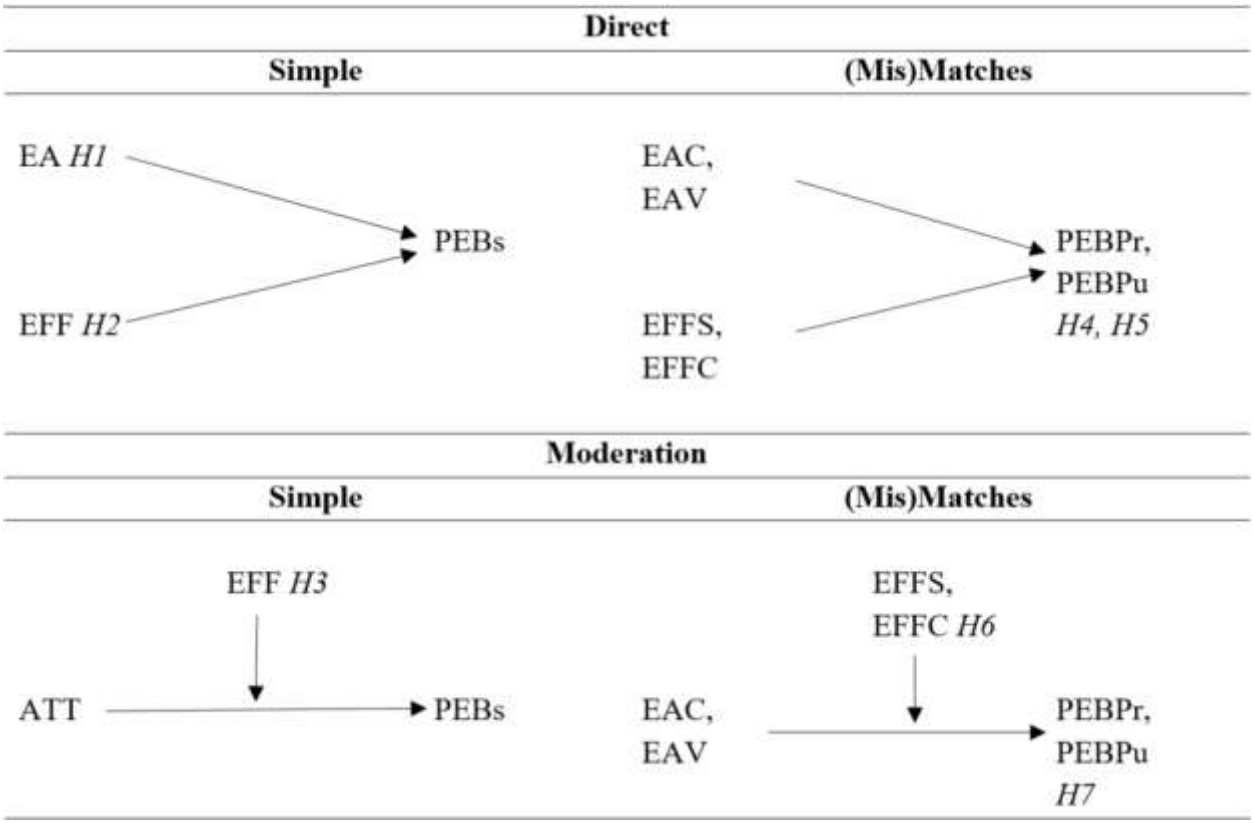
Tam and Milfont [87] summarized characteristics of 54 cross-cultural environmental articles in the *Journal of Environmental Psychology* from 2000-2019. A number of studies examine EA and PEBs outside of the United States. Many studies involve samples from one or two countries [e.g., 27,57,88]. For example, Kim et al. [9] concluded that EFFS was a stronger predictor of PEBs among American compared to Korean participants. In addition, several projects do consider large numbers of countries. Gifford and Sussman [29] provide a succinct review of similarities and differences in EA and EAC across a number of cross-national studies (p. 69); Chan [39] noted some prior cross-country studies on values-PEB relationships; Schultz et al. [34] found consistent associations between EAV and EAC across six countries; Wang's [13] study of EAs and sustainable consumption behaviors in 31 countries found that in low-income countries, individual attitudes are stronger predictors of sustainable behaviors under high levels of environmental governance but weaker when environmental governance is lacking; and Oreg and Katz-Gerro [12] ran a multilevel model on a very large sample across 27 countries, showing that country-level postmaterialism values influenced participants' level of EA, which then predicted their PEBs. Beyond the central goal of this study to test simple and (mis)matched, direct and moderation, relationships among both scales and subscales of EA, EFF, and PEBs, we also provide a global perspective from 11 diverse countries, describing similarities and differences in the relationships.

However, this study does not propose or test hypotheses about country-level differences, as it uses only individual-level data (see 6.2 Limitations and Future Directions, and Sections S4 and S5 in the S0 File). We apply the method of cross-cultural replication, comparing patterns of results across countries [87], though not via statistical tests. We refer to the cross-country sample as *overall* and the separate within-country sample as *by country*.

3.5 Models, hypotheses, and research questions relating EA, EFF, and PEBs, via direct and moderation effects, simple and (mis)matched models, overall and by country

Based on the above reviews, we propose a general model whereby EA relates positively to PEB (e.g., [30]), and EFF relates positively to PEB directly (e.g., [47,58,71,76]) and as a moderator in the EA-PEB relationship (e.g., [7,11,24,45,80]). Given previous research that has found significant relationships between these constructs across a range of countries (e.g., [9,12]), we expect this general model to be significant overall (across countries). Fig 1 portrays all the direct and moderation models, and the combined and (mis)matched models, in both visual and tabular form, and indicates the following hypotheses and research question.

Fig 1. Visual and Tabular Summary of Models: Direct or Moderation, Simple or (Mis)Matches



A. Visual Portrayal of Models

B. Textual Portrayal of Models

Direct					
Attitude	Efficacy	Pro-environmental behaviors	Attitude	Efficacy *H4*	Pro-environmental behaviors
	Simple			**Matches** *H5*	
ATT *H1*	EFF *H2*	PEBs	EAC	EFFS	PEBPr
			EAV	EFFC	PEBPu
				MisMatches *H5*	
			EAC	EFFS	PEBPr
			EAC	EFFC	PEBPu
			EAC	EFFC	PEBPr
			EAV	EFFS	PEBPu
			EAV	EFFS	PEBPr
			EAV	EFFC	PEBPu
Moderation					
Attitude	Pro-environmental behaviors	by Efficacy	Attitude	Pro-environmental behaviors *H6*	by Efficacy
	Simple			**Matches** *H7*	
ATT	PEBs	EFF *H3*	EAC	PEBPr	EFFS
			EAV	PEBPu	EFFC
				MisMatches *H7*	
			EAC	PEBPr	EFFS
			EAC	PEBPu	EFFS
			EAC	PEBPr	EFFC
			EAV	PEBPu	EFFS
			EAV	PEBPr	EFFC
			EAV	PEBPu	EFFC

[Legend at bottom of Fig1-page2:]
Note: Hypotheses are indicated by italics. All models are tested overall and by country: *RQ1*
ATT: Environmental attitudes; EAC: Environmental concern; EAV: Environmental value
PEB: Pro-environmental behavior; PEBPr: Private Pro-environmental behavior; PEBPu: Public Pro-environmental behavior
EFF: Efficacy; EFFS: Environmenal self-efficacy; EFFC: Environmental collective efficacy

The concepts used in each model are as follows. The simple overall model includes EA, EFF, PEBs. The two matching models include: 1: EAC, EFFS, and PEBPr; and 2: EAV, EFFC, and PEBPu. The six mismatching models include: 3: EAV, EFFS, and PEBPr; 4: EAC, EFFC, and PEBPu; 5: EAV, EFFS, and PEBPu; 6: EAV, EFFC, and PEBPr; 7: EAC, EFFS, and PEBPu; and 8: EAC, EFFC, and PEBPr. In addition to direct effects for each of those models, the moderation effect model includes the interaction between EA, EAC, and EAV, with EFF, EFFS, and EFFC, respectively.

First, we propose two simple direct effects.

H1: EA will be positively related to PEBs.

H2: EFF will be positively related to PEBs.

Next, we propose a simple moderation effect.

H3: The positive relationship between EA and PEBs will be positively moderated by EFF.

Then we test for the more subtle direct effects by considering two matches and six mismatches of the domains of EA, EFF and PEBs. As in the traditional TPB model, all listed (mis)match relationships should be positive [17], so we do not propose specific hypotheses for each, but rather group them under H4. However, based on the discussions in Section 2, we would expect that matches should explain more variance in PEBs than the mismatches (e.g., [15]), thus H5.

H4: All combinations of EA subscales and of EFF subscales are positively related to all combinations of PEB subscales.

H5: The two matched direct relationships (model 1: EAC, EFFS, PEBPr; model 2: EAV, EFFC, PEBPu) will explain more variance in PEBs than each of the six mismatched direct relationships (models 3-8).

Following, we test for more subtle moderation effects by considering the two matches and six mismatches of EA, EFF and PEBs. For example, the relationship of EAV with PEBPu moderated by EFFC should be positive (e.g., [17]); and explain more variance than when moderated by EFFS (e.g., [15]).

H6: All relationships of combinations of EA domains (EAC, EAV) to all combinations of PEB domains (PEBPr, PEBPu) are positively moderated by all combinations of efficacy domains (EFFS, EFFC).

H7: The two matched moderation models (EAC*EFFS, PEBPr; EAV*EFFC, PEBPu) will explain more variance in PEBs than each of the six mismatched moderation relationships.

For the separate country analyses, for parsimony, we use only (a) the simple direct and moderation effects models, and (b) the (mis)matched model in the overall analyses explaining the most variance.

RQ1: In what ways are the results from the simple direct or moderation effects model, and the (mis)matched model that explains the most variance, similar or different across 11 countries?

4 Methodology

4.1 Sample

The data are responses from 1,000 adults 18 years or older in each of 11 countries (United States, Mexico, Brazil, United Kingdom, South Africa, Kenya, China, South Korea, Australia, United Arab Emirates, and Indonesia; total N =11,000) to a survey conducted in January and February 2019 by Ipsos for the National Geographic Society (NGS). They followed their standard practices, and later provided the data to the researchers. The data are thus secondary, as well as anonymous, and we had no role in obtaining consent, so the authors did not need to obtain IRB review. Further, we use only a small set of the wide range of measures from the survey. The countries reflected the NGS's initiatives at the time, focused on reducing humans' environmental footprint. The sample sizes were selected to achieve an approximately +/-5% margin of error at the country level. The large country sample sizes have a power value of 1.00 for an estimated effect size of .15. All surveys were conducted online (Ipsos reports the samples are representative of Internet users in those countries), except for Kenya, which were obtained via computer-aided face-to-face interviews. Interviews were conducted in English, the country's native language, or English and multiple languages in South Africa and Kenya. Age and gender quotas were applied to reflect census data, so the data are not weighted. Items within each question were randomized.

After the data were collected, the authors were invited by NGS to collaborate in the analysis and publication of findings from these data. Tam and Milfont [87] summarize three recruitment methods for multi-country studies, including (a) convenience sampling, (b)

contracting research companies (typically applying quota sampling), or (c) using existing international datasets and their relevant survey questions. We used method (c), which collected data via method (b). Thus, our study is a secondary analysis, involving typical strengths and weaknesses of measures and data from a prior project. In particular, we emphasize that (a) all the items used in the analyses are selected from a prior dataset which we did not design, so more standard or valid measures were not available; (b) we do not have access to their research or literature justification for the specific items or specific countries analyzed, except as noted; and (c) we created combined scales and subscales from available items that corresponded to our notions of more specific and more general domains, so the subscales do not represent the most valid or explicit operationalizations. This study is therefore opportunistic, exploratory, and limited, yet extends the simple direct effects model, and tests it across large samples in 11 countries.

4.2 Measures

A variety of methodological issues attend such a study using non-standard measures, multiple concepts, direct and moderation analyses, and large sample sizes across multiple countries. Sections S1-S5 in the S0 File provide in-depth results and/or discussions concerning the absence of mediation analyses, exploratory factor analysis loadings of separate and all subscale items, confirmatory factor analysis loadings and fit for separate subscales and scales, reliabilities, discriminant validity, scale factor loadings and congruence across countries, country-level effects in the overall analyses, and statistical differences between models and countries. This section describes each measure used in the models, provides sample items, and the scale Cronbach's α. Table S3.1 in the S0 File provides the wording for the items measuring EA, EFF, and PEBs.

*Environmental attitudes***.** *EAC* was measured by asking participants to indicate their level of concern for eight global issues including "habitat loss" and "lack of clean drinking water," with response options ranging from 1 (*not at all concerned*) to 5 (*very concerned*). After dropping two items, α=.88. *EAV* was assessed through six items from the Moral Conviction Scale & Values Scale [89], including "Nature has its own value, independent of its value to people" and "Nature is important to me, to who I am as a person," with response options ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). After removing one item, Cronbach's α=.84. A combined measure of *pro-environmental attitudes* (EA) was created by taking the mean of the mean of the EAV scale and the mean of the EAC scale (because of the different number of items in each, 5 and 6 respectively). Cronbach's α for the 11-item scale is .90.

Pro-environmental behaviors. Participants were asked to indicate how frequently they personally engaged in six PEBs over the past 12 months, such as "recycle" and "talk to friends or family about an environmental issue," with response options ranging from 1 (*never*) to 5 (*all the time*). Kaiser [23] notes that "...there is no agreement about which behavior domains can be aggregated. A common way of aggregation is an empirical one," such as by factor analysis (p. 397). Thus, the principal component analysis of PEBs demonstrated that three of five items loaded onto one factor (*PEBPu*), while the remaining two loaded onto another factor (*PEBPr*). One item did not load cleanly onto either component and was removed.

The two-item PEBPr scale (recycle, reusable bags) had a low alpha and Spearman-Brown coefficient of .60 [90]. However, a lower α for instruments designed to measure multifaceted constructs is often expected, especially when limited to a low number of question items [91], so such a measure can still be highly useful with a low α. The three-item PEBPu scale had an α of .76. A combined measure of PEBs was created by taking the mean of the means of PEBPr and

PEBPu (as the two measures had unequal numbers of items). The combined five-item scale had an α of .71.

Environmental efficacy. Participants' level of EFFS was measured by asking participants to "Please rate how confident you are that YOU AS AN INDIVIDUAL can attain the following goals in the next 10 years," with four items including "protect habitats" and "save animals at risk of extinction," and response options ranging from 0 (*cannot do at all*), 50 (*moderately can do*), to 100 (*highly certain can do*; α=.85). Level of EFFC was measured by asking participants to "Please rate how confident you are that YOUR COUNTRY can collectively attain the following goals in the next 10 years," with the same items and response scale used to measure EFFS (α=.89). A combined measure of EFF was created by taking the mean of participants' scores on the eight EFFS and EFFC measures (α=.89).

Control variables. Participants reported their *age* in years. Participants indicated their gender as 1 (Male), 2 (Female), 3 (Other), or 4 (Prefer not to say). As less than .2% reported the last two, those were dropped from analyses, and gender was recoded as 0 (Male) and 1 (Female). Participants indicated their *residential location* by whether they currently live in a 1 (*rural*), 2 (*suburban*), or 3 (*urban*) area. *Socio-economic ladder* (*SES Ladder*) was measured by asking participants to respond to the adapted question 2 from the MacArthur Scale of Subjective Social Status [92]. This item included a picture of a 10-rung ladder ranging from 1 (*at bottom*) to 10 (*at top*) and stated, "The ladder below represents where people stand in your country's society. At the top of the ladder are the people who are the best off, those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off, those who have the least money, least education, worst jobs, or no job. Please select the rung that best represents where you think you stand on the ladder." Participants reported their *education* level by responding to, "Which of the following comes closest to the last level of education you completed?" with various categories appropriate to the country. Because of the wide variation in this measure across countries, the results were standardized within each country to enable comparison across countries. Participants estimated *descriptive environmental social norms* by answering the question, "What percentage of people do you think engage in environmentally friendly behaviors, such as buying recycled, organic, or biodegradable products or saving energy in your country?" by entering a percentage from 0 to 100.

4.3 Analyses

After data collection, measure development, and data dimensionality, reliability, and validity, discussed above, we then conducted a series of analyses. First were basic descriptive statistics, and then correlations among the combined, specific, and general measures. Next were hierarchical regressions using the full dataset for each of the simple direct and moderation effects models, with combined, specific, and general measures, organized into match models and mismatch models. For country-level analyses, we used the simple direct effects and moderation effects, and for parsimony, the one (mis)match model explaining the most variance in the overall analyses. Results from each of labeled according to the respective hypotheses or the research question.

5 Results

5.1 Overall (across all countries)

Table 1 presents descriptive statistics overall and for each country, for the combined scales and their specific/general subscales.

Table 1. Descriptives for Scales and Subscales, Overall and by Country.

Model Variables	All	US	Mex	Bra	UK	SA	Ken	Chi	SK	Aus	UAE	Indo
EAC: Environmental concern (6 concern items)	4.27/ .73	4.01/ .86	4.59/ .56	4.50/ .63	4.09/ .74	4.47/ .63	4.33/ .76	4.13/ .62	4.18/ .68	4.11/ .76	4.11/ .84	4.48/ .62
EAV: Environmental values (5 value items)	4.29/ .68	4.11/ .75	4.55/ .55	4.43/ .59	4.11/ .70	4.42/ .60	4.40/ .68	4.33/ .55	3.99/ .62	4.07/ .75	4.27/ .79	4.56/ .54
EA: Pro-environmental attitudes (mean of the mean of 6 Concern items and 5 Values items)	4.28/ .63	4.06/ .72	4.57/ .49	4.47/ .54	4.10/ .65	4.44/ .55	4.36/ .61	4.23/ .51	4.08/ .58	4.10/ .68	4.19/ .73	4.52/ .49
EFFS: Self-efficacy index (4 items)	47.31/ 26.10	38.93/ 26.92	57.05/ 26.68	55.83/ 27.34	37.32/ 24.56	46.79/ 26.39	47.42/ 22.65	50.77/ 23.68	42.55/ 22.41	41.10/ 26.68	48.60/ 25.59	54.06/ 24.84
EFFC: Collective efficacy index (4 items)	47.87/ 25.23	46.07/ 26.40	50.39/ 26.52	47.33/ 28.63	44.39/ 24.36	40.73/ 26.94	52.70/ 20.80	49.78/ 22.79	43.38/ 21.16	47.61/ 25.79	52.17/ 25.78	52.03/ 24.12
EFF: Efficacy (mean of 4 Self- & 4 Collective efficacy items)	47.59/ 22.74	42.50/ 23.57	53.72/ 23.34	51.58/ 24.28	40.85/ 21.34	43.76/ 22.66	50.06/ 18.22	50.28/ 21.89	42.97/ 19.65	44.35/ 23.34	50.39/ 23.71	53.05/ 22.53

PEBPr: (2 private PEB items)	3.90/ .91	3.71/ 1.08	3.95/ .81	3.77/ .91	4.57/ .65	3.81/ .96	3.58/ .86	3.98/ .68	3.88/ .82	4.45/ .69	3.79/ .95	3.46/ .88
PEBPu: (3 public PEB items)	3.26/ .95	2.68/ .99	3.58/ .81	3.46/ .87	2.81/ .92	3.31/ .94	3.13/ .92	3.60/ .71	3.03/ .83	2.87/ .98	3.73/ .89	3.66/ .76
PEBs (mean of mean of 2 PEBPr and mean of 3 PEBPu)	3.58/ .76	3.19/ .88	3.77/ .71	3.61/ .79	3.69/ .58	3.56/ .84	3.35/ .74	3.79/ .59	3.45/ .70	3.66/ .63	3.76/ .83	3.56/ .73
Demographics												
Age (Years)	41.14/ 15.28	48.62/ 18.61	40.13/ 14.36	41.35/ 14.30	47.66/ 17.45	37.67/ 13.97	34.00/ 12.18	41.11/ 13.59	44.40/ 14.17	45.66/ 15.86	33.65/ 9.89	38.26/ 13.20
Gender												
0 (Male)	52.0%	48.1	48.1	47.8	49.7	47.3	49.2	50.9	49.5	48.7	72.9	50.2
1 (Female)	48.0	51.2	51.3	52.2	50.0	52.7	50.8	49.1	50.5	50.9	27.1	49.8
Location	2.48/ .70	1.96/ .73	2.78/ .52	2.87/ .43	2.03/ .71	2.26/ .71	2.61/ .66	2.88/ .36	2.79/ .53	2.04/ .59	2.47/ .77	2.55/ .65
1 (Rural)	12.1%	28.6	5.0	3.5	24.0	15.7	9.6	1.1	5.9	15.7	17.2	8.4
2 (Suburban)	26.8	47.3	12.5	6.3	49.1	42.8	19.9	10.0	8.9	65.1	18.2	27.7
3 (Urban)	61.1	24.1	82.5	90.2	26.9	41.5	70.5	88.9	85.2	19.2	64.6	63.9
SES ladder	5.26/ 1.94	5.67/ 1.97	4.75/ 1.53	5.35/ 1.76	5.92/ 1.90	5.63/ 1.87	5.77/ 1.85	5.18/ 1.61	5.89/ 1.84	5.70/ 2.02	3.53/ 1.82	4.49/ 1.63
Education (Z-score)	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00	.00/ 1.00
Environ. soc. norms (%)	40.06/ 22.51	39.61/ 21.01	33.17/ 19.44	33.98/ 21.69	42.71/ 21.84	33.74/ 21.23	43.19/ 22.29	42.40/ 23.75	35.88/ 21.62	45.88/ 22.53	47.73/ 23.56	42.32/ 22.48

N=11,000 overall; 1,000 per country; Note: values are M/SD, except % for Gender.

As Table 2 shows, all bivariate correlations among the combined scales and their subscales were positive and significant (somewhat due to large sample size). Notably, correlations of EA with PEBs were stronger (.22-.43) than were the correlations of EA with EFF (.08-.32), and with PEBPu (.15-.43) than with PEBPr (.08-.25).

Table 2. Correlations among Scales and Subscales, Overall.

Model Variables	EAC	EAV	EA	EFFS	EFFC	EFF	PEBPr	PEBPu
EAC	--							
EAV	.58	--						
EA	.90	.88	--					
EFFS	.22	.24	.26	--				
EFFC	.08	.13	.12	.57	--			
EFF	.17	.21	.21	.89	.88	--		
PEBPr	.22	.23	.25	.12	.08	.11	--	
PEBPu	.37	.40	.43	.32	.15	.27	.32	--
PEBs	.37	.39	.42	.27	.14	.24	.80	.82

N=11,000

Off-diagonal values are Pearson correlations; all $p < .001$, 1-tailed

In the overall model (across all countries), to explore the unique variance explained by each variable, and to avoid non-robust cluster errors, we use hierarchical multiple regressions with dummy-coded countries to test both the simple and the (mis)matching models, predicting combined PEBs and its two subscales, respectively. Dummy-coded country variables, with the U.S. as the reference group (using the GLM default settings), were entered in block 1, and EA and EFF variables along with their respective centered interaction term were entered in block 2. Age, gender, location, SES ladder, education, and environmental social norms (descriptive) were entered in block 3, to assess the explanatory strength of the central model variables before indicating the additional variance explained by the demographic controls.

Table 3 presents results from the simple model and the eight (mis)matching models. All models were significant at $p < .001$. The simple model, using EA, EFF, and PEBs, the interaction between EA and EFF, and demographics, explained 31% of the variance in PEBs. Dummy-coded country variables explained 6.0% of the variance in PEBs. Both EA and EFF explained significant variance (supporting H1 and H2, respectively), although the interaction of EA and EFF was not (rejecting H3); together, they explained 27% of the variance in PEBs. Finally, age, gender, SES ladder (negatively), education, and environmental social norms (descriptive) were all significant, while residential location was not. Together, the demographics explained 4% of the variance in PEBs.

Table 3. Hierarchical Regressions for Simple Direct and Moderation Effects Models Using Combined Scales, and Using (Mis)match Subscales, Overall.

	Simple Model	Match Models (1, 2)		MisMatch Models (3-8)					
Model Variables	**EA/ EFF/ PEBs**	**1: EAC/ EFFS/ PEBPr**	**2: EAV/ EFFC/ PEBPu**	**3: EAV/ EFFS / PEBPr**	**4: EAC/ EFFC/ PEBPu**	**5: EAV/ EFFS / PEBPu**	**6: EAV/ EFFC/ PEBPr**	**7: EAC/ EFFS / PEBPu**	**8: EAC/ EFFC/ PEBPr**
Country a									
Mex	.12***	.01	.20***	.02	.18***	.17***	.02*	.16***	.02
Bra	.10***	-.04***	.19***	-.03**	.17***	.16***	-.02	.15***	-.02**
UK	.16***	.27***	.04***	.27***	.03***	.04***	.27***	.04***	.26***
SA	.10***	.01	.15***	.02	.14***	.14***	.02	.13***	.02
Ken	.02	-.06***	.08***	-.06***	.08***	.07***	-.07***	.07***	-.05***
Chi	.19***	.06***	.23***	.05**	.24***	.21***	.05**	.22***	.07***
SK	.11***	.04**	.13***	.07***	.10***	.12***	.06***	.09***	.04**
Aus	.14***	.22***	.05***	.23***	.03***	.05***	.23***	.03**	.22***
UAE	.17***	.02	.23***	.01	.23***	.22***	.01	.23***	.02
Indo	.06***	-.14***	.20***	-.14***	.19***	.18***	-.14***	.18***	-.13***
Adj R^2	.06	.12	.14	.12	.14	.14	.12	.14	.12
***F*(10, 10966)**	75.87***	155.18***	181.62***	155.18***	181.62***	181.62***	155.18***	181.62***	155.18***
Attitude & Efficacy									

EAC	--	.26***	--	--	.33***	--	--	.30***	.27***
EAV	--	--	.33***	.26***	--	.30***	.28***	--	--
EA	.41***	--	--	--	--	--	--	--	--
EFFS	--	.10***	--	.10***	--	.16***	--	.16***	--
EFFC	--	--	.04***	--	.05***	--	.04***	--	.05***
EFF	.11***	--	--	--	--	--	--	--	--
Inter EAx*EFFx b	-.004	.01	-.01	-.01	-.02*	-.02**	-.02*	-.01	-.01
Adj R^2	.27	.21	.26	.22	.26	.29	.21	.29	.20
***F*(13, 10963)**	311.56***	228.69***	299.20***	241.53***	292.23***	346.90***	229.56***	337.22***	216.89***
Demographics									
Age	.04***	.14***	-.04***	.13***	-.03***	-.04***	.12***	-.03*	.14***
Gender	.04***	.06***	.03**	.06***	.02*	.03***	.06***	.02*	.05***
Location	.01	.04***	-.00	.03***	.00	.00	.03**	.00	.04***
SES ladder	-.14***	-.05***	-.15***	-.04***	-.16***	-.14***	-.05***	-.15***	-.06***
Education (Z-score)	.05***	.04***	.06***	.04***	.06***	.06***	.04***	.06***	.04***
Environ. soc. norms	.13***	.10***	.14***	.09***	.14***	.11***	.10***	.12***	.11***
Adj R^2	.31	.25	.31	.25	.31	.33	.24	.33	.24

***F*(19, 10957)**	106.54***	189.79***	260.03***	194.94***	260.334***	286.44***	187.31***	284.98***	182.25***

N=11,000
For comparability, values are β coefficients; tables of B coefficients, SEs, and CIs are available from the corresponding author.
* $p < .05$; ** $p < .01$; *** $p < .001$
a. US is the reference country for the dummy codes.
b. The appropriate centered environmental attitudes (x) and efficacy (x) terms were used to compute the respective interaction terms.

Tests of the (mis)match models highlight small differences in relationships among subscales of EA, EFF, and PEBs. Across all matching (1-2) and mismatched models (3-8), EFFS (β from .10 to .16) was more influential than EFFC (β from .04 to .05). In addition, PEBPr compared to PEBPu involved (a) less overall variance explained (adj R^2 from 24 to 25% compared to from 31 to 33%), and (b) slightly weaker effects of EAC and EAV (β from .26 to .28 compared to .30 to .33). Concerning demographics, PEBPr compared to PEBPu was associated with (c) stronger effects of age (also positive, compared to negative associations for PEBPr), (d) very slightly stronger effects for females, (e) stronger positive effects of residential location (compared to none), (f) substantially weaker negative effects of the SES ladder, (g) very slightly weaker positive effects of education, and (h) slightly weaker effects of environmental social norms.

The role of efficacy as a moderator hardly mattered or varied throughout the (mis)match models (β from -.02 to .01). In three of the (mis)match models (4, 5, and 6), the EA-EFF interaction was barely significant; in all other models, it was not significant. Surprisingly, in all of those, the slight moderation by efficacy (whether self- or collective) was negative (e.g., β=-.02). EFFS significantly negatively moderated the relationship between EAV and PEBPu (model 5), while EFFC significantly negatively moderated the relationship between EAC and PEBPu (model 4), and between EAV and PEBPr (model 6).

The (mis)match models that explained the greatest amount of variance were, unexpectedly, models 5 and 7, including EAV, EFFS, and PEBPu (adj R^2=.33, F=286.44, p <.001; model 5), and EAC, EFFS, and PEBPu (adj R^2=.33, F=284.98, p < .001; model 7). Although we expected the two matching models (1, 2) to explain more variance than the mismatch models (3-8), the stronger results for these two mismatch models align with the findings that PEBPu models have higher adj R^2 values than PEBPr models, and that EFFS has higher βs than EFFC. For parsimony, our subsequent analyses consider only the first mismatch model 5.

5.2 By country

For the country-specific models, the combined and the subscale measures (by domain) of EA and EFF were entered in block 1, along with the product of their within-country centered terms as the interaction term. Demographics were entered in block 2.

Hierarchical regressions were computed for each country for both the simple models (Table 4) and for the one mismatch model explaining the most variance (i.e., model 5 in Table 4 and Table 5). At the country level, a visual inspection of results from both simple and mismatch models indicates that the simple model explained the same or more total variance in PEBs than mismatch model 5 in all countries except Kenya and Indonesia. Furthermore, in every country besides Indonesia, EA had a stronger association with PEBs in the simple model (β from .26 to .55) than did EAV in the mismatch model 5 (β from .05 to .42). Still, EFFS was slightly more strongly associated with PEBs in the mismatch model (β from .04 to .22) than was EFF in the simple model (β from .03 to .18) in every country besides China.

Table 4. Hierarchical Analysis for Simple Model, by Country.

Model Variables	**US**	**Mex**	**Bra**	**UK**	**SA**	**Ken**	**Chi**	**SK**	**Aus**	**UAE**	**Indo**
Attitude & Efficacy											
EA	.48***	.33***	.26***	.54***	.36***	.16***	.46***	.44***	.53***	.55***	.33***
EFF	.12***	.16***	.18***	.09**	.15***	.06	.06*	.12***	.06**	.03	.16***
Inter EA*EFFa	.03	-.03	-.03	.01	-.08**	-.02	-.03	.05	.03	.03	-.01
Adj R^2	.31	.18	.17	.34	.20	.03	.24	.28	.33	.31	.18
F	(3, 986) 150.94***	(3, 990) 75.76***	(3,996) 68.73***	(3,993) 172.88***	(3,996) 85.07***	(3,996) 12.76***	(3,996) 105.99***	(3,996) 128.44***	(3,992) 167.32***	(3,996) 147.85***	(3,996) 71.48***
Demo-graphics											
Age	-.01	-.02	.11***	-.02	.07*	.02	.03	.06*	.01	.04	.05*
Gender	.06*	.09**	.01	.06*	.01	.01	.04	.03	.04	.01	.03
Location	.06*	-.01	.05	.02	-.03	-.15***	.09***	.09***	-.04	-.00	.06*
SES ladder	-.12***	-.11***	-.07*	-.11***	-.14***	-.04	-.23***	-.13***	-.13***	-.21***	-.11***
Education	.10***	.06	.10***	.07*	.02	-.07*	.05*	-.01	.09**	.05*	.18***

Environ. soc. norms	.18***	.13***	.15***	.09***	.16***	.07*	.09**	.19***	.13***	.17***	.14***
Adj R²	.38	.23	.23	.37	.25	.07	.32	.34	.38	.39	.26
F	(9, 980) 67.60***	(9, 984) 33.02***	(9, 990) 33.55***	(,987) 66.29***	(9,990) 37.25***	(9,990) 8.67***	(9,990) 53.54***	(9,990) 57.82***	(9,986) 68.79***	(9,990) 72.16***	(9,990) 40.19***

N ~ 1,000 per country

Values are β coefficients; table of B coefficients, SEs, and CIs are available from the corresponding author.

* $p < .05$; ** $p < .01$; *** $p < .001$

a. The appropriate within-country centered environmental attitudes and efficacy terms were used to compute the respective interaction term.

Table 5. Hierarchical Regressions for Model 5 Subscale Mismatch (Values/Self/Public), by Country.

Model Variables	US	Mex	Bra	UK	SA	Ken	Chi	SK	Aus	UAE	Indo
Attitude & Efficacy											
EAV	.37***	.25***	.22***	.40***	.30***	.05	.37***	.31***	.40***	.42***	.33***
EFFS	.19***	.20***	.22***	.18***	.19***	.14***	.04	.17***	.16***	.10***	.19***
Inter EAV*EFFS a	.02	-.02	-.11***	-.03	-.05	-.02	.01	.02	.02	-.03	-.00
Adj R^2	.26	.14	.17	.23	.17	.04	.16	.19	.25	.21	.19
F	(3,986) 115.26***	(3,990) 55.89***	(3,996) 67.50***	(3,993) 100.07***	(3,996) 69.23***	(3,996) 14.83***	(3,996) 62.94***	(3,996) 77.94***	(3,992) 114.16***	(3,996) 90.05***	(3,996) 77.84***
Demographics											
Age	-.17***	-.04	.07**	-.15***	.01	-.02	-.01	.02	-.11***	.04	.05
Gender	.04	.08**	.01	.05	.02	.00	.02	-.01	.03	-.02	.03
Location	.05	-.01	.03	.05	-.04	-.18***	.04	.05	-.03	-.01	.02
SES ladder	-.10***	-.12***	-.06	-.13***	-.14***	-.08*	-.30***	-.15***	-.13***	-.21***	-.11***
Education	.08**	.07*	.11***	.07*	.03	-.06	.04	-.00	.13***	.09**	.17***
Environ. social norms	.15***	.10***	.16***	.08**	.12***	.07*	.09**	.16***	.12***	.15***	.12***
Adj R^2	.33	.18	.22	.29	.21	.08	.27	.24	.34	.29	.26

F	(9,980) 53.91***	(9,984) 25.53***	(9,990) 31.40**	(9,097) 46.81***	(9,990) 29.73***	(9,990) 10.44***	(9,990) 42.50***	(9,990) 36.24***	(9,986) 56.98***	(9,990) 46.77**	(9,990) 39.36**

N=1000 per country; values are β coefficients; table of B coefficients, SEs, and CIs are available from the corresponding author.
* $p < .05$; ** $p < .01$; *** $p < .001$
a. The appropriate within-country centered environmental attitudes and efficacy terms used to compute the respective interaction term.

EAV showed a significant association with PEBs in all countries except Kenya (β from .22 to .42). This one lack of significance corresponds with the finding that, in Kenya, the model only explained 8% of total variance in PEBs—less than a quarter to a half of that explained in any of the other countries. In comparison to the combined measure of EA tested on the overall sample (β from .16 to .55), EAV was less associated with PEBs (β from .05 to .42) in every country. EAV had the strongest association in the United Arab Emirates sample (β=.42, $p < .001$).

EFFS was significantly directly associated with PEBs in all of the countries except China. However, EFFS moderated the EAV-PEBPu relationship only in Brazil (β=-.11, $p < .001$).

6 Discussion

6.1 Summary

This study builds on prior research demonstrating relationships between EA, EFF, and PEB [e.g., 5-14,17-19], by comparing models based on these constructs overall, with models based on the matching and mismatching subdimensions of these constructs, with efficacy taking a direct and moderating role, and across 11 countries. The results provide slightly stronger support for two models: (a) the simple model of EA, EFF, and PEBs (in particular, the direct effects version); and (b) a mismatch model with the subscales of EAV, EFFS, and PEBPu. Our expectations that subscales that were matched by domain (models 1 and 2) would explain more variance in PEBs than the mismatched models (3-8), were not supported. Instead, models that examined the effects of various subscales on PEBPu explained consistently more variance than models that used PEBPr. Similarly, models with EFFS as a predictor variable tended to explain more variance in PEBs than models with EFFC. Both EAC and EAV were good explanatory associations with PEBs, though the combined EA was noticeably stronger than either subscale alone. In particular, the specific mismatch model with EAV, EFFS, and PEBPu emerged as explaining the most variance in the overall sample, though only 2% more variance in PEBs than explained in the simple model (33% vs 31%).

Although the lower variance explained when testing PEBPr was not anticipated, there are two possible explanations for this pattern of results. First, with only two behavior items to capture engagement in PEBPr, these data do not represent the range of possible PEBPr that individuals in the sample may have considered or been able to perform. This problem is exacerbated by this study's cross-country sample, in which diversity in contexts (such as recycling services) that influence participants' engagement in various PEBs is expected [13,39,85,86]. Second, because environmental problems cannot be solved by individual behaviors alone [71,76,81], it is possible that PEBPr are influenced by individuals' EA and EFF to a lesser extent than are PEBPu, in which collective effort to achieve environmental goals is more salient. However, Tam and Chan [54] conducted a multi-level model of private and public PEBs across 32 countries and found that the partial correlation between environmental concern and PEBPu was *weaker* than that between environmental concern and PEBPr. Although their measures of PEBs were also limited, the contradictory results suggest that further research is needed to understand differential engagement PEBPu and PEBPr.

As expected, and supporting prior literature (e.g., [5-14]), EA were significantly associated with PEBs in both the overall analyses and across the majority of individual countries. Furthermore, when comparing the results of the simple model and the best-fit mismatch model by country (see Tables 4 and 5), it appears that the combined EA slightly outperformed each of the two EA subscales (EAC and EAV). The results suggest that when conducting cross-country research, a combined or comprehensive measure of pro-environmental attitudes may provide more explanation of individuals' engagement in PEBs than measures of either domain alone.

These findings support Kaiser et al.'s [26] argument that both environmental attitudes and behavior should be measured generally, because many specific influences and challenges to PEBs vary across individuals and contexts. Nevertheless, it is important to note that these findings do not completely contradict arguments for measuring behavior-specific attitudes, as discussed in the TPB and earlier theory of reasoned action [17,21]. Still, in cross-country research, identifying PEB items and corresponding EAs at a granular level of specificity that are relevant to individuals in drastically diverse contexts may not be feasible or even useful, unless those specific behaviors are targets in environmental campaigns or interventions [3,93].

There are several potential explanations for the weaker direct effects of EFF compared to EA. The first considers how efficacy was measured. The measure referred to global environmental issues and to long-term (10 years) outcomes. Individuals' sense of efficacy in their ability to perform a small-scale, short-term pro-environmental task such as recycling in the coming week likely would have a stronger relationship with their engagement in that physically and temporally proximate behavior. Second, the role of some kinds of efficacy may be limited. In particular, the stronger relationships of EFFS compared to EFFC with PEBs suggest that the belief that one, personally, is capable of performing actions to achieve a goal is a stronger motivator of personal action than is the belief that one's group can make a difference. These findings are consistent with previous research (see Section 2.2) that indicates that EFFC could eventually lead to inaction because a member may feel that their single behavior is unnecessary or insubstantial for goal achievement, relative to larger collection action [e.g., 94]. In addition, these results are consistent with findings that EFFS may be somewhat necessary for EFFC to influence individual behavior intentions, especially in large-scale environmental contexts [76], although the opposite relationship has also been reported [88].

The moderating role of EFF was not supported, either in the combined or in the mismatch models. As Table 3 shows, the simple moderation effect was non-significant (overall β=-.004) and the (mis)matched moderation effects ranged from a barely significant -.02 ($p < .01$), to a non-significant .01. Within countries (Table 4), the simple moderation effect was significant only in South Africa (β=-.08, $p <.001$), and in the mismatch model 5 only in Brazil (β=-.11, $p <.001$). Although a moderation role of efficacy has been found previously (e.g., [20]), our findings align with the larger body of research that shows no significant moderation [7,11,24,45,80]. Notably, these significant relationships were negative, which may suggest that a sense of efficacy to accomplish broader and more influential environmental goals may slightly undermine people's drive to engage in the smaller-scale PEBs measured in this study.

When considered separately by country, the results indicate that countries share much in common, but that there are still some diverse strengths and even diverse directions of relationships between these variables. EA and EFFS were consistently related to PEBs, with one exception each in two countries. These findings align with a few previous international studies that demonstrate consistent influences of EA, EFF, and norms on PEBs across some countries (Section 3.4) (e.g., [9,29,30,]). Furthermore, descriptive environmental social norms and the SES ladder maintained nearly consistent relationships with PEBs across countries; however, as a regression block, demographics explained a wide range of unique variance (3.8% to 11.6%) in PEBs across countries. This variation likely reflects some of the different contextual factors in each country, as generally noted in Section 3.4 (e.g., [12,13,85,86]).

The consistency of relationships between these model variables across the countries suggests that theories applying these variables, including rational choice models such as the

TPB, and pro-social behavioral models such as the norm activation model and value-belief-norm model [25], are likely to be applicable (if somewhat unevenly) across countries [6].

Results of the simple and (mis)match models demonstrate that country-level differences (admittedly aggregated and unidentified) are not as influential on PEBs as are EA, and, to a slight extent, EFF. In the simple model, country-level influences explained only 6% of unique variance in PEBs, though in the (mis)match models, country differences explained a consistently greater 12%-14% of PEB variance. It appears that specifying the domain (specific or general) of PEBs allows country-level effects to emerge in the model to a greater extent than does using the combined measure of PEBs. Although prior cross-country studies have demonstrated consistency in the relationships between EA, PEB, and EFF across countries (e.g., [9,29,30,]), this study is the first that we are aware to suggest that country-level effects are more easily detected when examining the subdimensions of these constructs.

Concerning demographics, age, location, and education had significant associations with PEBs in only some countries. Age had a positive significant association on in Brazil, South Africa, South Korea, and Indonesia. Location mattered only in five countries, and negatively so only in Kenya, where respondents in more rural areas engaged in more public PEBs (β=-.15, p < .001). Education had a positive significant influence in six countries, but, unexpectedly, a negative association (β=-.07, p < .001), also in Kenya. The SES ladder had a significant negative association in all but one country (again, Kenya), while descriptive environmental social norms had a significant positive influence in all countries. Therefore, it is clear that these additional contextual variables should be taken into account when examining or attempting to motivate PEB locally. Policies or communication efforts concerning EA, EFF, or PEBs in different countries should be tailored accordingly.

6.2 Limitations and future directions

These findings are subject to several limitations. As noted in Section 2.2, there is a wide range of other direct, moderating, and mediating individual-level covariates associated with PEBs [29,95,96]. Gifford [3], for example, briefly reviews a wide range of influences and constraints on PEB, such as “childhood experience; knowledge and education; personality; perceived behavioral control; values, attitudes, and worldviews of various kinds; felt responsibility and moral commitment; place attachment; norms and habits; goals; affect; and many demographic factors” (p. 544). PEBs can be affected by routine, constraints, perceived small effect, awareness of effects, non-environmental considerations, etc.; more generally, by aspects of actor, context, and behavior [25], political ideology [97], and religious affiliation [98]. Other contextual forces include interpersonal, community expectations, media, regulation, institutional policies, incentives and costs, difficulty, built environment, public policies, and social, economic and political aspects, all of which may be differentially salient or interpreted [25]. Therefore, the strength of the relationships among measured variables are likely to vary when additional covariates are considered.

As noted, the literature is somewhat vague about distinctions among specific and general subdimensions of attitudes, efficacy, and pro-environmental behaviors. We have explicated these distinctions, based on prior theory and research, for the purposes of the mismatching/matching analyses. However, both the conceptual distinctions, and, as noted, the particular items used to measure these, may be improved and further tested in future research.

Furthermore, as mentioned above, the nature of this secondary analysis involves typical strengths and weaknesses of measures and data from a prior project. Copious research on environmental issues has led to a wide variety of measures of pro-environmental attitudes, in

some cases designed for specific contexts or behaviors. Gifford and Sussman [29], noting at least 15 measures, highlight the 120-item, 12-subscale, Environmental Attitudes Inventory (EAI) [28]. Thus, the use of more extensive and validated measures of environmental attitude such as the EAI or the New Environmental Paradigm (NEP) [99,100] could strengthen confidence in these findings. Certainly future research could consider other manifestations of environmental values, such as postmaterialism, altruism, or free market processes [25,29] or instrumental, intrinsic, and relational facets [89,101]. Additional environmental values measures emphasize different conceptualizations [28,102,103].

Additionally, PEBs were measured with only five items, a list that is both too short and not equally applicable for every participant. Broader measures of PEBs that capture a range of relevant cross-country public and private behaviors [6, p. 290, 104–106] can clarify differential engagement in the same PEBs across countries. Furthermore, self-reported PEBs do not necessarily correspond highly to actual PEBs, with an average association of r=.45 [3]; however, our measures did ask for PEBs in the past 12 months instead of intended PEBs, which is a strength of this study. The items used to measure the EFF scale and subscales also have incomplete construct validity; future studies should consider employing the validated scale developed by Moeller and Stahlmann [107] or measuring efficacy in terms of the specific PEBs items used in this study.

Finally, with a sample of only 11 countries, and the focus of this study on the consistency of the models overall and across countries, rather than on hypothesizing, explaining, or testing for country differences, we can only speculate as to the (apparently somewhat limited) country-level factors that influence these relationships. Scholars have examined many country-level influences, such as postmaterialist values [12], human development indices [106,108], cultural and psychological distance [109], and individualism vs. collectivism or other cultural values [54,106,110,111], all of which indicate that country-level contexts can facilitate or hinder PEBs. Future research on PEBs and their antecedents across a sufficient number of countries for multi-level modeling, applying relevant country-level measures [e.g., 30,54], can provide insight into the country-level contexts that affect the relationships between EA, EFF, and PEBs. As practitioners seek to promote increased engagement in PEB, interventions and promotions should be based on these detailed nuances of determinants of pro-environmental behavior, matching interventions to determinants [112] and taking into account implications from meta-analyses [113].

7 Conclusion

Understanding how the relationships between environmental attitudes, efficacy, and pro-environmental behaviors vary (or are similar) around the world adds important nuance to our theoretical and practical knowledge base. Counter to expectations based on prior research, we find that models that match pro-environmental attitude, environmental efficacy, and pro-environmental behavior variables on domain (specific or general) do not necessarily outperform simple models or some mismatch models. Further, while the relationships are fairly consistent across countries, variations do exist and may be useful in helping to shape environmental communication strategies in different countries. Together, these findings point to pro-environmental attitudes as being the strongest link to pro-environmental behaviors, both overall and within diverse countries.

More and better promotion of local and global engagement in pro-environmental behaviors is urgently needed, in accord with continuous reporting about the degradation of the environment and increasing consequences of climate change. Results from this study suggest that

interventions should center on strengthening these core relationships while simultaneously accounting for local contextual factors. Additional research that examines sufficient countries for multi-level modeling can further shed light on the contextual constructs that should be considered when developing pro-environmental interventions.

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S0_File: Supporting Information: Methodological Notes for (Mis)matched direct and moderating relationships among pro-environmental attitudes, environmental efficacy, and pro-environmental behaviors across and within 11 countries.

S1. Efficacy Review: Self/Collective

Self- and collective efficacy represent different, though related, concepts. Collective efficacy is theoretically distinct from, and can influence, self-efficacy [1, studying teachers' efficacy]. Some studies consider only collective efficacy. For example, Landmann and Rohmann [2] distinguished collective efficacy as people's appraisals of their perceptions of a behavior: "People can be positively moved by the belief that they can achieve something together, and this can motivate their intention to act collectively in the future" (p. 9). They found a positive relation between collective efficacy and collective action related to forest protection (esp. those actions requiring less effort), mediated by the emotion of "being moved." Other studies show independent effects of the two kinds of efficacy. Fernández-Ballesteros et al. [3] differentiated between personal/individual and collective efficacy, finding that the former was positively related to perceived ability to manage worklife, relationships, and financial condition, and the latter associated with achieving social change through joint action. Jugert et al. [4] reviewed literature discriminating self-efficacy from collective efficacy, and empirically showed that both can positively influence pro-environmental behavior intentions. Some studies report relationships

between self- and collective efficacy. For instance, in an educational setting, Versland and Erickson [5] showed that both a school's principal's self-efficacy (leadership, focus) and the school's collective efficacy (e.g., initiative, staff relations) were associated with teachers' self-efficacy. Roos et al.'s [6] analysis of surveys from Setswana, South African respondents indicated that collective efficacy and self-efficacy were positively associated with each other and with psychological well-being. In student engineering project teams, collective efficacy was associated with team cohesion, team performance, and personal self-efficacy, and had a stronger relationship with team performance than did self-efficacy [7].

S2. The Absence of Mediation Analyses

As noted in the text, we did not pursue the role of efficacy as a mediator. Most theoretical justification for the mediational role of environmental efficacy comes from other areas besides environmental psychology or communication, such as health behavior (e.g., [8]). These scholars point to the extended parallel process model, the health belief model, PMT, and SCT to demonstrate mediation pathways (see brief review by Knerr et al. [9]). A few significant mediation results have been found in the environmental literature (e.g., [10–15]). For example, Anker et al. [16] did not find that self-efficacy (one of three components of "vested interest") moderated the relationship between positive attitudes and prosocial donations, but did show that it mediated the relationship for organ/tissue and blood donation. Jugert et al. [4] reviewed research showing that collective efficacy interventions can positively influence pro-environmental behavior intentions, through both collective and self-efficacy. Hurst Loo and Walker [17] showed that efficacy mediated the relationships between pro-environmental knowledge and attitude toward climate change mitigation. Because of the lack of much research on efficacy as a mediator in environmental research, the associated expansion in the number of analyses that would be required, the cross-sectional nature of this study's data, and critiques of mediation analyses [18,19], we do not pursue the mediation approach here.

S3. Subscale and Scale Dimensionality (EFA and CFA), Reliability, Discriminant Validity, and Cross-Country Factor Congruence of Measures

Although, as the text notes, the measures were not designed by us, and do not reflect standard measures in the literature, we still need to verify that the scales can be operationalized as unidimensional, reliable, and congruent across countries. Thus, we report results and justifications from Exploratory Factor Loadings of Separate Subscales, Exploratory Factor Loadings of all Subscale Items, Confirmatory Factor Analysis Loadings and Fit for Subscales and Scales, Two Forms of Scale Reliabilities, Two Forms of Discriminant Validity, Scale Factor Loadings and Congruence across Countries, and Taking into Account Country-level Effects, and end with a Summary.

S3.1 Exploratory Factor Analysis Loadings of Separate Subscales

Table S3.1a shows that each separate subscale is unidimensional, consisting of sufficiently high loadings (from .745 to .889).

Table S3.1a. Exploratory Factor Analysis Loadings of Separate Subscales.

Environmental Concern (EAC)	
Q13_1 Habitat loss	.785
Q13_2 Plastic pollution	.795
Q13_3 Global climate change	.791
Q13_4 Species at risk of extinction	.773
Q13_5 Air pollution	.823
Q13_7 Lack of clean drinking water	.745
Eigenvalue	3.70
% Variance (AVE)	61.7
Kaiser-Meyer-Olkin measure of sampling adequacy	.886
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.91
Environmental Values (EAV)	
Q3_2 Conserving natural resources is important for the country's economy	.786
Q3_3 Conserving nature is a reflection of my core moral beliefs and convictions	.766
Q3_4 Nature is important to me, to who I am as a person	.804
Q3_5 Protecting nature is important for people's health	.804
Q3_6 Being in/seeing nature brings people pleasure or satisfaction	.771
Eigenvalue	3.09
% Variance (AVE)	61.8
Kaiser-Meyer-Olkin measure of sampling adequacy	.857
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.89
Self-Efficacy (EFFS)	
Q14_1 Protect habitats	.875
Q14_2 Reduce plastic pollution in our oceans	.802
Q14_3 Reduce use of fossil fuels (e.g., petroleum, natural gas, coal)	.804
Q14_4 Save animals at risk of extinction	.849
Eigenvalue	2.78
% Variance (AVE)	69.4
Kaiser-Meyer-Olkin measure of sampling adequacy	,783
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.90
Collective Efficacy (EFFC)	
Q15_1 Protect habitats	.889
Q15_2 Reduce plastic pollution in our oceans	.859
Q15_3 Reduce use of fossil fuels (e.g., petroleum, natural gas, coal)	.830
Q15_4 Save animals at risk of extinction	.876
Eigenvalue	2.98
% Variance (AVE)	74.6
Kaiser-Meyer-Olkin measure of sampling adequacy	.820
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.92
Private PEBs (PEBPr)	
Q17_1 Recycle	.845
Q17_3 Use your own reusable shopping bags	.845

Eigenvalue	1.43
% Variance (AVE)	71.5
Kaiser-Meyer-Olkin measure of sampling adequacy	.50
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.83
Public PEBs (PEBPu)	
Q17_2 Avoid products with ingredients that are bad for the environment	.790
Q17_5 Talk to friends or family about an environmental issue	.856
Q17_6 Used social media to share information about an environmental issue	.820
Eigenvalue	2.03
% Variance (AVE)	67.7
Kaiser-Meyer-Olkin measure of sampling adequacy	.682
Bartlett's test of sphericity	*p*<.000
Joreskog rho reliability	.86

N=10,999

Note: Principal Component Analyses; each separate extraction provided one component.

Table 3.1b confirms that all items load on their separate subscales when analyzed together. This also provides support for discriminant validity (see S3.3 below).

Table 3.1b. Exploratory Factor Loadings of All Subscale Items.

	Component/Construct					
Items	**EAC**	**EAV**	**EFFC**	**EFFS**	**PEBPu**	**PEBPr**
Q13_1 HabitatLoss	**.731**	.212	-.008	.070	.104	.131
Q13_2 PlasticPollution	**.753**	.229	.023	.042	.033	.139
Q13_3 GlobalClimateChange	**.757**	.190	.029	.080	.135	.018
Q13_4 SpeciesAtRiskOfExtinction	**.712**	.214	.006	.086	.135	.117
Q13_5 AirPollution	**.787**	.234	.029	.065	.072	.016
Q13_7 LackOfCleanDrinkingWater	**.730**	.188	.027	.036	.090	-.071
Q3_2 Conserving natural resources is important for the country's economy	.277	**.732**	.039	.056	.058	.049
Q3_3 Conserving nature is a reflection of my core moral beliefs and convictions	.216	**.695**	.064	.047	.243	.046
Q3_4 Nature is important to me, to who I am as a person	.236	**.733**	.030	.103	.228	.020
Q3_5 Protecting nature is important for people's health	.297	**.743**	.029	.070	.050	.045
Q3_6 Being in/seeing nature brings people pleasure or satisfaction	.228	**.745**	.030	.052	-.003	.127
Q14_1 SelfE Protect habitats	.064	.095	.260	**.815**	.163	-.041
Q14_2 SelfE Reduce plastic pollution in our oceans	.131	.102	.255	**.762**	-.046	.124

Q14_3 SelfE Reduce use of fossil fuels (e.g., petroleum, natural gas, coal)	.105	.054	.258	**.744**	.085	.089
Q14_4 SelfE Save animals at risk of extinction	.039	.057	.279	**.770**	.244	-.066
Q15_1 CollE Protect habitats	.016	.068	**.844**	.259	.043	-.008
Q15_2 CollE Reduce plastic pollution in our oceans	.023	.040	**.827**	.232	-.017	.069
Q15_3 CollE Reduce use of fossil fuels (e.g., petroleum, natural gas, coal)	.017	-.005	**.811**	.197	.039	.074
Q15_4 CollE Save animals at risk of extinction	.019	.063	**.830**	.260	.084	-.056
Q17_1 Recycle	.090	.068	.010	.058	.110	**.820**
Q17_3 Use your own reusable shopping bags	.092	.105	.049	.006	.130	**.792**
Q17_2 Avoid products with ingredients that are bad for the environment	.188	.200	.051	.120	**.641**	.323
Q17_5 Talk to friends or family about an environmental issue	.183	.185	.041	.126	**.771**	.178
Q17_6 Used social media to share information about an environmental issue	.117	.092	.047	.127	**.843**	-.038

N=10,999

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; Rotation converged in 6 iterations; bold values are loadings corresponding to the constructs in the column headings; Kaiser-Meyer-Olkin measure of sampling adequacy = .896; Bartlett's test of sphericity $p<.000$

S3.2 Confirmatory Factor Analysis Loadings and Fit for Subscales and Scales

We conducted confirmatory factor analysis for each subscale and scale, using Amos v. 24 (with ML estimation). Hu and Bentler [20] recommend reporting combinations of measures; Kline [21] argues for reporting $\chi 2$, CFI, and SRMR. Gaskin and Lim [22] prefer a combination of CFI>0.95 and SRMR<0.08, with additional evidence provided by RMSEA<0.06. Table S3.2 provides the standardized loadings and the fit measures for each analysis. Because of the very large sample size, all measures involving $\chi 2$ will typically be large and highly significant.

Note that for the combined scales (EA, EFF, PEBs) we are not testing for a second-order factor. We consider that the full scales can each be treated as unidimensional, each consisting of two unidimensional subscales. Thus, in the CFA analyses of the simple models, we link the two subscales, each with their own item indicators, via covariance between the two subscales. Fig S3.2 presents the visual model for each CFA.

Fig S3.2. CFA Models for Subscales and Scales

With some modifications, the models exhibited the following fit measures: for AGFI > .9, achieved for all analyses; for CFI > .95, achieved for all analyses; for RMSEA < .06, achieved for 4 of 7 analyses; and for SRMR < .08, achieved for all analyses.

Table S3.2. Confirmatory Factor Analysis Standardized Factor Loadings and Fit Measures for Subscales and Scales (using Amos v. 24).

Item	EAV	EAC	EA	EFFS	EFFC	EFF	PEBPr	PEBPu	PEBs
q3_2	.723		.727						
q3_3	.694		.691						
q3_4	.748		.743						
q3_5	.750		.756						
q3_6	.702		.699						
q13_1		.684	.692						
q13_2		.752	.753						
q13_3		.755	.751						
q13_4		.669	.679						
q13_5		.809	.804						
q13_7		.694	.692						
q14_1				.894		.881			
q14_2				.647		.658			
q14_3				.644		.657			
q14_4				.830		.836			
q15_1					.887	.885			
q15_2					.756	.754			
q15_3					.707	.704			
q15_4					.858	.863			
q17_1							--		.663
q17_3							--		.652
q17_2								--	.663
q17_5								--	.815
q17_6								--	.680
Fit	EAV	EAC	EA	EFFS	EFFC	EFF	PEBPr	PEBPu	PEBs
$\chi 2$ (df)	311.8 *** (5)	274.2 *** (8)	835.3 *** (42)	23.4 *** (1)	.43 ns (1)	2029.3 *** (16)	too few items	too few items	639.98 *** (4)
$\chi 2$ /df	62.4 ***	34.28 ***	19.8 ***	23.4 ***	.43	126.8 ***	--	--	159.99 ***
AGFI	.966	.979	not computed	.989	1.00	.905	--	--	.916
CFI	.985	.991	.986	.999	1.00	.962	--	--	.949
RMSEA	.075	.055	.041	.045	.000	.107	--	--	.120
SRMR	.0207	.0168	.0201	.0049	.0006	.0356	--	--	.0489
Latent variable corrs			EAC-EAV: .27			EFFS-EFFC: .63			PEBPr-PEBPu: .48
Modifications with error	--	e13.1-e13.4: .32	e13.1-e13.4: .30	e14.2-e14.3: .28	e15.2-e15.3: .25	e14.2-e14.3: .27 e15.2-e15.3: .25	--	--	--

covarian ces	e14.3 – e15.7: .34

N=11,000; *** p < .001
Note: See Table S3.1 for item wordings.

S3.3 Discriminant Validity

Table S3.3a provides results of the standard approach to verifying discriminant validity [23]. Bolded values on the diagonal are AVE (average variance extracted); they are all higher than the squared correlations between their respective specific constructs, and much higher than the squared correlations with the other combined, specific, and general constructs, indicating discriminant validity. The AVEs of the specific measures are less than the squared correlations with the combined constructs, indicating that the specific or general versions are subsets of the combined constructs.

Table S3.3a. Discriminant Validity among Subscales, Overall: AVE Approach

Construct	EAC	EAV	EFFS	EFFC	PEBPr	PEBPu
EAC	**.617**					
EAV	.336	**.618**				
EFFS	.048	.058	**.694**			
EFFC	.006	.017	.325	**.746**		
PEBPr	.048	.053	.014	.006	**.715**	
PEBPu	.137	.160	.102	.023	.102	**.677**

Note: N=11,000; Diagonal values are Average Variances Explained (AVE); off-diagonal values are squared Pearson correlations (see Table 2 in the text); values in boxes are from specific/general subscales of the respective combined construct.

Table S3.3b provides the results from a recent alternative approach, the heterotrait-monotrait ratio of correlations (HTMT) [24].

Table S3.3b. Discriminant Validity among Subscales, Overall: HTMT Approach

Construct	EAC	EAV	EFFS	EFFC	PERPr	PEBPu
EAC	--					
EAV	**.6773**	--				
EFFS	.2564	.2747	--			
EFFC	.0956	.1488	**.6556**	--		
PERPr	.3082	.3187	.1628	.1061	--	
PEBPu	.4574	.5020	.4027	.1872	**.4907**	--

Note: N=11,000; Bolded values are HTMT values; values in boxes indicate extent of construct discriminant validity from specific/general subscales of the respective combined construct; other values are between subscales from different combined constructs; satisfactory values are below .85.

S3.4 Reliabilities

After determining unidimensionality, we turn to scale and subscale reliability. The traditional measure from EFA is Cronbach's α. Hayes and Coutts [25] propose using a more general reliability measure "omega" (ω) instead of α for estimating reliability, show how it is computed in SEM and R programs, and provide a macro for SPSS or SAS which does not require CFA loadings or error variances but relies on maximum likelihood principal component

analysis (EFA-ML). Their analyses show, though, that both α and ω produce nearly identical values. However, Cho [26] does not like ω (nor α), stating that "There is little *empirical* evidence that FA reliability is more accurate than non-FA reliability.... currently available empirical findings offer evidence against the accuracy and conservatism of FA reliability....", and that there is little assessment of how small sample sizes or sampling errors affect FA type reliability estimators. Finally, Cho points out that ω really refers to a variety of FA reliability estimators, so it is inappropriate to refer to this measure as omega; rather, it should be referred to as *FAr* (factor analysis reliability).

Table S3.4 shows, indeed, that the *FAr* (omega or ω) and Cronbach's α for all scales and subscales are almost exactly the same.

Table S3.4. Subscale and Scale Reliabilities (FAr and Cronbach).

Subscales and Scales	# Items	EFA-ML *FAr*	Cronbach α
Environmental concern (EAC)	6	.875	.875
Environmental values (EAV)	5	.845	.844
Combined Pro-environmental attitude (EA)	11	.896	.895
Self-efficacy (EFFS)	4	.854	.853
Collective efficacy (EFFC)	4	.887	.886
Combined efficacy (EFF)	8	.885	.889
Private PEBs (PEBPr)	2	Too few items	.601
Public PEBs (PEBPu)	3	.762	.755
Combined PEBs (PEBs)	5	.723	.712

Note: Using SPSS Macro for omega reliability (Hayes & Coutts, 2020, 2022).

A3.5 Scale Factor Loadings and Congruence across Countries

Now that we have established appropriate dimensionality and reliability of the subscales and scales, we can consider whether the factor loadings are consistent across countries.

Lorenzo-Seva and Berge [27] note that while multigroup CFA is commonly used to test equivalence of factors, "when the sample size is large, any hypothesis of equal factors will systematically be rejected. Moreover, the available software for CFA often fails to converge to a solution" (p. 57) (though that was in 2006). It is also difficult to test complex factor structures. Finally, for the current study, there are six subscales for the overall sample and each of the 11 countries; across all invariance tests that would involve a very large number of group comparisons. Thus, we choose to test only congruence of the single overall factor for each of the three main constructs, for each country compared to the overall sample.

Lorenzo-Seva and Berge [27] propose the Tucker's congruence coefficient (often referred to as Phi or ϕ), and provide an empirical basis for categorizing values as terrible, poor, borderline, good, or excellent. Milfont et al. [28] used Tucker's Phi to support a uni-dimensional factor invariance of the value of social dominance orientation across countries. Fortunately,

DeCoster [29] provided a spreadsheet to use in computing this measure. They also note that prior Procrustes rotations of the factors maximizes the congruence coefficient, but that approach does not seem to be used much. For example, the Błachnio et al. [30] article does not, nor does the DeCoster [29] spreadsheet, but the Milfont et al. [28] does.

Thus one could use OrthoSim (https://www.pbarrett.net/orthosim/orthosim.html) [31], which offers orthogonal Procrustes rotation before then computing four congruence measures. Barrett [32] shows in detail how neither a Pearson correlation or the Tucker coefficient is fundamentally valid, concluding that "I will no longer use the congruence coefficient any more unless its value is corroborated by using an index which is sensitive to loading/coordinate magnitudes as well as monotonic relations, i.e., Double-scaled Euclidean [DESD] or the kernel smoothed distance [KSD] measures of agreement. However, it is probably fair to say that most factor solutions which have previously used the congruence coefficient are probably Ok - in that the loadings are invariably of similar size and scale and so its value could be considered a fair representation of the agreement between two vectors" (p. 12); "I recommend only using a congruence coefficient as a matching index alongside a DSED or KSD coefficient" (p. 55), and "when using raw factor loading comparisons (where no procrustean row normalization has been requested), never use a congruence coefficient now without confirming the validity of its value using a distance function alongside it" (p. 74). However, there are no levels or rankings associated with the two distance/similarity measures, so it is difficult to actually apply those as criteria.

Lovik et al. [33] focus on that sensitivity to difference in signs of comparison loadings (which Lorenzo-Seva & Berge [27] also noted), overestimation when signs of the loadings across the factor pairs are mostly the same, underestimation if signs are mostly different, problems when using different samples because the order of the factors may be different and thus not consistent with the comparison matrix (vector), and problems if items are negatively framed (incorrect if not reversed, likely low even if reversed). They attempt to resolve some of these problems by offering a modified Tucker's congruence coefficient. Referred to as mϕ (modified ϕ), this uses the absolute value of the products in the numerator. Thus, there is no direct relationship between phi and mϕ, but is similarly only valid for a simple factor structure. However, when cross-loadings are high, near or above primary loadings, or primary loadings are low, neither coefficient works well (though the modified congruence values are slightly higher), though this is typically not the situation for a single factor structure. For the modified measure they propose .95 as the acceptable threshold. They also conclude that "it is quite problematic to set cut-off values that are valid in every situation," so both the standard and the modified Tucker's coefficients "should be interpreted and used with caution."

Table S3.5 shows, indeed, that the factor loadings for each country are extremely congruent with the overall factor loadings. As all loadings are high and positive, using mϕ is unnecessary.

Table S3.5. Exploratory Factor Loadings and Factor Congruence for Combined Measures, Overall and by Country.

	ALL	US	Mex	Bra	UK	SA	Ken	Chi	SK	Aus	UAE	Indo
EA												
Q3 2	.683	.689	.638	.668	.713	.644	.570	.655	.693	.704	.676	.619
Q3 3	.652	.718	.631	.373	.722	.708	.614	.635	.660	.737	.668	.574
Q3 4	.688	.691	.667	.676	.724	.710	.584	.663	.541	.750	.687	.588
Q3 5	.705	.738	.663	.698	.740	.649	.541	.652	.721	.754	.710	.636
Q3 6	.651	.638	.624	.637	.702	.624	.583	.659	.682	.685	.671	.608
Q13 1	.720	.780	.736	.728	.775	.723	.645	.657	.694	.789	.655	.771

Q13 2	.732	.736	.730	.737	.780	.710	.659	.702	.734	.776	.733	.721
Q13 3	.720	.719	.723	.746	.696	.699	.721	.722	.770	.630	.709	.731
Q13 4	.715	.750	.730	.783	.729	.708	.634	.624	.702	.773	.714	.696
Q13 5	.756	.788	.745	.779	.728	.730	.688	.733	.775	.715	.772	.772
Q13 7	.675	.662	.719	.755	.593	.659	.550	.579	.705	.609	.713	.695
Eig	5.40	5.71	5.28	5.35	5.70	5.21	4.22	4.84	5.40	5.74	5.41	5.05
% Var	49.1	51.9	48.0	48.7	51.8	47.4	38.4	44.0	49.1	52.2	49.2	45.9
Congr	--	.999	.999	.991	.998	.999	.998	.999	.997	.997	.999	.998
EFF												
Q14 1	.758	.744	.755	.739	.729	.720	.720	.818	.747	.750	.749	.799
Q14 2	.705	.731	.691	.645	.695	.622	.633	.793	.674	.709	.795	.738
Q14 3	.703	.718	.664	.666	.683	.635	.680	.754	.678	.736	.717	.745
Q14 4	.746	.717	.721	.725	.705	.713	.704	.804	.734	.732	.763	.814
Q15 1	.803	.822	.782	.841	.792	.790	.711	.839	.801	.816	.789	.838
Q15 2	.766	.787	.775	.803	.787	.791	.593	.831	.719	.800	.766	.792
Q15 3	.733	.768	.683	.774	.757	.763	.630	.776	.706	.775	.725	.770
Q15 4	.797	.832	.781	.827	.811	.768	.673	.850	.778	.806	.770	.828
Eig	4.53	4.70	4.30	4.57	4.46	4.24	3.59	5.20	4.28	4.70	4.62	5.01
% Var	56.6	58.7	53.7	57.1	55.7	53.0	44.8	65.4	53.4	58.8	57.7	62.6
Congr	--	.999	.999	.999	.999	.999	.998	.999	.999	.999	.999	.999
PEB												
Q17 1	.565	.580	.747	.725	.384	.747	.640	.678	.610	.443	.718	.703
Q17 2	.784	.824	.743	.765	.827	.794	.655	.742	.744	.813	.755	.757
Q17 3	.568	.694	.722	.713	.245	.685	.328	.676	.687	.310	.725	.690
Q17 5	.797	.807	.770	.791	.824	.774	.799	.703	.778	.830	.784	.774
Q17 6	.695	.656	.683	.715	.671	.707	.709	.666	.666	.693	.736	.749
Eig	2.37	2.59	2.69	2.76	2.02	2.76	2.09	2.41	2.45	2.12	2.77	2.70
% Var	47.5	51.57	53.8	55.1	40.4	55.1	41.8	48.1	48.9	42.4	55.3	54.0
Congr	--	.997	.990	.994	.971	.993	.984	.993	.996	.983	.993	.995
	ALL	**US**	**Mex**	**Bra**	**UK**	**SA**	**Ken**	**Chi**	**SK**	**Aus**	**UAE**	**Indo**

Note: Loadings are from principal components analysis, first dimension, unrotated.
Tucker's congruence coefficient ϕ was computed using the spreadsheet provided by DeCoster [29]. Unlike Barrett's Orthosim program [31,32], this program does not first apply Procrustes rotation; however, there is only one factor analyzed for each country, so there is nothing to rotate. Further, congruence values for all three constructs indicate near-identical factor structure between the overall and each country-specific sample, so that Procrustes rotation is also unnecessary. Finally, we could not run the HA procedure with bootstrapping to obtain 95% CIs for the congruence values, because the sample sizes are so large that the program eventually freezes. However, all the congruence values are extremely high and the large sample sizes have tiny sample errors, so the CIs would be very narrow. Note the slight distinction between public (Q17_1 & 3) and private (Q17_2, 5 & 6) PEB loadings overall and for most countries, but a large distinction for UK and Australia.

S3.6 Summary

Given that, because of the secondary nature of the surveys and data,

- The specific concepts and respective items were not implemented by the researchers,
- And do not necessarily represent full or any representation of standard concepts or their measures in the literature, and
- Were not intended for the specific exploratory overall and (mis)matching tests,
- The EFA and CFA results and factor congruence tests, and

- Both Cronbach's α and Hayes and Coutts [25] ω reliability assessment results,

these results provide good justification for the scales and subscales, across and within countries, satisfactory for our purposes.

S4. Taking into Account Country-level Effects in the Overall Analyses

Even though we have established consistency of the factor loadings across countries, we can still consider whether there are country-level influences that need to be taken account. Because the overall analyses include data from 11 countries, it may be necessary to consider robust standard errors (due to heterogeneity in variance in each measure across countries) and cluster robust standard errors (due to differences associated with the countries, or second-level influences/random effects in a multi-level modeling approach), or bypass those through an approach that controls for country-level influences.

Table S5 shows results from analyses of overall mean differences across countries (F-test with standard errors and Welch-test with corrected robust errors), of heterogeneity of variances across countries (Levene), and the intracluster coefficient (ICC) along with the resulting effective sample size, for the main measures. The standard error and robust error means tests are all significant at $p<.001$, and the means exhibit significant heterogeneity of variance (Levene test; all $p<.001$). However, the sample size is very large, so there will be small *p*-values even for extremely small effect sizes. The ICC values are .04 for efficacy, .06 for PEBs, and .10 for EA, reducing the overall effective sample size, though those remain very large (from 5587 to 7914). We also assessed heteroscedasticity using the Glejser test. Results were significant for pro-EA and EFF ($p<.001$). Thus, there is some country-level effect, though not large, and some reduction of effective sample size. So country-level effects may be taken into consideration. The effective sample sizes are so large that estimated power for an effect size within each country of .15 is 1.00 (using GPower).

One might consider a multi-level modeling (MLM) approach toward managing the second-level (country) influences. However, Angrist and Pischke [34] recommend at least 40 to 50 second-level units, and Bryan and Jenkins [35] show through simulations that at least 20 countries are needed for unbiased and stable errors. Further, McNeish et al. [36] argue that MLM is unnecessary in many cases, and testing for, and correcting, cluster robust standard errors is often sufficient. In addition, for our study, detailed testing would require 11 cross-level country-by-construct interactions for direct effects along for each of the three main constructs, creating 33 tests, or 11 x 8 for each of the (mis)matches, creating 88 tests.

Bryan and Jenkins [35] summarize alternatives to MLM: 1) a common model applied to pooled data using country as fixed effects, 2) a common model applied for all countries combined using cluster robust standard errors, and 3) a separate model fitted to the data for each country (used for testing the country-specific relationships). We also considered an additional common model approach 4 (Hayes Process routine) that controls for the country level effects by standardizing relevant variables within countries before conducting the overall analyses, which removes the issue of cluster standard errors, because each country has the same mean and variance due to Z-scores; while the Process routine applies the HC3 correction for heteroscedasticity (i.e., uses robust standard errors), it does not implement cluster robust standard errors.

Thus the paper reports results from approach 1) for the overall analysis (i.e., GLM with dummy country codes as a factor), and approach 3) for the country analyses (i.e., separate regressions for each country).

Table S4.1. Tests for Overall Mean Differences, Robust Errors Mean Test, Homogeneity of Variance, and Intra-Cluster Coefficients across 11 Countries.

Variable	Overall F(10, 10989)	Adj R^2	Welch F(10, 4393.9, 4394.1, 4392.3)	Levene F(10, 10989)	Glejser β	ICC	ESS
EA	118.24 ***	.096	115.79 ***	20.78 ***	.066 ***	.097	5587.8
EFF	44.69 ***	.038	45.05 ***	18.78 ***	-.063 ***	.039	7913.7
PEB	64.1 ***	.054	59.89 ***	35.54 ***	--	.055	7096.8

Note: *F*: Overall Anova means test; Welch=robust errors means test; Levene=test of homogeneity of variances; Glejser=test for heteroscedasticity of predictors; ICC=intracluster coefficient; ESS=Effective overall sample size taking into account ICC (actual overall sample N=10,999).
*** $p < .001$.

S5. Statistical Differences across Models and Countries

We do not conduct statistical tests of differences in coefficients across models, or across countries, for three primary reasons. First, the sample sizes are sufficiently large to enable even very small differences to achieve statistical significance. Second, all the models share subsets of the same variables, so such tests would not be independent. Third, we do not hypothesize specific differences across countries.

S6. Definitions and Abbreviations

Table S6.1. Definitions and Abbreviations of Terms Used in Text.

Terms	Categories	Definition
Models	Simple	Models (direct and moderated) tested on combined measures of EA, EFF, and PEBs
	(Mis)match	Models (direct and moderated) tested on combinations of specific and general measures of EA, EFF, and PEBs
Domains		The Merriam-Webster dictionary (https://www.merriam-webster.com/dictionary) provides these definitions (along with others): General: involving, applicable to, or affecting the whole; relating to, determined by, or concerned with main elements rather than limited details; Specific: sharing or being those properties of something that allow it to be referred to a particular category; a characteristic quality or trait
	Specific	Specific measures are focused on a particular object or action and typically individual and/or direct: EAC, EFFS, PEBPr

	General	General measures include a broad range of objects or actions and are typically social and/or indirect: EAV, EFFC, PEBPu
	Combined	Measures that involve items relevant to both specific and general domains, or, in the literature, that do not distinguish between the domains: EA, EFF, PEBs
Environmental attitude	EA	Environmental attitudes (combined; concern and values)
	EAC	Environmental concern; typically refers to an individual's concern about a specific environmental condition, such as air pollution
	EAV	Environmental values; typically refers to a basic orientation toward nature or the environment in general
Pro-environmental behaviors	PEBs	Pro-environmental behaviors (combined; private and public)
	PEBPr	Private-sphere pro-environmental behaviors
	PEBPu	Public-sphere pro-environmental behaviors
Efficacy	EFF	Efficacy (combined; self- and collective)
	EFFS	Self-efficacy
	EFFC	Collective efficacy
Samples	Overall	Analysis uses the cross-country sample of N=11,000
	By Country	Analysis uses country-specific sample(s) of N=1,000
Other	NGS	National Geographic Society
	TPB	Theory of planned behavior

S7. References (for S1-S6)

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