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The connection between subjective wellbeing and pro-environmental behaviour: individual and cross-national characteristics in a seven-country study

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Abstract

A positive and reciprocal relationship between subjective wellbeing and pro-environmental behaviour (PEB) has been observed across a range of countries worldwide. There is good reason however to think that the nature of the PEB-wellbeing link might vary between individuals and cross-culturally. We use data obtained in Brazil, China, Denmark, India, Poland, South Africa, and the UK (total n=6,969) to test a series of hypotheses using pre-registered regression models. First, we assess the relationship between PEB and wellbeing across countries, and test the 'privilege' hypothesis that this varies according to personal income and a country's level of development. Second, we consider the role of individual values and motivations in relation to PEB and wellbeing. To this end, we test the 'enhancement' hypothesis, in which the PEB-wellbeing link is strengthened by people holding particular values and motivations. Third, we consider the role of cultural differences for the nature of the PEB-wellbeing link. We test the 'social green' hypothesis that public-sphere behaviours (e.g. addressing environmental issues with other people) are more closely linked to wellbeing in more collectivistic versus individualistic cultures; in tandem, we assess whether private-sphere behaviours (e.g. product purchasing) are more closely linked to wellbeing in more individualistic cultures. We obtain strong evidence for a PEB-wellbeing link across nations. There is partial evidence across countries to support the 'social green' hypothesis, but little evidence for the 'privilege' or 'enhancement' hypotheses. We discuss the implications of our findings for understanding the relationship between PEB and wellbeing, and consider how its promotion might feature in environmental and public health policy.

Keywords

Wellbeing; pro-environmental behaviour; values; motivations; cross-cultural; materialism

1. Introduction

Despite the pervasive and long-standing assumption that increasing material wealth brings greater happiness, beyond a certain point after which people's needs are met, this association does not hold (Layard et al., 2008). Growing material wealth and consumption may even undermine people's wellbeing at higher levels of income (Jebb et al., 2017), particularly if individuals prioritise these types of rewards over other, intrinsic motivations such as spending time with friends or family (Kasser, 2002). At the same time, there is a growing recognition of the wider ecological consequences of contemporary lifestyles, particularly in high-income countries and among high-income groups (UNEP, 2020). In short, there is evidence that societies are damaging natural environments and contributing to climate change, without even enhancing the wellbeing of their citizens.

Personal action of benefit to the environment – so-called 'pro-environmental behaviour' (PEB) – has separately been shown to be positively associated with wellbeing (Kasser, 2017; Zawadski et al., 2020). For example, Xiao and Li (2011) found sustainable consumption was correlated with life satisfaction in China, controlling for demographic factors including income. Tapia-Fonllem et al. (2013) have observed a similar relationship with research participants in Mexico; this analysis used measures of PEB such as recycling/reuse behaviours and energy conservation, and found this was statistically significant in predicting self-reported happiness. Drawing on a large sample of UK survey participants, Netuveli and Watts (2020) likewise found a significant association between PEB (operationalised as the use of household renewable energy and recycling) and life satisfaction. More generally, a recent meta-analysis of 78 studies spanning 37 countries in four continents, has concluded that the relationship between PEB and wellbeing is robust across a range of study designs (Zawadzki et al., 2020). Whilst there has been some variation in the ways in which wellbeing has been understood across such studies, for the most part they reflect the notion of 'subjective wellbeing' – a person's own perspective on the extent to which they have a 'positive state of mind' (Cummins et al., 2010). This in turn can be considered synonymous with the concept of happiness (Diener, 2006) and with the experience of meaning and satisfaction in one's life (Diener et al., 2010; Hicks, 2013; Medvedev and Landhuis, 2018). We adopt this broad conceptualisation in the present study.

It has been argued that undertaking PEB has the potential to influence wellbeing through several mechanisms. Kasser (2017) has proposed that pro-environmental action can exert positive influence through fulfilling people's inherent and intrinsic psychological needs for a sense of competence, relatedness to other people, and autonomy; this perspective is in line with the theoretical predictions of self-determination theory (Ryan and Deci, 2000) which proposes that fulfilling certain innate psychological needs is essential for wellbeing and good mental health. For example, taking steps to reduce energy use can fulfil the psychological need of 'competence' because one is able to perform a

useful behaviour, which in turn contributes to personal wellbeing. Alternatively, and from a perspective of economic psychology, Welsch and Kuling (2010) suggest that pro-environmental consumer choices are more utility-maximising than high-consumption lifestyles, and so are more beneficial to the person carrying them out. This is in part because pro-environmental choices are less subject to hedonic adaptation than are those that involve material consumption: people are less prone to 'get used to' their effects, than they are the extrinsic rewards from consumption.

As well as a role for PEB promoting wellbeing, it has been argued that being happy – in terms of positive mood or affect – can promote more pro-social behaviour; people in a good mood may have a more positive view of others, and so wish to act in a pro-social way (Kasser, 2017). Coelho et al. (2017) argue that positive mood can raise environmental concern (through promoting cognitive engagement) and perceived efficacy (through raising perceived ability to take action), hence promoting PEB. More generally, evidence points to a reciprocal causal relationship between wellbeing and PEB: this mutually reinforcing process may be summarised in terms of 'living better by consuming less' (Jackson, 2005).

1.1 Intricacies in the relationship between PEB and wellbeing

Combining the insights above, it would appear that there are parallel benefits both to personal wellbeing and a person's ecological footprint from acting in pro-environmental manner. However, the extent to which this relationship holds universally across individuals, countries and cultures has not been clear in the research literature to date. Is the connection between environmentally-friendly behaviour and wellbeing contingent upon a person's material circumstances, such that it applies only for those people and places with the *privilege* to engage in green behaviours? Alternatively, perhaps the link between environmentally-friendly behaviour and wellbeing applies mostly for people who are *personally inclined* towards taking socially responsible action, or towards taking environmentally-friendly action for its own, inherently rewarding sake? Finally, are there *cultural differences* in the ways that environmentally-friendly action is connected to wellbeing?

1.1.1 The role of income and material circumstances

There is good reason, first, to think that a PEB-wellbeing link might vary in terms of a person's material circumstances, or the level of development of a nation. Research into pro-environmental behaviours has primarily been carried out in Western, industrialised nations (Tam and Milfont, 2020), where for many people at least, the material necessities of life are largely met. A number of studies have

indicated that income is positively associated with PEB (Milfont and Markowitz, 2016); this is in line with the general observation that people have greater ability to exercise choices in line with their personal values, if they have access to greater economic resources (Fischer and Boer, 2016). Some other research has, however, observed the reverse relationship (Blankenberg and Alhusen, 2019), while research in the UK and Brazil has found that income predicts PEB in different ways depending on the country and context (Whitmarsh et al., 2017). This latter observation may be related to the fact that certain actions – such as avoiding buying new products – reflects different motivations for those with more money rather than less (in this case, frugality versus necessity). Previous research has found that higher income is associated with environmental citizenship (Stern, 1999) and has suggested that some choices such as vegetarianism and organic eating are primarily the preserve of the middle classes (Hayes-Conroy and Hayes-Conroy, 2013); but for other pro-environmental actions, such as use of public transport, the reverse relationship may hold, as these reflect, at least in part, people's economic circumstances (Longhi, 2013).

Given that the capacity to undertake voluntary PEB at a person's own discretion may be linked to income and material circumstances, it seems reasonable to suppose that these may in turn moderate the relationship between PEB and wellbeing. There is, however, little research that investigates this notion; one study from Spain that does assess a moderating effect found that while PEB was overall associated with *lower* life satisfaction, this negative relationship decreased with income (Binder et al., 2020). Whether or not income and material circumstances affect the connection between PEB and wellbeing link is important to assess, as this is relevant for understanding the personal benefits of PEB: specifically, is it the case that the higher wellbeing arising from PEB is effectively a privilege more accessible to those on higher incomes?

In the present study, we set out to assess whether the relationship between PEB and wellbeing varies by personal and national circumstances. We test what we term a 'privilege' hypothesis: that the positive link between PEB and wellbeing is a function of material wealth, and so more pronounced for wealthier individuals and in wealthier countries.

1.1.2 The role of values and motivations

Whether or not material conditions are found to be relevant to the link between PEB and wellbeing, we might still expect variability in relation to individuals' values and motivations.

People's values are known to be closely linked to their overall wellbeing (e.g. Sortheix and Schwartz, 2017). A range of evidence also suggests that personal values are strong determinants of behaviours that are intended to benefit other people or the natural world, including PEB. This relationship has

been well-demonstrated, both from the perspective of Schwartz's (Schwartz, 1994) universal values theory, whereby a personal emphasis on 'bigger than self' and altruistic considerations – so-called 'self-transcendent values' – predicts PEB (Corner et al., 2014; Punzo et al., 2019) and in terms of the function of 'biospheric' values (i.e. those that directly ascribe value and priority to the natural world, a framework itself derived from Schwartz's approach; Corner et al., 2014; de Groot and Steg, 2008). [1]

As well as PEB and wellbeing being connected in a reciprocal manner, there is then good reason to think that the *relationship* between PEB and wellbeing may be influenced by people's values. This is due to the fact that acting in line with one's values in a general sense (e.g. taking action to help others in the context of strong self-transcendent values) is connected with higher personal wellbeing (Veage et al., 2014; Ferssizidis et al., 2010). In the present research, we therefore set out to examine whether holding more self-transcendent values strengthens the link between PEB and wellbeing.

A separate strand of work in social psychology also affirms the importance of different types of motivation in bringing about a range of behaviours, including PEB. Drawing on self-determination theory (Ryan and Deci, 2000) this line of research strongly indicates that intrinsically motivated behaviour (that is, undertaking action for personal fulfilment, rather than in pursuit of external rewards) is more aligned with personal wellbeing than its converse, extrinsically motivated behaviour. There is less research assessing the link between extrinsic/intrinsic motivations and PEB, compared to that which considers the role of values; however, the research available does suggest that intrinsic motivation is predictive of PEB in a similar manner to self-transcendent values (Webb et al., 2013; Pelletier et al., 1998; Whitmarsh et al., 2017). Based on the notion that PEB has greater potential to influence wellbeing if it is aligned with a person's underlying motivations (Ryan and Deci, 2000), in the present study we therefore seek to extend the current evidence base by assessing whether more intrinsic motivations act as a moderating factor – in this case, to strengthen – the relationship between PEB and wellbeing.

In line with our assessment of the role of self-transcendent values and motivations, we also consider a potential role for a person's 'material values' to operate in a similar but reverse manner (Richins and Dawson, 1992; Richins, 2004). This approach treats materialism as the extent to which a person ascribes importance to the ownership and acquisition of money and material goods, including how this is applied to judge one's own and others' success (Richins, 2004). Measures of material values have been found to predict environmentally unfriendly attitudes and behaviours (Hurst et al., 2013; Prinzing, 2020) as well as lower subjective wellbeing (Elphinstone and Critchley, 2016). We seek to

[1] The notion of 'values' here originates in social psychological research that considers these to be 'guiding principles in the life of a person' which are both fundamental to a person's character, and present to varying different degrees across all peoples and cultures.

extend the current evidence base by further investigating the role of material values in relation to PEB and wellbeing – in this case, to assess whether materialistic values attenuate the PEB-wellbeing link (that is, that a lower degree of materialism is linked to a stronger relationship between PEB and wellbeing).

Taken together, our approach in the present study is to investigate whether the relationship between PEB and wellbeing varies in line with people's values and motivations. We test what we term an 'enhancement' hypothesis: that the holding of self-transcendent values, more intrinsic motivations and less materialistic values enhance the link between PEB and wellbeing.

1.1.3 Cross-cultural differences in the connection between PEB and wellbeing

Adding further complexity to the relationship between PEB and wellbeing, Oishi et al. (1999) have argued that whereas the importance of meeting basic needs is important worldwide, the role of higher-order needs and goals for life satisfaction varies depending on cultural background. Wellbeing may differ depending on cultural and socio-political factors: for example, life evaluation (a form of subjective wellbeing) has been found to be more closely tied to meeting basic needs in poorer countries, than wealthier contexts (Tay and Diener, 2011).

In considering cross-cultural differences, we turn our attention to the ways in which these may underpin the PEB-wellbeing link in relation to different types of PEB. While much of the literature has tended to see various types of pro-environmental behaviour as equivalent or inter-changeable, often combining a range of actions into a single scale (e.g. Pavalache-Ilie and Cazan, 2018; Ugulu et al., 2013) it is important to recognise distinctions between them; for example, participating in a climate protest is a quite different activity from reducing the temperature of a thermostat (Capstick et al., 2014).

Stern (2000) first proposed a distinction between PEBs in the public versus private sphere. The former entails actions which can be understood in terms of environmental citizenship and/or taking action with others, such as belonging to an environmental group; whereas the latter entails actions which are linked to individual consumption and behaviours with direct impact, such as recycling or buying green products. Public sphere action has previously been linked to personal wellbeing (for example, through meeting needs for interactions with others; Kasser, 2009). Research has, however, yet to ascertain whether and how public and private sphere PEBs might relate to wellbeing in different cultural contexts.

We suggest that there may be a divergent role for public sphere and private sphere PEBs across different cultural settings. The work described above by Stern (2000) suggested that contextual forces

including interpersonal influences and 'community expectations' would affect the level and type of PEB undertaken (i.e. public versus private sphere). Later work has also stressed the more socially-organised nature of public sphere action; and has shown that whether or not people undertake public sphere PEB is influenced by the individualism-collectivism of a culture (Tam and Chan, 2017; Eom et al., 2016). The individualism-collectivism distinction itself derives from the work of Hofstede (1980); this line of research proposes that some societies are organised in ways that emphasise closely bound groups (i.e. are collectively oriented) in contrast to other cultures in which individuals' identities are connected more loosely to social context (i.e. are individually oriented); the degree of individualism-collectivism of a culture is usually measured at a national/cultural level. In relation to PEB, some research has suggested that whilst individual (i.e. typically private sphere) action has been extensively promoted and reproduced in Western contexts, collective action may be emphasised in other parts of the world (Xue et al., 2015; Whitmarsh et al., 2017).

Drawing on these insights, we propose that public and private sphere PEB may serve different functions for personal wellbeing in different cultural contexts. In the present study we therefore examine what we term a 'social green' hypothesis: that the relationship between private sphere PEBs and wellbeing is stronger for relatively more individualistic cultures; with the opposite effect proposed in the case of public sphere PEBs.

2. Aim and hypotheses of the present study

The aim of the present study is to explore the 'privilege', 'enhancement' and 'social green' accounts of the relationships between pro-environmental behaviour and wellbeing as articulated above. The study makes use of data obtained from seven national-level surveys carried out in 2016.

The study hypotheses and analytic approach that follows from them do not assume a causal sequence only from PEB to wellbeing, however for the purpose of constructing regression models we treat wellbeing as an outcome variable and PEB as a predictor variable, with further variables treated as moderators and/or a way of comparing the PEB-wellbeing relationship. While there are arguments to support a causal relationship in both directions, the weight of evidence and theory tends more towards considering wellbeing as an outcome variable (Zawadzki et al., 2020); this cannot be directly tested using the present cross-sectional data, and so we refer to relationships between variables rather than in terms of cause and effect.

The hypotheses of the study are:

H1. There will be a general positive relationship between PEB and wellbeing across countries.

H2. The relationship between PEB and wellbeing will be stronger depending upon individual-level income (H2a), and in more developed versus less developed nations (H2b) ('privilege' hypothesis).

H3. The relationship between PEB and wellbeing will be stronger for individuals with stronger self-transcendent values (H3a) and intrinsic motivations (H3b), and weaker for those with more materialistic values (H3c) ('enhancement' hypothesis).

H4. The relationship between PEB and wellbeing will be stronger for public sphere PEBs than private sphere PEBs, in more collectivistic cultures (H4a). The relationship between PEB and wellbeing will be stronger for private sphere PEBs than public sphere PEBs, in more individualistic cultures (H4b) ('social green' hypothesis).

We pre-registered the study hypotheses and analyses on the Open Science Framework website [osf.io/[redacted for peer review]] to limit 'researcher degrees of freedom' (Simmons et al., 2011) and to avoid post-hoc explanations for patterns identified in the data (cf. Fischer and Poortinga, 2018). The pre-registered approach is also provided in full in the supplemental information (Appendix A). Although data collection took place prior to the registration of the analysis, the analytic approach was developed by the author team prior to any analysis or data exploration. One of the co-authors was responsible for conducting statistical tests, having collaborated to design hypotheses and analyses, but without having prior access to the relevant datasets. The pre-planned analyses were followed rigidly, except in specific cases where a departure was deemed necessary. We explicitly state in the Methods and Results sections where we depart from the pre-planned analyses.

3. Methods and Materials

3.1 The cross-national survey study

The study uses nationally-representative survey data obtained from seven countries (total n=6,969), these being South Africa, Brazil, China, India, Denmark, Poland, and the UK. These countries were selected to reflect cross-national variability in the cultural value orientations framework of Schwartz (2006), differences in individualism and collectivism (based on Hofstede Insights, 2018; see also Minkov et al., 2017), levels of economic development (UNDP, 2017), and an international index of the status of nations' environmental quality and policy standards (Hsu & Zomer, 2014; Yale Center for

Environmental Law and Policy, 2018). In addition to these selection criteria, we also set out intentionally to obtain participant data from non-Western countries, in order to effectively test hypotheses and in response to a wider lack of research that has looked at these issues in non-Western contexts (as summarised by Tam and Milfont, 2020). Further details about country selection are provided in the supplemental information (Appendix B).

The overall sample comprised 6,969 individuals, with approximately 1,000 people per country, with sample size somewhat lower in Poland (n=658) and India (n=985). The survey was conducted online between March and November 2016, with participants recruited through a research panel provider. Participants were recruited using quota sampling to ensure participants were broadly representative for each of the countries surveyed, by age (18 years and over), gender and income. Income sampling was based on quintiles for each country, in line with publicly available national statistics. Income bands for each country, together with source material, are given in the supplemental information (Appendix B).

The survey was designed in conjunction with local collaborators, who in all cases were professional researchers based in the nations surveyed. All collaborators were fluent speakers of both English and the language(s) used in the surveys. Survey items were professionally translated into languages and scripts reflecting widely-spoken official and indigenous languages, with sense-checking undertaken by a second independent translator. As appropriate to the country surveyed, versions were made available in Portuguese, traditional and simplified Chinese, Danish, Hindi, Polish, Afrikaans, Zulu, and English.

3.2 Measures

The survey consisted of range of measures administered in blocks of items, using online survey randomisation features to preclude ordering effects. The following measures were used in the present study.

3.2.1 Pro-environmental behaviour measures

The full survey administered across countries contained 32 pro-environmental behaviour items that were derived from an allied study using a qualitative, in-person card sort exercise ([anonymised for peer review]). These were developed in collaboration with researchers in each of the sampled countries.

Eight pro-environmental behaviours were selected from this long list in a systematic way, for use in the present study. First, we excluded a small number of items such as 'avoided eating meat' due to them having differing cultural meanings across the seven countries. Second, we excluded items based on the distributional properties of the data, in particular their skewness scores. Third, we selected three public and four private sphere behaviours using a pre-determined procedure (see supplemental information, Appendix A Methods). The selection was based on previous findings indicating a two-factor distinction between these types of PEBs in a two-country sample ([citation removed for peer review]). We however deviated from our pre-planned method due to low internal consistency of the public sphere behaviour scale in two countries, using the pre-registered approach. As such, we included an additional public sphere item from the longer list of available items, which enabled us to obtain good scale properties across all countries. Further detail about the selection of items is provided in supplemental information (Appendix A, Methods). Further detail on the properties of the PEB scales based on exploratory factor analysis is provided in supplemental information (Appendix D).

The final list of PEBs included in our analyses were as follows:

1. Done something together with neighbours, people at work or friends to address an environmental issue [public sphere]
2. Donated money to an environmental campaign group [public sphere]
3. Got involved in conservation work to protect natural environments (e.g. national parks, coastline) [public sphere]
4. Found out more about environmental issues (e.g. learning more about climate change) [public sphere]
5. Bought products with less packaging [private sphere]
6. Bought environmentally-friendly products [private sphere]
7. Taken short showers (less than 3 minutes long) or infrequent baths [private sphere]
8. Avoided wasting food (e.g. by using leftovers) [private sphere]

Participants self-reported frequency of carrying out actions on a 10-point scale, ranging from 'not at all in the past year' to 'at least once a day' with each of the frequency response options accompanied by specific wording.

3.2.2 Personal values and motivations

We used a 4-item measure of 'self-transcendent' values, taken from Schwartz's Portrait Values Questionnaire (Schwartz, 2003; Sandy et al., 2016), incorporating items that gauged the extent to which a person placed value on helping others, acting for the good of society, protecting the environment, and preventing pollution. Participants indicated the extent to which they personally related to brief 'portrait' descriptions, on a 6-point scale. We derived participant scores to reflect individually relative 'self-transcendent' values; this was computed based on relative values in line with the recommendations of Schwartz (2003), for which we subtracted the grand mean (all items) from the mean of those self-transcendent items.

To measure materialistic values, we used three items from the 'Success' subscale from Richins's Material Values Scale (2004). This subscale has the advantage that it assesses people's perspectives on the meaning or desirability of material wealth, without being contingent on their present material circumstances; the items we used focus on the extent to which a person admires others who own expensive things, or whether it is felt that the possessions one owns can be used to impress others or to show how well one is doing in life. Participants indicated the extent to which they agreed or disagreed with statements presented, on a 7-pont scale ranging from 'entirely disagree' to 'entirely agree'. Scores from these three items were summed to form a reliable scale (Cronbach's alpha ranged from .640 to .853 across the seven countries).

We used 12 items from Kasser and Ryan's (1996) Aspiration Index to measure the relative importance of individuals' intrinsic motivations. Participants indicated the extent to which six intrinsic and six extrinsic items were important to them personally, on a 5-point scale from 'not at all important' to 'extremely important'. Example item phrasing includes working to make the world a better place, helping others improve their lives, and having supportive relationships with others. Following Kasser's (2019) recommendation, we derived individually relative intrinsic motivation scores by subtracting the 6 intrinsic aspiration items from the grand mean (all items: 6 intrinsic, 6 extrinsic).

For full item wordings for these measures see supplemental information (Appendix A, Methods).

3.2.3 Subjective wellbeing

We used two items to assess subjective wellbeing. One of these has been designed to assess eudemonic wellbeing (meaning/purpose), the other evaluative wellbeing (life satisfaction) (Hicks et al., 2013). These items ask, respectively, whether a person feels the things they do in life are worthwhile, and how satisfied they are with life; see supplemental information (Appendix A, Methods). As anticipated, these two items were highly correlated (r = .56 or above for all countries) and so were combined to form a single measure of wellbeing.

3.3 Statistical analysis

3.3.1 Analytic approach

As specified in the pre-registered methods, we conducted multiple linear regression analyses to test hypotheses. In all cases, wellbeing was treated as the outcome variable. PEB, income, personal values (self-transcendent and materialistic), and intrinsic motivations were used as predictor and/or moderator variables. We consider effect sizes and significance levels of variables, comparing these between countries where relevant. For these analyses and tabulations of results, item and scale *Z* scores are used.

In order to test the general relationship between PEB and wellbeing (H1) we carried out a series of linear regressions of wellbeing on the full PEB index (8 items) for each country; PEB was entered into the regression, with individual income subsequently included as a predictor to allow us to assess the extent to which PEB independently predicted wellbeing. The pre-registered methods required a significant relationship between PEB and wellbeing to be obtained in a minimum of three of seven countries (with or without the inclusion of income as a predictor) for H1 to be supported. We include income as a predictor in these analyses given a person's material circumstances are known to be directly linked to wellbeing, albeit not always in a straightforward manner (Jebb et al., 2017; Layard et al., 2008).

To examine whether the relationship between PEB and wellbeing is contingent on income (H2a) and country-level development (H2b), we carried out a series of linear regressions of wellbeing on the full PEB index. This analysis extended the regression carried out for H1, through the additional inclusion of an interaction term (PEB X income) to test for a moderating effect of income on the PEB-wellbeing association, in addition to examining for main effects of income and PEB. The preregistered methods required the interaction term to be significant in a minimum of three of seven countries, for H2a to be supported. In order to test H2b (stronger effect of PEB for more developed nations) we compared 95% confidence intervals of effect sizes, between the two most-developed (UK and Denmark) and two least-developed countries (South Africa and India), based on the UN's Human Development Index (2017). The preregistered methods required that the two highest-ranked countries would have confidence intervals that fall outside those of the two lowest-ranked countries.

In order to test whether values and motivation would moderate the relationship between PEB and wellbeing (H3a, H3b, H3c), we carried out linear regressions of wellbeing on the full PEB index. These analyses extended the regression analysis carried out for H1, through the additional inclusion of interaction terms to test separately for a moderating effect of self-transcendent values (H3a: PEB X self-transcendent values score), intrinsic motivation (H3b: PEB X motivation score), and material values (H3c: PEB X material values score). In all cases, PEB and values/motivation variables were also included as separate predictors. The preregistered methods required a significant positive interaction term to be obtained in at least three of seven countries, in order for H3a, H3b and/or H3c to be supported.

In order to compare the relative importance of public sphere PEBs and private sphere PEBs for the PEB-wellbeing relationship in different cultural types (H4a and H4b), we compared effect sizes for public and private sphere PEB in the two most collectivistic cultures in our dataset (China and Brazil), and separately for the two most individualistic cultures in our dataset (UK and Denmark). The preregistered methods required that the two countries highest-ranked for individualism (UK and Denmark) had larger effect sizes of private sphere PEB on wellbeing, than for public sphere PEB, in order for H4a to be supported. For H4b to be supported, the two countries highest-ranked for collectivism (China and Brazil) were required to have larger effect sizes of public sphere PEB on wellbeing, than for private sphere PEB. 95% confidence intervals were used to assess whether effect sizes could be considered significantly different.

As we outline above, the criterion that significant effects should be observed in 3 of 7 countries is applicable to hypotheses H1, H2a and Hs 3a, b, c. This allows us to adopt an appropriate threshold for statistical significance across multiple tests: across these five hypotheses, an overall probability threshold of $p \leq .018$ is derived, in comparison to a conventional significance level of $p < .05$. Further details of the rationale for the use of this approach are provided in the supplemental information (Appendix C).

3.3.2 Measurement equivalence

We adopted several, linked approaches to assess equivalence of measures across countries; that is, to ascertain the extent to which measures have a similar latent structure in different cultural settings. For the PEB items, for which we anticipated a two-factor solution, we initially used exploratory factor analysis for the full PEB scale (8 items), and then separately for private and public sphere PEB (each 4 items); this was done separately for each country context. We next used Procrustes Rotation to more directly assess structural equivalence across contexts, using the

statistical procedure outlined in Fischer and Fontaine (2011). Finally, we examined factorial equivalence through constraining parameters using multi-group confirmatory factor analysis.

For the values and motivation measures, for which we anticipated and applied single-factor (scalar) measures, we carried out confirmatory factor analysis, again constraining parameters to compare model fit between countries.

More detail on the methods used and indicators obtained for these procedures is given in the supplemental information (Appendix D). Overall, we conclude that there is good evidence for measurement equivalence of the PEB items across countries. In addition, model fit for the self-transcendent and material values items is found to be acceptable. There is weaker evidence for measurement equivalence of the intrinsic motivation items. While we use these in the analysis in the present study, we acknowledge the limitations in this case for the robustness of our findings.

4. Results

4.1 Relationship between pro-environmental behaviour and wellbeing

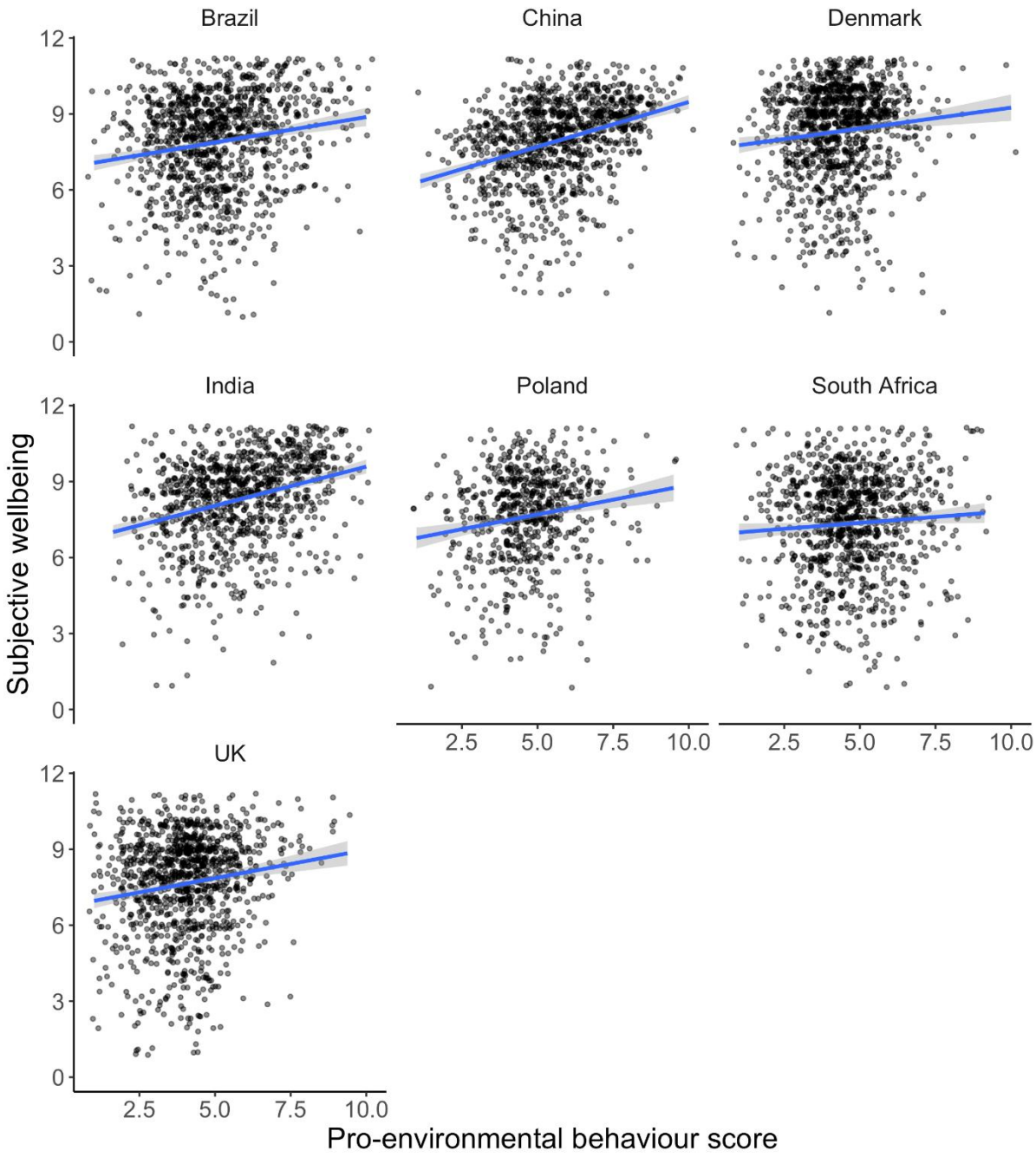
We hypothesised that there would be a general relationship between PEB and wellbeing across countries.

The results of the linear regressions are shown in Table 1. For all countries, a significant relationship is obtained between PEB and wellbeing (step 1), whether or not income is also included as a predictor (step 2). These findings support H1 that there would be a relationship between PEB and wellbeing across countries. Figure 1 further illustrates the nature and strength of these relationships, showing least-squares regression lines for each country's PEB-wellbeing association.

Table 1 Linear regressions of wellbeing on PEB across countries

Country			B (SE)	Beta	R^2 change
	Regression stage	Predictors			
Brazil					
	1	PEB scale	.170 (.030)	.169***	.029
	2	PEB scale	.144 (.030)	.143***	
		Income	.228 (.036)	.189***	.035
China					
	1	PEB scale	.299 (.026)	.340***	.116
	2	PEB scale	.283 (.026)	.321***	
		Income	.128 (.030)	.127***	.016
Denmark					
	1	PEB scale	.140 (.038)	.109***	.012
	2	PEB scale	.118 (.038)	.092**	
		Income	.175 (.027)	.190***	.036
India					
	1	PEB scale	.262 (.027)	.302***	.091
	2	PEB scale	.243 (.027)	.280***	
		Income	.116 (.026)	.136***	.018
Poland					
	1	PEB scale	.197 (.045)	.167***	.028
	2	PEB scale	.174 (.044)	.147***	
		Income	.248 (.042)	.223***	.049
South Africa					
	1	PEB scale	.080 (.037)	.068*	.005
	2	PEB scale	.078 (.037)	.067*	
		Income	.045 (.032)	.044 ns	.002
UK					
	1	PEB scale	.190 (.038)	.152***	.023
	2	PEB scale	.178 (.037)	.142***	
		Income	.184 (.032)	.172***	.029

Figure 1 **Relationship between PEB scale and wellbeing across countries**

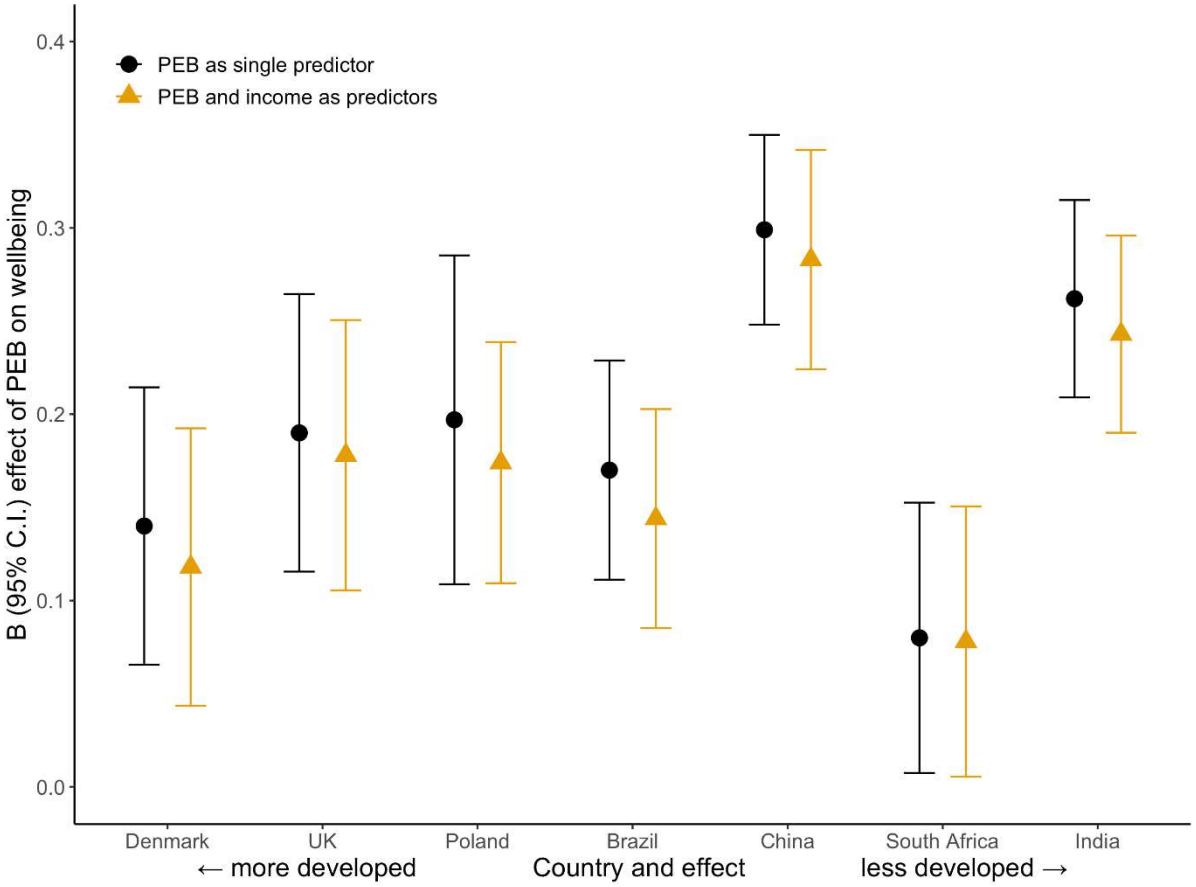


4.2 The 'privilege hypothesis': Moderation of behaviour-wellbeing relationship by income and development

The analyses carried out do not support H2a (stronger effect of PEB with higher individual income), although these results are somewhat borderline. While a significant moderation effect is obtained for the Brazil data, and a near-significant effect for India (p = .051), as shown in Table S5 (Supplemental Information, Appendix E) our findings do not show moderation effects across the minimum three countries required to support this hypothesis, based on the pre-registered criteria.

There is no indication that the effect sizes of PEB on wellbeing for more-developed nations are greater than those for least-developed nations; hence these analyses do not support H2b. The results of this analysis are shown in Figure 2, where black-coloured circle points represent coefficients for PEB as a predictor variable alone, and yellow-coloured triangle points represent coefficients for PEB as a predictor where income is included; this allows us to also assess country-level effects while accounting for individual-level income as a potential covariate. Error bars are +/- 1.96 standard errors (95% confidence interval).

Figure 2 **Effect sizes and 95% C.I.s for PEB relationship to wellbeing by country**



4.3 The 'enhancement hypothesis': Moderation of relationship between behaviour and wellbeing by values and motivations

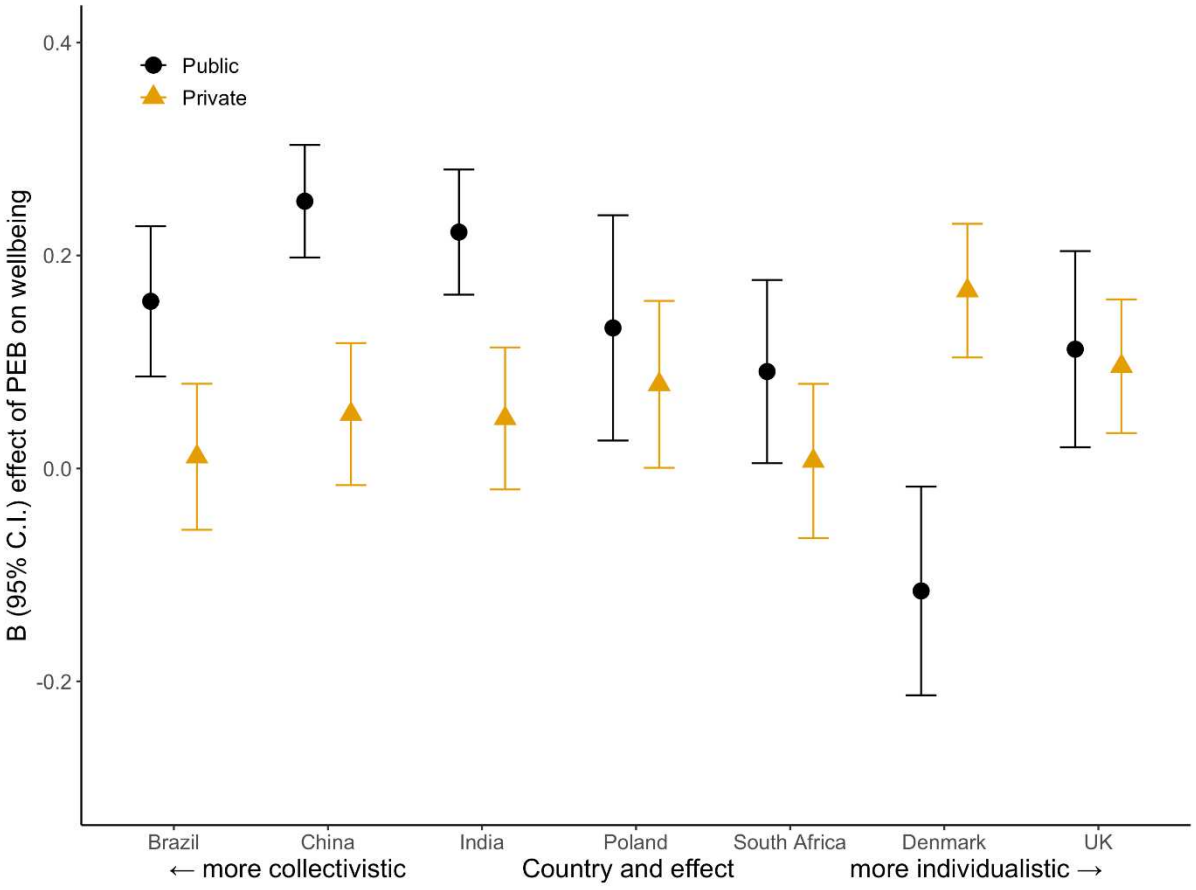
We find no evidence to support H3, across countries or predictor variables; in all cases, non-significant relationships are obtained. In the case of self-transcendent values (H3a), these independently predicted wellbeing, but the interaction term (PEB X values) did not significantly increase the variance accounted for in the regression models. The interaction terms used to test the moderating effect of motivation and material values, also did not significantly predict wellbeing.

Full details of the regressions carried out are given in Tables S6 to 8 (Supplemental Information, Appendix F).

4.4 The 'social green' hypothesis: Types of PEB and individualism-collectivism

Our analysis supports H4a, in that the effect size for public sphere PEB, as a predictor of wellbeing, is substantially higher than that for private sphere PEB, for both China and Brazil. Our analysis does not support for H4b; while our prediction is observed for the Denmark sample, this does not also hold for the UK. Given our pre-registered methods required this finding to hold in both countries, we conclude the hypothesis has not been supported. These findings are illustrated in Figure 3, showing the full sample of seven countries.

Figure 3 **Effect sizes and 95% C.I.s of relationships between PEB and wellbeing across countries**



5. Discussion

The present study finds strong evidence that higher levels of PEB are associated with greater subjective wellbeing. Across seven countries at different levels of development, from Denmark

(ranked 11th in the UN's Human Development Index; UNDP, 2017) to India (ranked 130th) we find that the PEB-wellbeing relationship holds. This finding was in line with our study predictions, and in keeping with the notion that citizen awareness of environmental problems and support for action to protect the environment are not limited to wealthy nations and/or those of the Global North (Dunlap and York, 2008). Other recent research looking at the relationship between PEB and wellbeing has also confirmed that this is obtained in different parts of the world (Zawadzki et al., 2020).

The compatibility of pro-environmental action and personal wellbeing has important implications for advancing policy in both the environmental and health domains. As Karlsson et al. (2020) point out, climate policies are often obstructed due to a focus on their costs; but as these authors also show, there exist a wide range of societal benefits that can be attained through their implementation. Even so, policy initiatives have to date hardly considered the potential synergies between climate policy and outcomes in terms of happiness and life satisfaction (Karlsson et al., 2020); one exception is analysis by Liu et al. (2016) who conclude that a policy emphasis on low-carbon living can heighten subjective wellbeing via improved physical health and inter-personal relationships. More typically, however, pro-environmental action by individuals tends to be conceived of as entailing 'sacrifice' (Laffan, 2020). By contrast, there is more established research and policy interest in how nature-based health interventions – such as promoting people's involvement in conservation activities – can enhance personal wellbeing in a manner that helps to integrate public and environmental health objectives (Robinson and Breed, 2019). The findings of the present study point towards the value of recognising the wellbeing benefits of a broader range of pro-environmental behaviour, spanning both the private sphere (e.g. domestic energy conservation) and public sphere (e.g. civic engagement).

An important observation from the present study, is that although we observe a PEB-wellbeing link across all seven countries surveyed, the strength of this association differs between nations. We predicted that the relationship would be stronger in wealthier nations, in line with a 'privilege' hypothesis; however, contrary to expectations, the strongest associations are seen in China and India, even when taking into account individual-level income. It is unclear why we obtain this finding, contrary to our predictions. It is plausible, however, that this reflects variations in the extent to which PEB is perceived as meaningful across different cultural contexts: Zawadzki et al. (2020) argue that PEB is particularly strongly related to eudemonic wellbeing – that is, wellbeing connected with meaning and purpose in life – a measure of which is also incorporated in the present study. It is argued by Patel et al. (2017:190) that "environmental consciousness and its practices may have a different meaning in developing countries" as compared to industrialised countries; these authors

also point out that among Asian nations, India has scored highest in relation to a sense of responsibility towards the environment (Greendex, 2014). In China, the range of subnational and community initiatives focussing on issues like air pollution, recycling and energy saving has proliferated in recent years (Koehn, 2016) including efforts to expand and deepen public awareness and personal action (Lo and Tang, 2014).

As well as a lack of evidence for a cross-national 'privilege' hypothesis, we did not obtain evidence to support this within countries, in terms of people's income. We suggest that this finding runs counter to the portrayal of PEB as something that provides a 'warm glow' (or assuages the guilt) of those with the capacity to act, yet is of limited benefit to those on lower incomes (Pagiaslis and Krontalis, 2014). While it is important to recognise that some PEBs do indeed require financial resources, it may also be of relevance that other PEBs (e.g. avoiding waste, or acting with others) do not incur costs and may indeed promote resource conservation. Either way, our finding that income did not moderate the relationship between PEB and wellbeing would seem to reflect the observation that willingness to take action – and even to incur economic costs – to protect the environment is unrelated to affluence (Dunlap and York, 2008). More generally, it may be argued that, just as general psychological needs and values to some extent span cultural boundaries (Nalipay et al., 2020; Schwartz, 1994), so too might there be similar positive benefits to be obtained from meeting these needs through behaviours which are seen as worthwhile, such as PEB. This said, a focus on personal wellbeing in terms of attaining meaning in life and fulfilling psychological needs (as opposed to through proxies such as consumption) is yet to be well-integrated into climate policy or mainstream approaches to climate change mitigation (Lamb and Steinberger, 2017). The present study adds to the growing body of literature that aims to align human wellbeing and environmental protection in this vein (e.g. Dietz et al., 2009). One example of how such considerations can be translated into policy is the case of Wales's Wellbeing of Future Generations Act which has sought to align behaviour change (e.g. more active travel) with improved mental health outcomes and a national response to the climate emergency (Welsh Government, 2020; Nesom and MacKillop, 2020).

Our findings suggest that the extent to which PEB and wellbeing are connected is not moderated by value or motivation types, contrary to our 'enhancement' hypothesis. While we did not obtain good measurement equivalence for intrinsic motivations, undermining our ability to draw conclusions here, we did find that self-transcendent values and material values had good cross-cultural comparability. That these measures were not found to moderate the effect of PEB on wellbeing might be taken to indicate that the reciprocity between PEB and wellbeing is not contingent upon particular values bases – perhaps, again, being more universal across individuals.

At the same time, our research suggests that while PEB overall is linked to wellbeing, there may be a particular premium for action that is contextualised to the culture in which it is located. We find some evidence to support our 'social green' hypothesis, whereby public sphere action is more strongly associated with wellbeing in the more collectivistic cultures considered, although the second part of our prediction (relating to private sphere action and individualistic cultures) was obtained only in one of the two countries predicted.

These findings raise the prospect that particular types of pro-environmental behaviour might be inherently more rewarding in certain cultural contexts than others. Although to our knowledge, the present study is the first to draw attention to this finding in the context of PEB, this is in line with research suggesting that happiness is pursued in more socially-engaged ways in collectivistic (versus individualistic) cultures (Ford et al., 2015). That we observe a connection in particular between public sphere (i.e. socially-engaged) PEB and wellbeing in collectivistic cultures points to an encouraging avenue for future research. Nevertheless, it is important to recognise critiques that have been levelled at the individualism-collectivism construct, not least for lacking specificity (Fiske, 2002). As such, we suggest that future research consider the role of additional cultural dimensions in relation to PEB and wellbeing, which have also been shown to moderate the relationship between environmental concern and PEB (Tam and Chan, 2017).

In the present study, we set out to include less-considered public-sphere behaviours within our PEB scale – actions entailing involvement with others, and relating to environmental citizenship (Stern, 2000) – which might also be those types of pro-social activity which are aligned with personal wellbeing. These specific findings reflect those of Aknin et al. (2013) who find that prosocial action is associated with greater happiness in both rich and poor countries. Schmitt (2018) has likewise observed a particularly strong association between life satisfaction and PEBs that entail social interaction. There is some indication in the present study of a general trend towards public sphere PEBs being more strongly linked to wellbeing than private sphere PEBs – although this was not predicted. We recommend further consideration be given in future research to the potential co-benefits of public sphere or prosocial environmental PEB in terms of personal wellbeing (cf. Bain et al., 2016) including whether this varies according to cultural context.

A general limitation of the present study relates to the extent to which we are able to draw conclusions about causation versus correlation. For the purposes of our analyses and regression models, we have assumed PEB as predictive of wellbeing. As with other correlational research in this field, however, caution is required in extrapolating from this assumption. Given lines of evidence suggesting a two-way relationship, a reciprocal relationship may well exist between PEB and

wellbeing. In terms of our statistical analysis, it should be acknowledged that absence of evidence in support of hypotheses cannot logically be taken as evidence of absence for effects. Borderline results which warrant attention in future research include our observation of a significant and near-significant relationship in two countries (Brazil and India) for income as a moderator, and a stronger association between private sphere PEB than public sphere action in one of the two locations where this was predicted (Denmark).

Conclusion

Overall, our findings strongly support the proposition that pro-environmental behaviour (PEB) is connected to subjective wellbeing, across cultural contexts. We do not find evidence for individual differences affecting the strength of association between PEB and wellbeing, however we do observe some cross-national differences. In line with our predictions, we obtain evidence to support the notion that public sphere PEB is more closely aligned with wellbeing in collectivistic cultures. Unexpectedly, our analyses suggest that PEB and wellbeing are related in an especially pronounced manner in China and India; however, this finding was not predicted and should be interpreted with caution.

The present study provides further evidence for the connection between PEB and wellbeing, and should prompt debate about the co-benefits of action on the environment across diverse contexts. Whilst behaviour that protects the environment may require effort, and at times personal investment of time or money, it is clear that it is associated with personal benefits as well as benefits to the immediate and global environment. Policy interventions and campaigns designed to promote pro-environmental behaviour would do well to stress the value of action for both people and planet.

5. References

Aknin, L., Barrington-Leigh, C., Dunn, E., et al. (2013). Prosocial spending and well-being: Cross-cultural evidence for a psychological universal. *Journal of Personality and Social Psychology*, *104*(4), 635.

Bain, P., Milfont, T., Kashima, Y. et al. (2016). Co-benefits of addressing climate change can motivate action around the world. *Nature Climate Change*, *6*(2), 154.

Binder, M., Blankenberg, A. K., & Guardiola, J. (2020). Does it have to be a sacrifice? Different notions of the good life, pro-environmental behavior and their heterogeneous impact on well-being. *Ecological Economics*, *167*, 106448.

Blankenberg, A. and Alhusen, H. (2019). *On the determinants of pro-environmental behavior: A literature review and guide for the empirical economist*, cege Discussion Papers, No. 350, University of Göttingen, Center for European, Governance and Economic Development Research (cege), Göttingen.

Capstick, S. (2013). Public understanding of climate change as a social dilemma. *Sustainability*, *5*(8), 3484-3501.

Capstick, S., Lorenzoni, I., Corner, A., & Whitmarsh, L. (2014). Prospects for radical emissions reduction through behavior and lifestyle change. *Carbon Management*, *5*(4), 429-445.

Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N., & Upham, P. (2015). International trends in public perceptions of climate change over the past quarter century. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(1), 35-61.

Coelho, F., Pereira, M. C., Cruz, L., Simões, P., & Barata, E. (2017). Affect and the adoption of pro-environmental behaviour. *Journal of Environmental Psychology*, 54, 127-138.

Cummins, R. A. (2012). Cultural response bias. *The Encyclopedia of Cross-Cultural Psychology*, 330-333.

Cummins, R. A., Mellor, D., Stokes, M., & Lau, A. (2010). Measures of subjective wellbeing. *Rehabilitation and health assessment: Applying ICF guidelines*, 409-426.

De Groot, J. I., & Steg, L. (2008). Value orientations to explain beliefs related to environmental significant behavior: How to measure egoistic, altruistic, and biospheric value orientations. *Environment and Behavior*, *40*(3), 330-354.

Dermody, J., Hanmer-Lloyd, S., Koenig-Lewis, N., & Zhao, A. (2015). Advancing sustainable consumption in the UK and China: the mediating effect of pro-environmental self-identity. *Journal of Marketing Management*, *31*(13-14), 1472-1502.

Diener, E., Oishi, S., & Lucas, R. (2003). Personality, culture, and subjective well-being: Emotional and cognitive evaluations of life. *Annual review of psychology*, *54*(1), 403-425.

Diener E. (2006). Guidelines for national indicators of subjective well-being and ill-being. *Journal of Happiness Studies* 7(4):397-404.

Diener E, Wirtz D, Tov W, Kim-Prieto C, Choi D, Oishi S, Biswas-Diener R. (2010). New well-being measures: short scales to assess flourishing and positive and negative feelings. *Social Indicators Research* 97(2):143-156.

Diener, E., Lucas, R., & Oishi, S. (2018). Advances and open questions in the science of subjective well-being. *Collabra: Psychology*, *4*(1).

Dietz, T., Rosa, E. A., & York, R. (2009). Environmentally efficient well-being: rethinking sustainability as the relationship between human well-being and environmental impacts. *Human Ecology Review*, 114-123.

Dittmar, H., Bond, R., Hurst, M., & Kasser, T. (2014). The relationship between materialism and personal well-being: A meta-analysis. *Journal of personality and social psychology*, *107*(5), 879-924.

Dunlap, R. E., & York, R. (2008). The globalization of environmental concern and the limits of the postmaterialist values explanation: Evidence from four multinational surveys. *The Sociological Quarterly*, *49*(3), 529-563.

Elphinstone, B., & Critchley, C. (2016). Does the way you think and look at the world contribute to being materialistic? Epistemic style, metaphysics, and their influence on materialism and wellbeing. *Personality and individual differences*, *97*, 67-75.

Eom, K., Kim, H. S., Sherman, D. K., & Ishii, K. (2016). Cultural variability in the link between environmental concern and support for environmental action. *Psychological Science*, *27*(10), 1331–1339.

Ferssizidis, P., Adams, L. M., Kashdan, T. B., Plummer, C., Mishra, A., & Ciarrochi, J. (2010). Motivation for and commitment to social values: The roles of age and gender. *Motivation and Emotion*, *34*(4), 354-362.

Fischer, R., & Poortinga, Y. (2018). Addressing methodological challenges in culture-comparative research. *Journal of Cross-Cultural Research, 49.*

Fischer, R., & Boer, D. (2016). Values: the dynamic nexus between biology, ecology and culture. *Current Opinion in Psychology*, 8, 155-160.

Fischer, R. & Fontaine, J. (2011). Method for investigating structural equivalence. In D. Matsumoto and F. van de Vijver (Eds.), *Cross-cultural research methods in Psychology*. Cambridge, UK.

Fiske, A. P. (2002). Using individualism and collectivism to compare cultures – a critique of the validity and measurement of the constructs. *Psychological Bulletin*, 128, 78e88.

Ford, B., Dmitrieva, J., Heller, D., et al. (2015). Culture shapes whether the pursuit of happiness predicts higher or lower well-being. *Journal of Experimental Psychology: General*, *144*(6), 1053.

Hayes-Conroy, J., & Hayes-Conroy, A. (2013). Veggies and visceralities: A political ecology of food and feeling. *Emotion, Space and Society*, *6*, 81-90.

Hicks, S., Tinkler, L., & Allin, P. (2013). Measuring subjective well-being and its potential role in policy: Perspectives from the UK office for national statistics. *Social Indicators Research*, *114*(1), 73-86.

Hofstede, G. (1980). Culture and organizations. *International Studies of Management & Organization*, *10*(4), 15-41.

Hofstede, G. (2011). Dimensionalizing cultures: The Hofstede model in context. *Online readings in psychology and culture*, *2*(1), 8.

Hurst, M., Dittmar, H., Bond, R., Kasser, T. (2013). The relationship between materialistic values and environmental attitudes and behaviors: a meta-analysis. *Journal of Environmental Psychology, 36*, 257–269.

Jackson, T. (2005). Live better by consuming less?: is there a "double dividend" in sustainable consumption?. *Journal of Industrial Ecology*, *9*(1-2), 19-36.

Jebb, A., Tay, L., Diener, E., & Oishi, S. (2017). Happiness, income satiation and turning points around the world. *Nature Human Behaviour*, *2*(1), 33.

Karlsson, M., Alfredsson, E., & Westling, N. (2020). Climate policy co-benefits: a review. *Climate Policy*, *20*(3), 292-316.

Kasser, T. (2002). *The High Price of Materialism*, Cambridge MA: MIT Press

Kasser, T. (2011). Cultural values and the well-being of future generations: A cross-national study.

Journal of Cross-cultural Psychology, 42, 206-215.

Kasser, T. (2017). Living both well and sustainably: a review of the literature, with some reflections on future research, interventions and policy. *Phil. Trans. R. Soc. A*, *375*(2095), 20160369.

Kasser, T. (2019). An overview of the Aspiration Index. Unpublished manuscript, Knox College, Galesburg, Illinois, USA. https://474a02bb-de49-4063-9137-1dfe7d1ff49e.filesusr.com/ugd/4b0efd_8133854a74934fdabf7a8c5ccb733ea3.pdf

Kasser, T., & Ryan, R. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and social psychology bulletin*, *22*(3), 280-287.

Lamb, W. F., & Steinberger, J. K. (2017). Human well-being and climate change mitigation. *Wiley Interdisciplinary Reviews: Climate Change*, *8*(6), e485.

Layard, R., Mayraz, G., & Nickell, S. (2008). The marginal utility of income. *Journal of Public Economics*, *92*(8-9), 1846-1857.

Laffan, K. (2020). Green with satisfaction: the relationship between pro-environmental behaviours and subjective wellbeing. In *Handbook on Wellbeing, Happiness and the Environment*. Edward Elgar Publishing.

Liu, M., Huang, Y., Hiscock, R., Li, Q., Bi, J., Kinney, P. L., & Sabel, C. E. (2016). Do climate change policies promote or conflict with subjective wellbeing: A case study of Suzhou, China. *International Journal of Environmental Research and Public Health*, 13(3), 344.

Longhi, S. (2013). *Individual pro-environmental behaviour in the household context*. Technical report, ISER Working Paper Series.

Lucas, R., & Schimmack, U. (2009). Income and well-being: How big is the gap between the rich and the poor? *Journal of Research in Personality*, 43(1), 75–78.

Medvedev, O. N., & Landhuis, C. E. (2018). Exploring constructs of well-being, happiness and quality of life. *PeerJ*, *6*, e4903.

Milfont, T., & Markowitz, E. (2016). Sustainable consumer behavior: A multilevel perspective. *Current Opinion in Psychology, 10*, 112-117.

Minkov, M., Dutt, P., Schachner, M., et al. (2017). A revision of Hofstede's individualism-collectivism dimension: A new national index from a 56-country study. *Cross Cultural & Strategic Management*, 24(3), 386-404.

Nalipay, M. J. N., King, R. B., & Cai, Y. (2020). Autonomy is equally important across East and West: Testing the cross-cultural universality of self-determination theory. *Journal of Adolescence*, *78*, 67-72.

Nesom, S., & MacKillop, E. (2020). What matters in the implementation of sustainable development policies? Findings from the Well-Being of Future Generations (Wales) Act, 2015. *Journal of Environmental Policy & Planning*, *23*(4), 432-445.

Oishi, S., Diener, E., Lucas, R., & Suh, E. (1999). Cross-cultural variations in predictors of life satisfaction: Perspectives from needs and values. *Personality and social psychology bulletin*, *25*(8), 980-990.

Oreg, S., & Katz-Gerro, T. (2006). Predicting proenvironmental behavior cross-nationally: Values, the theory of planned behavior, and value-belief-norm theory. *Environment and Behavior*, 38(4), 462-483.

Pagiaslis, A., & Krontalis, A. (2014). Green consumption behavior antecedents: Environmental concern, knowledge, and beliefs. *Psychology & Marketing*, *31*(5), 335-348.

Patel, J., Modi, A., & Paul, J. (2017). Pro-environmental behavior and socio-demographic factors in an emerging market. *Asian Journal of Business Ethics*, *6*(2), 189-214.

Pavalache-Ilie, M., & Cazan, A. M. (2018). Personality correlates of pro-environmental attitudes. *International journal of environmental health research*, *28*(1), 71-78.

Pelletier, L. G., Tuson, K. M., Green-Demers, I., Noels, K., & Beaton, A. M. (1998). Why are you doing things for the environment? The motivation toward the environment scale (mtes) 1. *Journal of applied social psychology*, *28*(5), 437-468.

Prinzing, M. (2020). Going green is good for you: Why we need to change the way we think about pro-environmental behavior. *Ethics, Policy & Environment*.

Punzo, G., Panarello, D., Pagliuca, M. M., Castellano, R., & Aprile, M. C. (2019). Assessing the role of perceived values and felt responsibility on pro-environmental behaviours: A comparison across four EU countries. *Environmental Science & Policy*, *101*, 311-322.

Richins, M. (2004). The material values scale: Measurement properties and development of a short form. *Journal of consumer Research*, *31*(1), 209-219.

Robinson, J. M., & Breed, M. F. (2019). Green prescriptions and their co-benefits: Integrative strategies for public and environmental health. *Challenges*, *10*(1), 9.

Sandy, C., Gosling, S., Schwartz, S., & Koelkebeck, T. (2017). The development and validation of brief and ultrabrief measures of values. *Journal of personality assessment*, *99*(5), 545-555.

Schmitt, M.T., Aknin, L.B., Axsen, J. and R.L. Shwom (2018), 'Unpacking the relationships between pro-environmental behavior, life satisfaction, and perceived ecological threat', *Ecological Economics*, 143, 130–140.

Schwartz, S. (1992). Universals in the content and structure of values: Theoretical advantages and empirical tests in 20 countries. In M. P. Zanna (Ed.), Advances in experimental and social psychology (Vol. 25, pp. 1–65). New York, NY: Academic Press.

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values?. *Journal of social issues*, *50*(4), 19-45.

Schwartz, S. (2003). A proposal for measuring value orientations across nations. In: Questionnaire development report of the European Social Survey (pp. 259–319).

Schwartz, S. (2006). A theory of cultural value orientations: Explication and applications. *Comparative sociology*, 5(2), 137-182.

Simmons, J., Nelson, L., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological science*, *22*(11), 1359-1366.

Sortheix, F., & Schwartz, S. (2017). Values that underlie and undermine well-being: Variability across countries. *European Journal of Personality*, *31*(2), 187-201.

Steel, S., Schmidt, J., & Shultz, J. (2008). Refining the relationship between personality and subjective well-being. *Psychological Bulletin, 134*, 138–161.

Stern, P. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of social issues*, *56*(3), 407-424.

Tam, K. P., & Chan, H. W. (2017). Environmental concern has a weaker association with pro-environmental behavior in some societies than others: A cross-cultural psychology perspective. *Journal of Environmental Psychology*, 53, 213-223.Tay, L., & Diener, E. (2011). Needs and subjective well-being around the world. *Journal of Personality and Social Psychology*, 101, 354–365.

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

Tranter, B., Lester, L., & McGaurr, L. (2017). Who Cares About Climate Change?. In *Leadership and the Construction of Environmental Concern* (pp. 29-51). Palgrave Macmillan, London.

Ugulu, I., Sahin, M., & Baslar, S. (2013). High school students' environmental attitude: Scale development and validation. *International Journal of Educational Sciences*, *5*(4), 415-424.

United Nations Development Programme (UNDP) (2017). *Global Human Development Indicators.* http://hdr.undp.org/en/countries

United Nations Environment Program (UNEP) (2020). Bridging the Gap: the Role of Equitable Low-carbon Lifestyles-Emissions. Chapter 6, *Emissions Gap Report 2020*.

van der Linden, S. (2018). Warm glow is associated with low-but not high-cost sustainable behaviour. *Nature Sustainability*, *1*(1), 28.

Van de Vijver, F., & Leung, K. (2011). Equivalence and bias: A review of concepts, models, and data analytic procedures. In D. Matsumoto & J.R. van de Vijver (Eds.), *Cross-cultural methods in Psychology*. Cambridge University Press.

Veage, S., Ciarrochi, J., Deane, F. P., Andresen, R., Oades, L. G., & Crowe, T. P. (2014). Value congruence, importance and success and in the workplace: Links with well-being and burnout amongst mental health practitioners. *Journal of Contextual Behavioral Science*, *3*(4), 258-264.

Webb D, Soutar GN, Mazzarol T, Saldaris P. 2013 Self-determination theory and consumer behavioural change: evidence from a household energy-saving behaviour study. *J. Environ. Psychol.* **35**, 59–66.

Welsch H., & Kuhling J. (2010). Pro-environmental behavior and rational consumer choice: evidence from surveys of life satisfaction. *Journal of Economic Psychology*, *31*(3), 405–420.

Welsh Government (2020). *The Future Generations Report 2020*. Welsh Government and Future Generations Commissioner for Wales. https://www.futuregenerations.wales/wp-content/uploads/2020/05/FGC-Report-English.pdf

Whitmarsh, L., Capstick, S., & Nash, N. (2017). Who is reducing their material consumption and why? A cross-cultural analysis of dematerialization behaviours. *Phil. Trans. R. Soc. A*, *375*(2095), 20160376.

Wicherts, J., Veldkamp, C., Augusteijn, H., et al. (2016). Degrees of freedom in planning, running, analyzing, and reporting psychological studies: A checklist to avoid p-hacking. *Frontiers in Psychology*, *7*, 1832.

Wing-Hung Lo, C., & Tang, S. Y. (2006). Institutional reform, economic changes, and local environmental management in China: The case of Guangdong Province. *Environmental Politics*, *15*(02), 190-210.

Xiao, J., & Li, H. (2011). Sustainable consumption and life satisfaction. *Social indicators research*, *104*(2), 323-329.

Xue, W., Hine, D., Marks, A., Phillips, W., & Zhao, S. (2016). Cultural worldviews and climate change: A view from China. *Asian Journal of Social Psychology, 19*(2), 134-144.

Zawadzki, S. J., Steg, L., & Bouman, T. (2020). Meta-analytic evidence for a robust and positive association between individuals' pro-environmental behaviors and their subjective wellbeing. *Environmental Research Letters*.

SUPPLEMENTAL INFORMATION

Appendix A – preregistered analysis

The following material was preregistered prior to data analysis. Sections of this pre-planned analysis are not reported in the main paper – and are noted in that regard – however we include all proposed hypotheses and analytic approaches for transparency and completeness.

The connection between subjective wellbeing and pro-environmental behaviour: individual and cross-national characteristics in a seven-country study

[authors anonymised for review]

Abstract

A positive and reciprocal relationship between pro-environmental behaviour (PEB) and personal wellbeing is well-established and has been demonstrated to exist within several nations. There is good reason however to think that the nature of the PEB-wellbeing link might vary cross-culturally and between individuals. First, it has been argued that environmental concern and action is principally the preserve of individuals and nations whose more essential needs, such as employment and healthcare, have been met. In relation to this, the proposed research will test what we term a 'privilege' hypothesis, that the PEB-wellbeing link varies by country-level economic development, and in relation to individual-level income. Second, we consider the role of individual values and goals as an influence on PEB and wellbeing. Whereas several studies have shown that these individual-level factors are important separately for PEB and wellbeing, the proposed research will assess the extent to which they are also relevant for the connection between them. To this end, we propose testing an 'enhancement' hypothesis, in which the PEB-wellbeing link is moderated by values and goals. Third, we consider the role of cultural differences for the nature of the PEB-wellbeing link. We test what we term the 'social green' hypothesis that public-sphere behaviours (e.g. encouraging others to save energy) are more closely linked to wellbeing in more collectivist versus individualistic cultures; in tandem, we also assess whether private-sphere behaviours (e.g. product purchasing) are more closely linked to wellbeing in more individualistic cultures. We will use primary data obtained in Brazil, China, Denmark, India, Poland, South Africa, and the UK during 2016-2017 (n=1,000 X 7) and test hypotheses using a series of regression models, as detailed in the Methods section.

Our hypotheses are as follows:

[Note that hypothesis numbering in the preregistered analysis does not correspond to that reported in the submitted paper.]

1. There will be a positive relationship between PEB and wellbeing across countries.
2. The relationship between PEB and wellbeing will be stronger for high-income versus low-income individuals, and in more developed versus less developed nations.

3. There will be a relationship between PEB and values (negative: materialism, positive: self-transcendent values), and a positive relationship between PEB and intrinsic goals (aspirations) across countries. [not assessed in submitted paper]
4. The relationship between PEB and values will be stronger in more developed versus less developed nations, and for those with higher versus lower incomes. [not assessed in submitted paper]
5. The relationship between PEB and wellbeing will be stronger for individuals with more intrinsic aspirations and self-transcendent values, and weaker for those with more materialistic values.
6. The relationship between PEB and wellbeing is stronger for public sphere PEBs than for private sphere PEBs, in more collectivistic cultures. The relationship between PEB and wellbeing is stronger for private sphere PEBs than for public sphere PEBs, in more individualistic cultures.

Contributions of Authors

Co-ordinated project: [anonymised]

Developed materials: [anonymised]

Analysed data: [anonymised] in consultation with [anonymised]

Note: The proposed hypotheses and analyses have not been examined prior to the pre-registration. Previous preliminary analyses have identified the distributional properties, and latent construct (factor) properties, of self-reported PEBs for two of the seven countries (UK and Brazil). Previous preliminary analyses have also identified the direct relationship between PEB and wellbeing for two of the seven countries (UK and Brazil).

[anonymised] has not previously had access to the dataset and will lead the analyses independently, but will consult with the other authors during the data analysis phase.

Will write report: all

Methods

Dataset

The dataset to be used was obtained as part of the Low-Carbon Lifestyles and Behavioural Spillover (CASPI) project between 2016-2017. Members of the public were surveyed in each of seven countries, to be broadly representative in terms of age, gender, and income in each location. The countries surveyed were Brazil, China, Denmark, India, Poland, South Africa, and the UK. The sample size for each country is approx. 1,000. Participants were sampled using panel databases, and completed the survey online.

The measures to be used, or considered for use, are detailed in Table S1 together with dataset codes. They are described in more detail below.

The dataset containing variables used in the analysis will be deposited with OSF by the end of 2018.

<u>Variables</u>

Selection of PEBs – see Table S1, items/measures 1 to 23

We propose the creation of an index of PEB incidence, this being the self-reported frequency of taking action. The PEB index will comprise seven items, which we anticipate to have means close to scale mid-points, with similar distributional properties across the sampled countries, to be transferable across cultures, to reflect pro-environmental intentions, and to incorporate both private and public sphere action. Items will be selected from the PEB_engagement items 1-20 as shown in Table S1.

The final selection of PEBs for the full PEB index will be carried out and finalised before hypothesis testing is undertaken, and will be based in part on comparison of distributional properties across countries. The criteria used to select the choice of four PEBs for the index is as follows; these steps are taken in order:

a. A shortlist of PEBs is assembled, which are applicable across each country surveyed. The first aspect of this is to ensure that the same items were asked in all countries; in particular, for the China survey, some items were modified for ethical or practical reasons (e.g. where respondents were asked about 'voting'). The second aspect of this is to ensure that items are transferable across contexts (i.e. not having a different meaning in different locations) and reflect pro-environmental intentions or motivations. This second consideration is carried out through discussion between authors;
b. From the PEB shortlist, a subset of 'public sphere' PEBs and a separate subset of 'private sphere' PEBs is assembled;
c. Three public sphere and four private sphere PEB items are selected to form the 7-item PEB index; this reflects the ratio of public : private PEBs in the full list of PEBs. The criteria for selection of these PEBs are as follows:
    - Item mean score to be relatively close to the scale mid-point, compared to other items (private or public sphere, as applicable) in the subset; NB skewness of many items means that there are floor and ceiling effects in the data. Mean scores are compared across the seven countries to judge this criterion.
    - Item skewness to be relatively close to zero, compared to other items (private or public sphere, as applicable) in the subset. Skewness scores are compared across the seven countries to judge this criterion.
d. Item scores will be summed for all respondents for each of the four items (as selected in step c) to form a PEB index. The 7-item PEB index [PEB_index] will be used in H1-H5. A separate 3-item public sphere measure [Public_PEB], and 4-item private sphere measure [Private_PEB], will be assembled for use in H6.

The internal consistency (Cronbach's alpha) will be assessed for the 7-item scale. If the alpha score demonstrates poor reliability (<.6 for a majority of countries) then we retain the option to remove one item from the scale to enhance its reliability. If reliability is still low, we will use private and public sphere scales separately for all analyses.

Wellbeing measures – see Table S1, items 24-26

We propose to use two items, each designed to assess a dimension of wellbeing, the former intended to measure eudaimonic wellbeing, the latter evaluative wellbeing; participants indicate a rating on a 1-11 scale:

- Overall, to what extent do you feel the things you do in your life are worthwhile? [Life_worthwhile]
- Overall, how satisfied are you with life as a whole these days? [Life_satisfaction]

In anticipation that these are likely to be highly correlated, for the purposes of the proposed analysis we expect to combine these items to form a two-item wellbeing measure [Wellbeing]. If the items are not highly correlated (r<.5) in a majority of countries, we will use the eudaimonic measure only.

Values – see Table S1, items 27 to 39

We propose to use a four-item measure based on Schwartz's Portrait Values survey, relating to Universalism and Benevolence; participants indicate the extent to which they consider they themselves relate to the depictions presented:

- It is important to her [/him/this person] to do something for the good of society [PVQ_M_univer1 / PVQ_F_univer1 / PVQ_N_univer1]
- It is important to her [/him/this person] to help other people nearby; to care for their well-being [PVQ_M_benev / PVQ_F_benev / PVQ_N_benev]
- Looking after the environment is important to her [/him/this person]; to care for nature and save resources [PVQ_M_univer2 / PVQ_F_univer2 / PVQ_N_univer2]
- It is important to her [/him/this person] to prevent pollution; to take care of the environment around her [/him/them] [PVQ_M_univer3 / PVQ_F_univer3 / PVQ_N_univer3]

Scores for each variable will be used to produce a four-item scale. We will follow the recommended procedure to do this. This entails obtaining the mean of the value items of interest (items 27-30), which is then mean-centred in relation to the mean of all value items (items 27-38): see https://www.europeansocialsurvey.org/docs/methodology/ESS1_human_values_scale.pdf

The derived scale to be used will be [ST_values].

Intrinsic goals [motivations] – see Table S1, items 40 to 52

We propose to use the six-item intrinsic goals scale of the Aspiration Index, derived from Kasser and Ryan (1996); participants indicate the extent to which they consider each of these to be important to them in the future:

- You will donate time or money to charity [Aspiration_intrinsic_1]
- You will work to make the world a better place [Aspiration_intrinsic_2]
- You will help others improve their lives [Aspiration_intrinsic_3]
- You will have good friends that you can count on [Aspiration_intrinsic_4]
- You will have people who care about you and are supportive [Aspiration_intrinsic_5]
- You will have good friends that you can talk to about personal things [Aspiration_intrinsic_6]
- You will have a job that pays well [Aspiration_extrinsic_1]
- You will have a job with high social status [Aspiration_extrinsic_2]
- You will be financially successful [Aspiration_extrinsic_3]
- Your name will be known by many people [Aspiration_extrinsic_4]
- You will be admired by many people [Aspiration_extrinsic_5]
- You will do something that brings you much recognition [Aspiration_extrinsic_6]

Scores for each variable will be used to produce a six-item scale. We will use mean-centred values for the Aspiration Index. This entails obtaining the mean of the aspiration items of interest (intrinsic goals:

items 40-45), which is then mean-centred in relation to the mean of all aspiration items (intrinsic and extrinsic goals: items 40-51). The derived scale to be used will be [Intrinsic_goals].

We will also consider the internal consistency (Cronbach's alpha) of the 6-item intrinsic goals items. If the alpha score demonstrates poor reliability (<.6 for a majority of countries) then we retain the option to remove one item from the scale to enhance its reliability. If reliability is still low, we retain the option to use a single item ('you will work to make the world a better place…') to represent intrinsic aspiration.

Materialistic values – see Table S1, items 53-56

We propose to use a three-item measure based on Richin's (2004) material values scale; participants indicate the extent to which they agree or disagree with the following statements:

- I admire people who own expensive homes, cars, and clothes [Material_value_1]
- The things I own say a lot about how well I'm doing in life [Material_value_2]
- I like to own things that impress people [Material_value_3]

Scores for each value will be summed to produce a three-item scale [Material_values]

The internal consistency (Cronbach's alpha) will be assessed for the 3-item scale. If the alpha score demonstrates poor reliability (<.6 for a majority of countries) then we retain the option to remove one item from the scale to enhance its reliability. If reliability is still low, we will use a single item ('the things I own…') to represent materialistic values.

Hypothesis testing and statistical analyses

For H1, we propose carrying out the following analyses:

Linear Regression of **wellbeing** on the full **PEB index**, carried out separately for each country

- This analysis predicts a significant positive relationship between PEB and wellbeing
- Measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable; we will carry out these regressions initially with no control variables, and subsequently including income as an additional predictor (control) variable [Income]
- The hypothesis will be confirmed if there is a significant positive relationship between PEB and wellbeing in at least three of seven countries, for either or both regression types (with or without income as a control variable)
- We also consider Beta values and R^2 as indicators of the strength of the relationship between wellbeing and PEB.

For H2, we propose carrying out the following analyses:

a) Linear regression of **wellbeing** on the full **PEB index**, with **individual-level income** included as a moderator variable; this analysis will be carried out separately for each country.

- This analysis predicts a significant positive relationship between PEB and wellbeing (as per H1), and a significant positive moderation effect of income, across the sampled countries.
- The regression will be carried out in two stages:
    - In stage (1) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable
    - In stage (2) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [PEB_index] X [Income]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

b) Regression of **wellbeing** on the full **PEB index**, compared by **country rank-ordered** by the UN human development index (UNHDI).

- This analysis predicts a stronger relationship between PEB and wellbeing for countries ranked higher on the UNHDI, than those ranked lower on the UNHDI.
- Measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable; in addition, we control for individual-level income [Income]
- Unstandardised predictor coefficients for measure [PEB_index], together with their standard errors, will be compared by country.
- The hypothesis will be confirmed if the two countries highest-ranked on the UNHDI (UK and Denmark) have confidence intervals (coefficient value +/- 1.96 S.E., i.e. 95% C.I.) that are higher, and fall outside the confidence intervals of the two countries lowest-ranked on the UNHDI (South Africa and India)

For H3, we propose carrying out the following analyses:

a) [This analysis is not reported in the submitted paper, but is included for transparency.] Linear regression of the **PEB index** on **self-transcendent values**, carried out separately for each country

- This analysis predicts a significant positive relationship between PEB and self-transcendent values
- Measure [PEB_index] will be treated as the outcome variable; measure [ST_values] will be treated as the independent variable; we also control for individual-level income [Income]
- The hypothesis will be confirmed if there is a significant positive relationship between PEB and self-transcendent values in at least three of seven countries
- We also consider Beta values and R^2 as indicators of the strength of the relationship between PEB and values.

b) [This analysis is not reported in the submitted paper, but is included for transparency.] Linear regression of the **PEB index** on **materialistic values**, carried out separately for each country

- This analysis predicts a significant negative relationship between PEB and materialistic values
- Measure [PEB_index] will be treated as the outcome variable; measure [Material_values] will be treated as the independent variable; we also control for individual-level income [Income]
- The hypothesis will be confirmed if there is a significant negative relationship between PEB and materialistic values in at least three of seven countries
- We also consider Beta values and R^2 as indicators of the strength of the relationship between PEB and values.

c) [This analysis is not reported in the submitted paper, but is included for transparency.] Linear regression of the **PEB index** on **intrinsic goals**, carried out separately for each country

- This analysis predicts a significant positive relationship between PEB and intrinsic goals
- Measure [PEB_index] will be treated as the outcome variable; Measure [Intrinsic_goals] will be treated as the independent variable; we also control for individual-level income [Income]
- The hypothesis will be confirmed if there is a significant positive relationship between PEB and intrinsic goals in at least three of seven countries
- We also consider Beta values and R^2 as indicators of the strength of the relationship between PEB and intrinsic goals.

For H4, we propose carrying out the following analyses:

a) [This analysis is not reported in the submitted paper, but is included for transparency.] Linear regression of the **PEB index** on **self-transcendent values** moderated by **individual income**, carried out separately for each country

- This analysis predicts a significant positive moderation effect of income on the relationship between PEB and self-transcendent values
- The regression will be carried out using two stages:
    - In stage (1) measure [PEB_index] will be treated as the outcome variable; measure [ST_values] will be treated as the independent variable; we do not include any control variables
    - In stage (2) measure [PEB_index] will be treated as the outcome variable; measure [ST_values] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [ST_values] X [Income]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

b) Linear regression of the full **PEB index** on **self-transcendent values**, compared by **country rank-ordered** by the UN human development index (UNHDI). [This analysis is not reported in the submitted paper, but is included for transparency.]

- This analysis predicts a stronger positive relationship between PEB and self-transcendent values for countries ranked higher on the UNHDI, than those ranked lower on the UNHDI.
- Measure [PEB_index] will be treated as the outcome variable; measure [ST_values] will be treated as the independent variable; in addition, we control for individual-level income [Income]
- Unstandardised predictor coefficients for measure [ST_values], together with their standard errors, will be compared by country.
- The hypothesis will be confirmed if the two countries highest-ranked on the UNHDI (UK and Denmark) have confidence intervals (coefficient value +/- 1.96 S.E., i.e. 95% C.I.) that are higher, and fall outside the confidence intervals of the two countries lowest-ranked on the UNHDI (South Africa and India)

c) Linear regression of the **PEB index** on **materialistic values** moderated by **individual income**, carried out separately for each country
[This analysis is not reported in the submitted paper, but is included for transparency.]

- This analysis predicts a significant negative moderation effect of income on the relationship between PEB and materialistic values
- The regression will be carried out using two stages:
    - In stage (1) measure [PEB_index] will be treated as the outcome variable; measure [Material_values] will be treated as the independent variable; we do not include any control variables
    - In stage (2) measure [PEB_index] will be treated as the outcome variable; measure [Material_values] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [Material_values] X [Income]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

d) Linear regression of the full **PEB index** on **materialistic values**, **compared by country rank-ordered** by the UN human development index (UNHDI).
[This analysis is not reported in the submitted paper, but is included for transparency.]

- This analysis predicts a stronger negative relationship between PEB and materialistic values for countries ranked higher on the UNHDI, than those ranked lower on the UNHDI.
- Measure [PEB_index] will be treated as the outcome variable, measure [Material_values] will be treated as the independent variable; in addition, we control for individual-level income [Income]
- Unstandardised predictor coefficients for measure [Material_values], together with their standard errors, will be compared by country.
- The hypothesis will be confirmed if the two countries highest-ranked on the UNHDI (UK and Denmark) have confidence intervals (coefficient value +/- 1.96 S.E., i.e. 95% C.I.) that are lower, and fall outside the confidence intervals of the two countries lowest-ranked on the UNHDI (South Africa and India)

e) Linear regression of the **PEB index** on **intrinsic goals** moderated by **individual income**, carried out separately for each country
[This analysis is not reported in the submitted paper, but is included for transparency.]

- This analysis predicts a significant positive moderation effect of income on the relationship between PEB and intrinsic goals
- The regression will be carried out using two stages:
    - In stage (1) measure [PEB_index] will be treated as the outcome variable; measure [Intrinsic_goals] will be treated as the independent variable; we do not include any control variables
    - In stage (2) measure [PEB_index] will be treated as the outcome variable; measure [Intrinsic_goals] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [Intrinsic_goals] X [Income]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

f) Linear regression of the full **PEB index** on **intrinsic goals**, compared by **country rank-ordered** by the UN human development index (UNHDI).
[This analysis is not reported in the submitted paper, but is included for transparency.]

- This analysis predicts a stronger positive relationship between PEB and intrinsic goals for countries ranked higher on the UNHDI, than those ranked lower on the UNHDI.
- Measure [PEB_index] will be treated as the outcome variable; measure [Intrinsic_goals] will be treated as the independent variable; we also control for individual-level income [Income]
- Unstandardised predictor coefficients for measure [Intrinsic_goals], together with their standard errors, will be compared by country.
- The hypothesis will be confirmed if the two countries highest-ranked on the UNHDI (UK and Denmark) have confidence intervals (coefficient value +/- S.E.) that are higher, and fall outside the coefficient ranges of the two countries lowest-ranked on the UNHDI (South Africa and India)

For H5, we propose carrying out the following analyses:

a) Linear regression of **wellbeing** on the full **PEB index**, with **self-transcendent values** included as a moderator variable; this analysis will be carried out separately for each country.

- This analysis predicts a significant positive relationship between PEB and wellbeing (as per H1), and a significant positive moderation effect of self-transcendent values, across the sampled countries.
- The regression will be carried out using two stages:
    - In stage (1) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable; in addition, we include individual income as a predictor variable [Income]
    - In stage (2) measure [Wellbeing] will be treated as the outcome variable; measures [PEB_index], [ST_values] and item [Income] will be treated as independent variables;

we will additionally include an interaction term comprised of [PEB_index] X [ST_values]
    - The hypothesis will be confirmed if the interaction term is significant, in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

b) Linear regression of **wellbeing** on the full **PEB index**, with **intrinsic goals** included as a moderator variable; this analysis will be carried out separately for each country.

- This analysis predicts a significant positive relationship between PEB and wellbeing (as per H1), and a significant positive moderation effect of intrinsic goals, across the sampled countries.
- The regression will be carried out using two stages:
    - In stage (1) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable; in addition, we include individual income as a predictor variable [Income]
    - In stage (2) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index], [Intrinsic_goals] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [PEB_index] X [Intrinsic_goals]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

c) Linear regression of **wellbeing** on the full **PEB index**, with **materialistic values** included as a moderator variable; this analysis will be carried out separately for each country.

- This analysis predicts a significant positive relationship between PEB and wellbeing (as H1), and a significant negative moderation effect of materialistic values, across the sampled countries.
- The regression will be carried out using two stages:
    - In stage (1) measure [Wellbeing] will be treated as the outcome variable; measure [PEB_index] will be treated as the independent variable (as per H1); in addition, we include individual income as a predictor variable, item [Income]
    - In stage (2) measure [Wellbeing] will be treated as the outcome variable; measures [PEB_index], [Material_values] and item [Income] will be treated as independent variables; we will additionally include an interaction term comprised of [PEB_index] X [Material_values]
    - The hypothesis will be confirmed if the interaction term is significant in at least three of seven countries
    - We also consider Beta values and R^2 as indicators of the strength of these relationships

For H6, we propose carrying out the following analyses:

a) Linear regression of **wellbeing** on the **private sphere PEB measure** and the **public sphere PEB measure**, compared for strongly individualistic countries (based on Hofstede's classification).

- This analysis predicts that the relationship between PEB and wellbeing is stronger for private sphere PEBs than for public sphere PEBs, in more individualistic cultures;
- The regressions will be carried out as follows, for each country:
    - Measure [Wellbeing] will be treated as the outcome variable; measure [Public_PEB] and measure [Private_PEB] will be treated as the independent variables; in addition, we include individual income as a predictor variable, item [Income]
- Unstandardised predictor coefficients for measures [Public_PEB] and [Private_PEB], together with their standard errors, will be compared for each country.
- The hypothesis will be confirmed if the two countries highest-ranked for individualism (UK and Denmark) have coefficient ranges (coefficient value +/- S.E.) for the private sphere predictor measure [Private_PEB] that is higher, and falls outside the coefficient ranges for the public sphere predictor measure [Public_PEB]

b) Linear regression of **wellbeing** on the **private sphere PEB measure** and the **public sphere PEB** measure, compared for strongly collectivistic countries (based on Hofstede's classification).

- This analysis predicts that the relationship between PEB and wellbeing is stronger for public sphere PEBs than for private sphere PEBs, in more collectivistic cultures;
- The regressions will be carried out as follows, for each country:
    - Measure [Wellbeing] will be treated as the outcome variable; measure [Public_PEB] and measure [Private_PEB] will be treated as the independent variables; in addition, we include individual income as a predictor variable, item [Income]
- Unstandardised predictor coefficients for measures [Public_PEB] and [Private_PEB], together with their standard errors, will be compared for each country.
- The hypothesis will be confirmed if the two countries highest-ranked for collectivism (China and Brazil) have coefficient ranges (coefficient value +/- S.E.) for the public sphere predictor measure [Public_PEB] that is higher, and falls outside the coefficient ranges for the private sphere predictor measure [Private_PEB]

Introduction

The positive relationship between personal wellbeing and pro-environmental behaviour (PEB) is well-established (e.g., Brown & Kasser, 2005), and has been demonstrated to exist within several nations (e.g. Xiao & Lee, 2011). Although the direction of causation is not always clear within individual studies, multiple lines of evidence point to a reciprocal causal relationship between wellbeing and PEB (Kasser, 2017). In this paper, for the first time, we examine this relationship from a cross-cultural perspective, using primary data obtained from large-scale surveys carried out in seven culturally-diverse countries (Brazil, China, Denmark, India, Poland, South Africa, and the UK).

In doing so, we investigate the extent to which pro-environmental behaviour is linked to personal wellbeing, taking into account national and individual contexts. First, we consider the extent to which a PEB-wellbeing link is contingent upon the material circumstances (income) of individuals, and the level of development of sampled countries. At the country level, post-materialist values have been found to predict sustainable consumption (Milfont & Markowitz, 2016); while a separate, though complementary, literature points to a negative association between individual-level materialism and PEBs (Hurst, Dittmar, Bond & Kasser, 2013), and between materialism and wellbeing (Dittmar, Hurst, Bond & Kasser, 2014). Combining these insights, it may be argued that for those whose basic material needs are met, particularly in Western countries, there are parallel benefits both to personal wellbeing and a person's environmental impact to acting in a pro-environmental manner. However, in other contexts where material needs have not been fully met, this relationship may not hold in the same way.

Even where material conditions are found to be relevant to the link between PEB and wellbeing, we might still expect variability in relation to individuals' values and aspirations (cf. Kasser and Ryan, 1996): the relevance of PEB to wellbeing may be stronger for a low-paid individual who is passionate about improving the world, than for a highly-paid individual who has no interest in helping other people. We therefore set out to assess how individual values and aspirations are associated with PEB, in the context of individual material circumstances and the level of development of the sampled country. Our analyses then examine whether and how personal values and goals underpin the connection between PEB and wellbeing, across the sampled countries.

Finally, we consider whether and how cultural dimensions may underpin the PEB-wellbeing link. Some research suggests that the degree of individualism-collectivism of a culture affects the relationship between environmental concern and personal-level PEB (Eom, Kim, Sherman, & Ishii, 2016). Whereas in Western contexts individual-level action has been extensively promoted and reproduced by people (Fudge & Peters, 2011), collective responses may be emphasised or more openly accepted in other parts of the world (Xue, 2015; Whitmarsh et al., 2017). At the same time, public-sphere action has been linked to personal wellbeing (for example, through meeting needs for interactions with others; Kasser, 2009). Research has, however, yet to ascertain whether and how public- and private- sphere PEBs might relate to wellbeing in different cultural contexts. In the present study we assess whether the link between private sphere PEBs and wellbeing is stronger for relatively more individualistic cultures; we examine the opposite effect in the case of public sphere PEBs.

The present research uses data obtained from seven national-level surveys carried out by the paper authors between 2015 and 2017 (n~=7,000) in Africa (South Africa), South America (Brazil), Asia (China, India), and Europe (Denmark, Poland, UK). These countries were selected, in part, to reflect cross-national variability in the cultural value orientations framework of Schwartz (2006), as well as to elicit environmentally-significant perceptions and behaviours in important yet under-researched parts of the world. Surveys were designed in conjunction with local collaborators, and professionally translated with these versions again revisited with partners. Within resource limitations, we incorporated local language versions (e.g., Zulu and Afrikaans, as well as English, in the South African survey). Surveys were broadly representative by geographical location, age, gender, and income; as these were carried out online, this does however restrict our ability to draw inferences with respect to lower-income groups or those without internet access.

We obtained data on the following measures via the survey: subjective wellbeing (life satisfaction and wellbeing relative to others in society); personal values, based on Schwartz's framework; materialist values (Richins, 2004); intrinsic goals (Kasser & Ryan, 1996); and self-reported enactment of, 23 pro-environmental behaviours; as well as sociodemographic data, including income.

Our analyses first entail an assessment of the relative prevalence of PEBs across countries and exploration of measure equivalence of our constructs across cultural contexts. We next undertake a series of planned analyses using multiple linear regression, each with linked hypotheses. We consider

first the relationship between personal wellbeing and PEBs, hypothesising that PEB incidence is a stronger predictor of wellbeing in high-income (developed) countries and for higher-income individuals, relative to developing countries and lower-income individuals (this we term the 'privilege' hypothesis). We consider next the relationship between personal values, PEB and wellbeing across contexts. We hypothesise that personal values are a stronger predictor of PEBs in higher-income countries and for higher-income individuals, relative to lower-income countries and individuals (this we term the 'consolidation' hypothesis); in addition, we test whether the PEB-wellbeing link is moderated by individual values and goals, across countries. We consider next the relationship between personal wellbeing and private- versus public- sphere PEBs. We hypothesise that the relationship between wellbeing and public- (private-) sphere behaviour is stronger in collective-oriented (individualistic) societies.

At the time of writing, analyses designed to evaluate these hypotheses had not been be carried out in any form. Findings will be discussed in light of limitations of the methods used, including lack of objective behavioural measures, use of cross-sectional data, and under-representation of lower income groups. Implications for theory and practice will also be discussed.

References

Ariely, D., Bracha, A., & Meier, S. (2009). Doing good or doing well? Image motivation and monetary incentives in behaving prosocially. *American Economic Review*, *99*(1), 544-55.

Brown, K. W., & Kasser, T. (2005). Are psychological and ecological well-being compatible? The role of values, mindfulness, and lifestyle. *Social Indicators Research*, *74*(2), 349-368.

Boujbel, L., & d'Astous, A. (2012). Voluntary simplicity and life satisfaction: Exploring the mediating role of consumption desires. *Journal of Consumer Behaviour*, *11*(6), 487-494.

Carlisle, J., & Smith, E. R. (2005). Postmaterialism vs. egalitarianism as predictors of energy-related attitudes. *Environmental Politics*, *14*(4), 527-540.

Chung, S. S., & Poon, C. S. (2001). A comparison of waste-reduction practices and new environmental paradigm of rural and urban Chinese citizens. *Journal of Environmental Management*, *62*(1), 3-19.

Clark, C. F., Kotchen, M. J., & Moore, M. R. (2003). Internal and external influences on pro-environmental behavior: Participation in a green electricity program. *Journal of environmental psychology*, *23*(3), 237-246.

Dittmar, H., Bond, R., Hurst, M. & Kasser, T. (2014). The relationship between materialism and personal well-being: ameta-analysis*. Journal of Personality & Social Psychology, 107*, 879–924.

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

Fudge, S., & Peters, M. (2011). Behaviour change in the UK climate debate: an assessment of responsibility, agency and political dimensions. *Sustainability*, *3*(6), 789-808.

Hurst M, Dittmar H, Bond R, Kasser T. 2013 The relationship between materialistic values and environmental attitudes and behaviors: a meta-analysis. *Journal of Environmental Psychology, 36,* 257–269.

Kasser, T. (2017). Living both well and sustainably: a review of the literature, with some reflections on future research, interventions and policy. *Phil. Trans. R. Soc. A*, *375*(2095), 20160369.

Kasser, T. (2009). Psychological need satisfaction, personal well-being, and ecological sustainability. *Ecopsychology*, *1*(4), 175-180.

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. Personality and social psychology bulletin, 22(3), 280-287.

Milfont, T. L., & Markowitz, E. (2016). Sustainable consumer behavior: A multilevel perspective. *Current Opinion in Psychology*, *10*, 112-117.

Richins, M. L. (2004). The material values scale: Measurement properties and development of a short form. *Journal of Consumer Research*, *31*(1), 209-219.

Schwartz, S. H. (2006). A theory of cultural value orientations: Explication and applications. *Comparative sociology*, *5*(2), 137-182.

Thomas, C., & Sharp, V. (2013). Understanding the normalisation of recycling behaviour and its implications for other pro-environmental behaviours: A review of social norms and recycling. *Resources, Conservation and Recycling*, *79*, 11-20.

van der Linden, S. (2018). Warm glow is associated with low-but not high-cost sustainable behaviour. *Nature Sustainability*, *1*(1), 28.

Venhoeven, L. A., Bolderdijk, J. W., & Steg, L. (2013). Explaining the paradox: how pro-environmental behaviour can both thwart and foster well-being. *Sustainability*, *5*(4), 1372-1386.

Whitmarsh L, Capstick S, Nash N. (2017). Who is reducing their material consumption and why? A cross-cultural analysis of dematerialization behaviours. *Philosophical Transactions of the Royal Society A,* 20160376.

Xiao, J. J., & Li, H. (2011). Sustainable consumption and life satisfaction. *Social indicators research*, *104*(2), 323-329.

Xue, W., Hine, D. W., Marks, A. D., Phillips, W. J., & Zhao, S. (2016). Cultural worldviews and climate change: A view from China. *Asian Journal of Social Psychology*, *19*(2), 134-144.

Table S1 Items and measures

Item/ measure no.	*Code*	*Construct*	*Item wording / measure description*	*Response options*
1	PEB_engagement_1	Pro-environmental behaviour	Done something together with neighbours, people at work or friends to address an environmental issue	1=Not at all in the past year 2=About once in the past year 3=About 2 to 3 times in the past year 4=About 4 to 6 times in the past year 5=About once a month 6=About 2 to 3 times per month 7=About once a week 8=About 2 to 3 times per week 9=About 4 to 6 times per week 10=At least once a day
2	PEB_engagement_2	Pro-environmental behaviour	Eaten organic, locally-grown or in season food	As above
3	PEB_engagement_3	Pro-environmental behaviour	Encouraged other people to save energy	As above
4	PEB_engagement_4	Pro-environmental behaviour	Turned off lights when not in use	As above
5	PEB_engagement_5	Pro-environmental behaviour	Avoided eating meat	As above
6	PEB_engagement_6	Pro-environmental behaviour	Donated money to an environmental campaign group	As above
7	PEB_engagement_7	Pro-environmental behaviour	Bought products with less packaging	As above
8	PEB_engagement_8	Pro-environmental behaviour	Contacted a politician about an environmental issue	As above
9	PEB_engagement_9	Pro-environmental behaviour	Bought environmentally-friendly products	As above
10	PEB_engagement_10	Pro-environmental behaviour	Took part in a protest about an environmental issue	As above
11	PEB_engagement_11	Pro-environmental behaviour	Recycled household waste (e.g. glass, plastic, food waste)	As above
12	PEB_engagement_12	Pro-environmental behaviour	Taken short showers (less than 3 minutes long) or infrequent baths	As above
13	PEB_engagement_13	Pro-environmental behaviour	Signed a petition about an environmental issue	As above
14	PEB_engagement_14	Pro-environmental behaviour	Turned off the tap when brushing teeth	As above

15	PEB_engagement_15	Pro-environmental behaviour	Offered support (e.g. by voting) for political action to protect the environment	As above
16	PEB_engagement_16	Pro-environmental behaviour	Avoided wasting food (e.g. by using leftovers)	As above
17	PEB_engagement_17	Pro-environmental behaviour	Avoided buying new things (e.g. clothes, luxury items)	As above
18	PEB_engagement_18	Pro-environmental behaviour	Found out more about environmental issues (e.g. learning more about climate change)	As above
19	PEB_engagement_19	Pro-environmental behaviour	Avoided littering (throwing rubbish on the street)	As above
20	PEB_engagement_20	Pro-environmental behaviour	Got involved in conservation work to protect natural environments (e.g. national parks, coastline)	As above
21	**PEB_index**	Pro-environmental behaviour	Sum of four selected pro-environmental behaviours, as described in Methods	Sum of selected 7 items
22	**Public_PEB**	Pro-environmental behaviour	Sum of two selected public sphere pro-environmental behaviours, as described in Methods	Sum of selected 3 items
23	**Private_PEB**	Pro-environmental behaviour	Sum of two selected private sphere pro-environmental behaviours, as described in Methods	Sum of selected 4 items
24	Life_worthwhile	Eudaimonic wellbeing	Overall, to what extent do you feel the things you do in your life are worthwhile?	1-11 rating
25	Life_satisfaction	Evaluative wellbeing	Overall, how satisfied are you with life as a whole these days?	1-11 rating
26	**Wellbeing**	Wellbeing		Sum of Life_worthwhile and Life_satisfaction
27	PVQ_M_univer_1 (male respondents) PVQ_F_univer_1 (female respondents) PVQ_N_univer_1 (other-identifying respondents)	Self-transcendent value (universalism)	It is important to her to do something for the good of society (female version)	1=Not like me at all 2=A little like me 3=Not much like me 4=Somewhat like me 5=A lot like me 6=Very much like me
28	PVQ_M_benev (male respondents) PVQ_F_benev (female respondents) PVQ_N_benev (other-identifying respondents)	Self-transcendent value (benevolence)	It is important to her to help other people nearby; to care for their well-being (female version)	As above
29	PVQ_M_univer_2 (male respondents)	Self-transcendent	Looking after the environment is important	As above

	PVQ_F_univer_2 (female respondents) PVQ_N_univer_2 (other-identifying respondents)	value (universalism)	to her; to care for nature and save resources (female version)	
30	PVQ_M_univer_3 (male respondents) PVQ_F_univer_3 (female respondents) PVQ_N_univer_3 (other-identifying respondents)	Self-transcendent value (universalism)	It is important to her to prevent pollution; to take care of the environment around her (female version)	As above
31	PVQ_M_SelfDir (male respondents) PVQ_F_SelfDir (female respondents) PVQ_N_SelfDir (other-identifying respondents)	Self-direction	It is important to her to think up new ideas and be creative; to do things his own way (female version)	
32	PVQ_M_power (male respondents) PVQ_F_power (female respondents) PVQ_N_power (other-identifying respondents)	Power	It is important to her to be rich; to have a lot of money and expensive things (female version)	
33	PVQ_M_secure (male respondents) PVQ_F_secure (female respondents) PVQ_N_secure (other-identifying respondents)	Security	Living in secure surroundings is important to her; to avoid anything that might be dangerous (female version)	
34	PVQ_M_Hdonism (male respondents) PVQ_F_Hdonism (female respondents) PVQ_N_Hdonism (other-identifying respondents)	Hedonism	It is important to her to have a good time; to 'spoil' herself (female version)	
35	PVQ_M_achieve (male respondents) PVQ_F_achieve (female respondents) PVQ_N_achieve (other-identifying respondents)	Achievement	Being very successful is important to her; to have people recognise her achievements (female version)	
36	PVQ_M_stimulate (male respondents) PVQ_F_stimulate (female respondents) PVQ_N_stimulate (other-identifying respondents)	Stimulation	Adventure and taking risks are important to her; to have an exciting life (female version)	
37	PVQ_M_conform (male respondents)	Conformity	It is important to her to always behave properly; to	

	PVQ_F_conform (female respondents) PVQ_N_conform (other-identifying respondents)		avoid doing anything people would say is wrong	
38	PVQ_M_tradition (male respondents) PVQ_F_tradition (female respondents) PVQ_N_tradition (other-identifying respondents)	Tradition	Tradition is important to her; to follow the customs handed down by her religion or family	
39	**ST_values**	Self-transcendent values		Relative score on self-transcendent values; mean of items 27-30 mean-centred using mean of all PVQ (values) items
40	Aspiration_intrinsic_1	Intrinsic goals	You will donate time or money to charity	1=not at all important 2=slightly important 3=moderately important 4=very important 5=extremely important
41	Aspiration_intrinsic_2	Intrinsic goals	You will work to make the world a better place	As above
42	Aspiration_intrinsic_3	Intrinsic goals	You will help others improve their lives	As above
43	Aspiration_intrinsic_4	Intrinsic goals	You will have good friends that you can count on	As above
44	Aspiration_intrinsic_5	Intrinsic goals	You will have people who care about you and are supportive	As above
45	Aspiration_intrinsic_6	Intrinsic goals	You will have good friends that you can talk to about personal things	As above
46	Aspiration_extrinsic_1	Extrinsic goals	You will have a job that pays well	As above
47	Aspiration_extrinsic_2	Extrinsic goals	You will have a job with high social status	As above
48	Aspiration_extrinsic_3	Extrinsic goals	You will be financially successful	As above
49	Aspiration_extrinsic_4	Extrinsic goals	Your name will be known by many people	As above
50	Aspiration_extrinsic_5	Extrinsic goals	You will be admired by many people	As above
51	Aspiration_extrinsic_6	Extrinsic goals	You will do something that brings you much recognition	As above
52	**Intrinsic_goals**	Intrinsic goals		Relative score on intrinsic goals; mean of items 40-45 mean-centred using mean of all Aspiration Index items
53	Material_value_1	Materialistic values	I admire people who own expensive homes, cars, and clothes	1=entirely disagree 2=mostly disagree 3=somewhat disagree 4=neither agree nor disagree 5=somewhat agree 6=mostly agree 7=entirely agree

54	Material_value_2	Materialistic values	The things I own say a lot about how well I'm doing in life	As above
55	Material_value_3	Materialistic values	I like to own things that impress people	As above
56	**Material_values**	Materialistic values		Sum of materialistic value scores
57	Income_Poland Income_SA Income_Denmark Income_India Income_UK Income_Brazil Income_China	Income		1=first quintile 2=second quintile 3=third quintile 4=fourth quintile 5=top quintile 6=MISSING VALUE

Appendix B – Country selection and characteristics

Countries were selected on the basis of three main criteria. First, we based our country selection largely upon Schwartz's cultural values approach (Schwartz, 1992), though with an intention also to survey countries which varied on the basis of individualism and collectivism (Hofstefe et al., 2004). The selected countries vary across Schwartz's values dimensions, particularly in terms of affective autonomy (in which the UK scores highly), embeddedness (S. Africa), hierarchy (China), and egalitarianism (Denmark) (based on Schwartz, 2006). These countries also vary on the basis of individualism-collectivism, ranging from a highly collectivistic society (China) to collectivistic/intermediate cultures (Brazil and India), as well as countries that score highly on individualism (UK and Denmark) (based on Hofstede Insights, 2018; see also Minkov et al., 2017).

Second, following ongoing research highlighting the complexity of relationships between economic development and environmentally-relevant attitudes (e.g. Rizio & Kashima, 2018), we aimed to measure values and opinions across a range of economic development contexts. The United Nations Human Development Index (HDI) is a composite index of life expectancy, education and per capita income used to rank countries into four categories of human development (UNDP, 2017). Alongside differences in cultural values, the countries selected include countries ranked as 'very high development' (Denmark, Poland, UK), 'high development' (Brazil, China), and 'medium development' (India, South Africa).

Finally, we were interested in selecting a range of countries based upon environmental performance as nations. The Environmental Performance Index (EPI) ranks 180 countries on 24 performance indicators based on environmental health and ecosystem vitality (Hsu & Zomer, 2014). The EPI therefore gauges how close countries are to established environmental policy goals. The countries selected represent a range of EPI ranks in the latest iteration of rankings (Denmark-3rd; UK-6th; Poland- 50th; Brazil- 69th; China- 120th; South Africa- 142nd; India- 177th; Yale Center for Environmental Law and Policy, 2018).

In addition to these criteria, the current project was embedded in larger work that entailed in-depth qualitative research undertaken across the selected countries. In this sense, pragmatic and practical constraints also influenced the feasibility of field work and hence countries selected for the allied survey research. While we incorporate three 'Western' countries in our approach, incorporation of participants from China, Brazil, India and South Africa goes some way to addressing the relative lack of research within environmental psychology outside this context.

We used quota sampling by income for each country surveyed, with the aim of obtaining representative samples by personal income. We set quotas at 20% of respondents for each income for each country surveyed. These quotas were relaxed in some cases (e.g. where high income respondents were problematic to obtain, we allowed inclusion of additional respondents from lower income bands). We measured respondents' income in the context of each country's income distribution. In order to do so, we derived income quintiles for each country. We used both official government and academic data sources to derive nation-specific income quintiles. These included the China Statistical Yearbook (2015), Statistics South Africa (2012) and Office of National Statistics, UK (2016), the Demographic Yearbook of Poland (2017), and Shukla (2010; for India). Full details of income quintiles used and sources are given below.

Survey respondents were asked to indicate their income relative to average income and income distribution for each surveyed country. We derived income quintiles, such that five income bands were presented to each respondent, contextualised to their country of residence. Each quintile was intended to span approximately 20% of the population of that country's income range.

We used several sources in order to derive income quintiles for each country

For all countries, income bands were presented to participants; in the case of Brazil, we also presented income bands in terms of multiples of minimum wage, a typical way in which relative income is understood, based on the advice of our in-country collaborator. We followed advice of in-country collaborators as to whether to present income in terms of monthly and/or annual amounts.

The income bands used were as follows:

- Brazil: less than two minimum wages (less that R1,750 per month); between two and four minimum wages (between R1,750 and R3,500 per month); between four and 10 minimum wages (between R3,500 and R8,800 per month); between 10 and 20 minimum wages (between R8,800 and R17,500 per month); more than 20 minimum wages (more than R18,000 per month).

- China: Less than ¥20,000 per year (less than ¥1,650 per month); Between ¥20,001 and ¥40,000 (between ¥1,6501 and ¥3,300 per month); Between ¥40,001 and ¥80,000 (between ¥3,301 and ¥6,650 per month); Between ¥80,000 and ¥120,000 (between ¥6,651 and ¥10,000 per month); More than ¥120,000 (more than ¥10,000 per month)

- Denmark: Less than DKK 150,000 (less than DKK 12,500 per month); Between DKK 150,001 and DKK 200,000 (between DKK 12,501 and DKK 16,665 per month); Between DKK 200,001 and DKK 250,000 (between DKK 16,666 and DKK 20,835 per month); Between DKK 250,001

and DKK 320,000 (between DKK 20,836 and DKK 26,665 per month); More than DKK 320,000 (more than DKK 26,665 per month)

- India: Less than Rs 55,000 per year (less than Rs 4,600 per month); Between Rs 55,001 and Rs 80,000 per year (between Rs 4,601 and Rs 6,650 per month); Between Rs 80,001 and Rs 120,000 per year (between Rs 6,651 and Rs 10,000 per month); Between Rs 120,001 and Rs 225,000 per year (between Rs 10,001 and Rs 18,750 per month); More than Rs 225,000 per year (more than Rs 18,750 per month)
- Poland: Less than 1700 zl per month; between 1701 zl and 3000 zl per month; between 3001 zl and 4300 zl per month; between 4301 zl and 6600 zl per month; more than 6600 zl per month.
- South Africa: Less than R9,000 per year (less than R750 per month); R9,001 - R17,000 (R751 – R1,400 per month); R17,001 – R32,000 (R1,401 – R2,650 per month); R32,001 – R70,000 (R2,651 – R5,800 per month); More than R70,000 (more than R5,800 per month)
- UK: Less than £13,000 per year, before tax (less than £1,080 per month); Between £13,000 and £18,000 per year, before tax (between £1,080 and £1,500 per month); Over £18,000 but less than £25,000 per year, before tax (between £1,500 and £2,080 per month); Over £25,000 but less than £37,000 per year, before tax (between £2,080 and £3,080 per month); More than £37,000 per year, before tax (more than £3,080 per month)

Appendix C – Derivation of statistical thresholds

In several cases, we state that a statistically significant effect should be observed in a minimum of 3 of 7 countries for a hypothesis to be supported; this criterion is applied to five hypotheses in the paper: H1 (general relationship between pro-environmental behaviour and wellbeing), H2a (PEB X income interaction), and Hs 3a, b, c (interactions between PEB and values/motivation).

This aim of this approach is to ensure that across a series of analyses, a sensible and stringent *p* value is retained. The criterion that 3 of 7 countries should show a significant effect ($p < .05$) achieves this, once all possible combinations of statistically significant outcomes are accounted for: it provides a suitable threshold for detecting a statistically significant effect, while recognising that the risk of a single 'chance' finding (i.e. a Type 1 error) is influenced through the use of multiple tests.

The use of a statistically significant threshold of $p < .05$ (for any effect obtained in any country) is associated with an equivalent probability of observing such a $p < .05$ effect across three or more countries of $p = 0.00356$, for each hypothesis considered. This takes into account the potential to observe an effect in any combination of three countries, of which there are a total of 35 combinations: for example, three significant effects could be observed in [UK, Poland, Denmark], [India, China, UK], [Brazil, UK, Poland] etc. The equation from which this is derived relates to ${}_7C_3 = 35$ (the number of combinations of 3 objects within a set of 7):

$$P = (0.05 \text{ X } 0.05 \text{ X } 0.05 \text{ X } (1 - 0.05)^4) \text{ X } 35 = 0.00356$$

As this applies across five separate hypothesis tests, the equivalent probability of obtaining a significant result across one or more of the five hypotheses is further considered, which is in turn equal to $(0.00356 \text{ X } (1 - 0.00356)^4 \text{ X } 5)$, equivalent to a probability threshold of 0.0175. This threshold of 0.0175 can be treated as the probability of obtaining an effect in 3 or more of 7 countries, for just one out of the five hypotheses. The probability of obtaining 4 or more significant country effects by chance and/or obtaining 2 or more hypotheses by chance is small enough to be treated as negligible.

This overall probability threshold ($p \leq .017$) for the full set of five hypotheses for which these considerations apply, is lower than a standard figure of $p < .05$ for a single test; as such, we can be confident that the likelihood of obtaining any result across the five hypotheses by 'chance' is small (avoiding a Type 1 error), but allows for a reasonable threshold (i.e. not excessively stringent) to be able to detect such a 'true' effect (avoiding a Type 2 error).

Appendix D – Structural equivalence of measures

Pro-environmental behaviour measures

As we note in section 2.4.1 of the main paper, the PEB items used have been previously found to separate into a two-factor solution, encompassing private and public sphere action. However, due to the present use of pro-environmental behaviour measures in a wider series of divergent cultural contexts, it is appropriate to consider in some detail the extent to which these have a similar underlying structure.

In order to assess structural equivalence, we first apply exploratory factor analysis of the PEB items for each of the seven countries, and in comparison with the pooled factor structure, as described by Vijver and Leung (2011).

Where each of the 4-item public sphere and private sphere PEB scales are examined separately, a single factor structure is obtained in each of the seven countries. In addition, Cronbach's alpha scores for these scales are acceptable to excellent in all cases, again indicating a unitary structure in each case. The results from this factor analysis are shown in Table S2.

We also consider the factor structure of the full PEB scale, where this is treated as a combined indicator of pro-environmental behaviour reflecting both private and public sphere action; here we use principal components analysis with Varimax rotation. It would be expected that a two-factor structure would be obtained, reflecting each PEB type. We would also look to obtain an internally consistent 8-item scale, with acceptable levels of Cronbach's alpha.

In the case of the full 8-item scale, we observe convincing evidence for the anticipated two-factor structure across all seven countries, as well as good evidence of internal consistency. The results from the exploratory factor analysis are shown in Table S3, where loadings above .4 are shown in bold, and shading is used to show an item's principal loading.

Table S2. Structural equivalence of pro-environmental behaviour: public and private sphere scales

	Brazil	China	Denmark	India	Poland	S. Africa	UK	Full dataset
Public sphere PEB								
Factor loadings								
Item 1: acted with others	.811	.881	.677	.846	.748	.762	.743	.840
Item 2: donated money	.730	.847	.712	.826	.756	.714	.792	.801
Item 3: sought information	.729	.709	.682	.759	.703	.730	.749	.760
Item 4: conservation work	.850	.880	.751	.851	.812	.807	.829	.863
Public sphere: variance explained	61.1%	69.2%	49.9%	67.4%	57.1%	56.8%	60.7%	66.8%
Public sphere: Cronbach's alpha	.781	.851	.628	.838	.737	.738	.771	.828
Private sphere PEB								
Factor loadings								
Item 1: less packaging	.795	.822	.787	.790	.814	.788	.827	.802
Item 2: environmentally-friendly products	.729	.783	.767	.786	.793	.781	.767	.756
Item 3: short showers	.618	.687	.596	.615	.626	.624	.635	.635
Item 4: avoided wasting food	.618	.461	.609	.548	.609	.636	.609	.598
Private sphere: variance explained	48.2%	49.3%	48.4%	48.0%	51.4%	50.6%	51.1%	49.4%
Private sphere: Cronbach's alpha	.629	.648	.626	.629	.674	.657	.658	.647

Table S3. Measurement equivalence of pro-environmental behaviour: public and private sphere scales

	Brazil		**China**		**Denmark**		**India**		**Poland**		**S. Africa**		**UK**		**Full dataset**	
PEB scale	Component		Component		Component		Component		Component		Component		Component		Component	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Item 1: acted with others	**.787**	.146	**.849**	.222	**.639**	.123	**.836**	.120	**.725**	.145	**.736**	.158	**.736**	.058	**.817**	.146
Item 2: donated money	**.757**	-.128	**.858**	.020	**.719**	.027	**.832**	-.016	**.775**	-.022	**.737**	.020	**.788**	.089	**.818**	-.006
Item 3: sought information	**.635**	.331	**.567**	**.487**	**.601**	.313	**.674**	.373	**.619**	.340	**.647**	.303	**.692**	.303	**.681**	.333
Item 4: conservation work	**.811**	.056	**.859**	.110	**.761**	-.012	**.824**	.053	**.813**	.051	**.789**	.075	**.820**	.002	**.846**	.063
Item 5: less packaging	**.549**	**.477**	.376	**.677**	.330	**.681**	**.489**	**.517**	.316	**.713**	.355	**.658**	.321	**.732**	**.433**	**.615**
Item 6: environmentally friendly products	**.627**	.315	**.599**	**.535**	.341	**.657**	**.638**	**.426**	.372	**.666**	**.431**	**.619**	**.428**	**.625**	**.503**	**.512**
Item 7: short showers	.141	**.710**	.223	**.630**	-.015	**.655**	.155	**.655**	-.045	**.701**	.111	**.650**	.053	**.668**	.100	**.688**
Item 8: avoided wasting food	.001	**.823**	-.383	**.760**	-.055	**.690**	-.050	**.797**	-.012	**.680**	-.122	**.779**	-.137	**.729**	-.073	**.774**
Variance explained	42.2%	15.7%	47.3%	18.1%	33.6%	16.5%	45.8%	15.0%	37.8%	17.9%	38.9%	16.5%	39.2%	18.7%	47.3%	16.6%
Cronbach's alpha	.793		.823		.693		.818		.747		.762		.740		.800	

In order to assess in more detail the extent to which the two-factor structure of public versus private sphere PEB held across the surveyed countries, we additionally carried out a Procrustes Rotation that compared factor loadings between the UK and each of the remaining six samples. This enables us to assess the degree of similarity between countries in the latent structure obtained across the eight pro-environmental behaviour items. We applied the SPSS syntax detailed in Fischer and Fontaine (2011) in order to do so.

From this analysis, we obtain strong evidence to support cross-cultural congruence of our PEB measure. Tucker's phi is at or above an acceptable threshold of .95 for each factor, for each country (cf van de Vijver and Leung, 1997; cited in Fischer and Fontaine, 2011). We report this statistic as well as further indices in Table S4. Overall, this analysis indicates that the PEB factor structure holds well across the countries surveyed, with all indices at or above an acceptable value of .85 for each factor.

Table S4 Factor congruence with UK as reference (target) group

	South Africa	Poland	India	Denmark	China	Brazil
Mean squared difference per factor	.04, .06	.06, .06	.08, .12	.07, .04	.14, .10	.08, .15
Identity coefficient per factor	1.00, .99	.99, .99	.99, .97	.99, 1.00	.97, .98	.99, .95
Additivity coefficient per factor	.99, .98	.98, .98	.98, .91	.98, .99	.93, .94	.97, .85
Proportionality coefficient (Tucker's phi) per factor	1.00, .99	.99, .99	.99, .97	1.00, 1.00	.98, .98	.99, .95
Correlation coefficient per factor	1.00, .98	.98, .98	.98, .93	.99, .99	.94, .94	.97, .86

In addition to the tests of measurement equivalence described above, we carried out a confirmatory factor analysis of the two-factor scale, using a multi-group approach. This enables us to compare model fit indices across countries. The comparative fit index (CFI) for the configural model (multigroup representation of separate country models) is equal to .960; this decreases by .020 where measurement weights are constrained (metric invariance); this indicates that the factor structure is acceptably similar across countries, based on a threshold of $\Delta CFI \leqslant .02$ (appropriate for tests of metric invariance with large group sizes, Rutkowski and Svetina, 2014; cited in Putnick and Bornstein, 2016); model fit according to the RMSEA statistic is equal to 0.029 for the latter model, again an acceptable fit. Further decreases in CFI where constraining measurement intercepts (metric invariance) indicate that the model does not hold under this 'strong factorial' condition. However, we consider that across the indicators considered (exploratory factor analysis, Tucker's phi, CFI of configural and metric invariance models) there is good evidence for similar factorial structure of the PEB scale, enabling us to apply this in further analyses.

Values and goals measures

In order to assess measurement equivalence across the surveyed countries, we carried out a confirmatory factor analysis of the three 'universalism' items and one 'benevolence' item, designed to reflect self-transcendent values. Although we did not treat these items directly as a scale – using instead responses centred to the mean of all Schwartz values items – nevertheless this enables us to assess whether the latent structure for these values items holds across countries.

The comparative fit index (CFI) for the configural model (multigroup representation of separate country models) is equal to .941, representing a good model fit; this decreases by a little under .001 where measurement weights are constrained (metric invariance); this indicates that the factor structure is acceptably similar across countries; model fit according to the RMSEA statistic is equal to 0.070 for the latter model, again suggesting a good fit. Further decreases in CFI where constraining measurement intercepts (scalar invariance) indicate that the model does not hold as well under this 'strong factorial' condition (CFI=.849, RMSEA=.079) although these indicators are close to threshold.

Where the three material values are treated as a three-item scale, the comparative fit index (CFI) for the configural model is equal to 1.000; this decreases by approx. .01 where measurement units are constrained, suggesting a similar factor structure across countries; RMSEA for the latter model is equal to .028. A further decrease in CFI where constraining measurement intercepts indicates this

more stringent model does not fit the data well; however, we again consider that the good configural and metric invariance obtained enables the use of this scale in the main analyses.

We obtain less convincing model fit indices for the aspiration index items. Here again, our treatment of these measures is not in terms of a two-factor scale; however we use confirmatory factor analysis in order to assess the extent to which the use of these items can be considered to provide a reasonable model across countries.

Here we do not obtain as convincing model fit statistics as in the other scales and measures described above. Analyses are based on five countries as data were not collected for these items in the UK and Brazil. The configural model has a CFI equal to .824, with RMSEA=.060; where measurement weights are constrained the CFI declines by approx. .01, with RMSEA=.060. Further constraints on the models lead to declines in CFI suggestive of poor model fit. While we utilise the aspiration index derived from relative values, as described above, its use in subsequent analyses are to be interpreted with caution given lack of good model fit and measurement equivalence.

Appendix E – Moderation of PEB effect on wellbeing by income

Table S5 Relationships between PEB and wellbeing moderated by income

Country		B (SE)	Beta	Adj. R^2	Human Development Index (rank, score)
	Predictors				
Denmark				.047	
	PEB scale	.116 (.038)	.091**		1, .929
	Income	.193 (.030)	.209***		
	PEB X income	.048 (.036)	.044 ns		
UK				.050	
	PEB scale	.180 (.038)	.143***		2, .922
	Income	.178 (.037)	.166***		
	PEB X income	-.012 (.037)	-.011 ns		
Poland				.074	
	PEB scale	.166 (.046)	.140***		3, .865
	Income	.244 (.043)	.219***		
	PEB X income	-.034 (.050)	-.027 ns		
Brazil				.065	
	PEB scale	.165 (.031)	.164***		4, .759
	Income	.225 (.036)	.186***		
	PEB X income	.072 (.034)	.064*		
China				.129	
	PEB scale	.278 (.027)	.316***		5, .752
	Income	.124 (.030)	.123***		
	PEB X income	.022 (.029)	.023 ns		
South Africa				.004	
	PEB scale	.075 (.037)	.064*		6, .699
	Income	.043 (.032)	.042 ns		
	PEB X income	-.035 (.036)	-.030 ns		
India				.110	7, .640
	PEB scale	.226 (.028)	.260***		
	Income	.096 (.028)	.113***		
	PEB X income	.048 (.024)	.068 ns		

Dependent variable: wellbeing. Note that the Human Development Index score is not itself included in the regression analysis.

Appendix F – Moderation of PEB effect on wellbeing by values and goals

Table S6 Relationship between PEB and wellbeing, moderated by self-transcendent values

Country		**B (SE)**	**Beta**	**Adj. R^2** (full model)	**Human Development Index** (rank, score)
	Predictors				
Denmark				.049	
	PEB scale	.114 (.048)	.096*		1, .929
	Income	.256 (.042)	.230***		
	ST values	.108 (.038)	.120**		
	(PEB X ST values)	-.020 (.036)	-.022ns		
UK				.051	
	PEB scale	.181 (.042)	.144***		2, .922
	Income	.190 (.033)	.177***		
	ST values	.021 (.040)	.020ns		
	(PEB X ST values)	.014 (.036)	.016ns		
Poland				.085	
	PEB scale	.114 (.048)	.096*		3, .865
	Income	.256 (.042)	.230***		
	ST values	.108 (.038)	.120**		
	(PEB X ST values)	-.020 (.036)	-.022ns		
Brazil				.067	
	PEB scale	.126 (.031)	.126***		4, .759
	Income	.236 (.036)	.196***		
	ST values	.078 (.031)	.077*		
	(PEB X ST values)	-.025 (.027)	-.028ns		
China				.139	
	PEB scale	.271 (.027)	.307***		5, .752
	Income	.123 (.029)	.123***		
	ST values	.108 (.031)	.110**		
	(PEB X ST values)	-.015 (.028)	-.018ns		
South Africa				.003	
	PEB scale	.070 (.040)	.060ns		6, .699
	Income	.042 (.032)	.041ns		
	ST values	.017 (.035)	.017ns		
	(PEB X ST values)	-.015 (.035)	-.014ns		
India				.109	7, .640
	PEB scale	.242 (.027)	.279***		
	Income	.116 (.026)	.136***		
	ST values	.011 (.035)	.011ns		
	(PEB X ST values)	-.040 (.028)	-.048ns		

Dependent variable: wellbeing. Note that the Human Development Index score is not itself included in the regression analysis.

Table S7 Relationship between PEB and wellbeing, moderated by materialist values

Country		B (SE)	Beta	Adj. R^2 (full model)
	Predictors			
Denmark				.012
	PEB scale	.068 (.044)	.053ns	
	Income	.176 (.027)	.191***	
	material values	-.132 (.039)	-.121**	
	(PEB X material values)	-.064 (.042)	-.056ns	
UK				.021
	PEB scale	.177 (.038)	.142***	
	Income	.186 (.033)	.173***	
	material values	-.021 (.039)	-.018ns	
	(PEB X material values)	-.025 (.036)	-.023ns	
Poland				.085
	PEB scale	.173 (.045)	.147***	
	Income	.252 (.042)	.226***	
	material values	-.042 (.041)	-.039ns	
	(PEB X material values)	-.021 (.044)	-.019ns	
Brazil				.031
	PEB scale	.145 (.030)	.145***	
	Income	.225 (.036)	.187***	
	material values	.016 (.030)	.016ns	
	(PEB X material values)	.012 (.027)	.013ns	
China				.125
	PEB scale	.231 (.040)	.263***	
	Income	.126 (.029)	.126***	
	material values	.132 (.042)	.100**	
	(PEB X material values)	.037 (.037)	.050ns	
South Africa				.002
	PEB scale	.079 (.037)	.068*	
	Income	.045 (.032)	.044ns	
	material values	.018 (.034)	.016ns	
	(PEB X material values)	.014 (.035)	.013ns	
India				.092
	PEB scale	.207 (.032)	.238***	
	Income	.110 (.026)	.129***	
	material values	.088 (.033)	.095**	
	(PEB X material values)	.026 (.026)	.042ns	

Dependent variable: wellbeing

Table S8 Relationship between PEB and wellbeing, moderated by intrinsic goals

Country		B (SE)	Beta	Adj. R^2 (full model)
	Predictors			
Denmark				.071
	PEB scale	.082 (.045)	.064ns	
	Income	.199 (.027)	.216***	
	intrinsic goals	.156 (.032)	.159***	
	(PEB X intrinsic goals)	-.027 (.035)	-.027ns	
Poland				.087
	PEB scale	.142 (.046)	.120**	
	Income	.257 (.042)	.230***	
	intrinsic goals	.083 (.042)	.080*	
	(PEB X intrinsic goals)	-.090 (.045)	-.078*	
China				.133
	PEB scale	.254 (.032)	.288***	
	Income	.127 (.030)	.127***	
	intrinsic goals	.074 (.037)	.062*	
	(PEB X intrinsic goals)	-.055 (.035)	-.059ns	
South Africa				.005
	PEB scale	.075 (.037)	.064*	
	Income	.044 (.032)	.043ns	
	intrinsic goals	.023 (.034)	.022ns	
	(PEB X intrinsic goals)	-.043 (.036)	-.038ns	
India				.110
	PEB scale	.230 (.033)	.266***	
	Income	.116 (.026)	.136***	
	intrinsic goals	-.014 (.038)	-.012ns	
	(PEB X intrinsic goals)	-.027 (.035)	-.032ns	

Dependent variable: wellbeing

References (additional to main paper)

China Statistical Yearbook (2015). http://www.stats.gov.cn/tjsj/ndsj/2015/indexeh.htm

Hsu, A., & Zomer, A. (2014). Environmental performance index. *Wiley StatsRef: Statistics Reference Online*, 1-5.

Minkov, M., Dutt, P., Schachner, M., et al. (2017). A revision of Hofstede's individualism-collectivism dimension: A new national index from a 56-country study. *Cross Cultural & Strategic Management*, 24(3), 386-404.

Office for National Statistics, UK (2017). Annual Survey of Hours and Earnings: 2017 provisional and 2016 revised results. https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2017provisionaland2016revisedresults

Putnick, D. L., & Bornstein, M. H. (2016). Measurement invariance conventions and reporting: The state of the art and future directions for psychological research. *Developmental review*, 41, 71-90.

Rizio, S. M., & Kashima, Y. (2018). The economy and environmental attitudes: Does a good economy make citizens care more about the environment?. *BioRxiv*, 502682.

Rutkowski, L. & Svetina, D. (2014). Assessing the hypothesis of measurement invariance in the context of large-scale international surveys. *Educational and Psychological Measurement,* 74, 31–57.

Shukla, R. (2010). How India earns, spends and saves: unmasking the real India. SAGE Publications India.

Statistics Poland (2017). *The Demographic Yearbook of Poland.* https://stat.gov.pl/en/topics/statistical-yearbooks/statistical-yearbooks/demographic-yearbook-of-poland-2017,3,11.html

Statistics South Africa (2012). Statistical release, census 2011. https://www.statssa.gov.za/publications/P03014/P030142011.pdf

United Nations Development Programme (2017). *Country profiles.* http://hdr.undp.org/en/countries

Yale Center for Environmental Law and Policy (2018). *Environmental Performance Index.* https://epi.envirocenter.yale.edu/