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Meta-analytic evidence for a robust and positive association between individuals' pro-environmental behaviors and their subjective wellbeing

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Supplementary material for this article is available [online](#)

Abstract

While it is often suggested that individuals' pro-environmental behaviors may be linked with their subjective wellbeing, the strength and direction (e.g. positive or negative) of this relation is unclear. Because pro-environmental behaviors impact peoples' everyday lives, understanding this relation is critical for promoting long-term environmental solutions. Using a series of meta-analyses, we systematically reviewed the literature on the association between individuals' pro-environmental behaviors and their subjective wellbeing. We hypothesized that the relation between pro-environmental behavior and subjective wellbeing would be positive and strongest among types of behaviors (e.g. sustainable purchase decisions) and indicators of subjective wellbeing which more clearly reflect personal meaning (e.g. warm glow). We sourced studies via PsychINFO, PsychARTICLES, GreenFile, SocINDEX, Web of Science, and Scopus, as well as professional email lists, direct contact with authors who publish in this domain, data from the authorship team, and the European Social Survey (2016). We included studies with quantitative data on the relation between individuals' pro-environmental behavior and their subjective wellbeing, ultimately identifying 78 studies (73 published, 5 unpublished) for synthesis. Across multiple indicators of pro-environmental behaviors and subjective wellbeing, we found a significant, positive relation (overall $r = .243$), and this relation did not meaningfully differ across study characteristics (e.g. sample, design). As predicted, the relation was particularly strong for indicators of pro-environmental behavior and subjective wellbeing which clearly reflect meaning, such as sustainable purchase decisions ($r = .291$) and for warm glow ($r = .408$). We found a robust, positive relation between people's pro-environmental behaviors and subjective wellbeing, and initial evidence that this relation may be stronger the more clearly behaviors and indicators of subjective wellbeing reflect meaning. Our results indicate that program and policy-makers can seek opportunities to design 'win-win' sustainability programs which could positively impact both people and the environment.

1. Introduction

Successfully transitioning to low- or zero-carbon societies is becoming increasingly urgent as the need to mitigate to climate change rapidly grows (IPCC 2018). Wide-scale changes in environment-related behaviors will be critical to achieving the low-carbon transition and to reduce the negative impacts of climate change and other global environmental challenges (Steg *et al* 2015). For example,

people could reduce the frequency and distance of motorized travel, eat more sustainably produced food, and reduce home energy consumption to lower their carbon emissions. Given the potential impact of such behavior changes on people's daily lives, a key question is whether and how individuals' pro-environmental behavior is related to *subjective wellbeing*, and whether we can promote pro-environmental behaviors in a way that protects and promotes individuals' subjective wellbeing. We

define subjective wellbeing as the extent to which people experience positive emotions, happiness, and positively evaluate their own lives (Diener *et al* 2003).

The purpose of our paper is to achieve an overarching view of the empirical research on the relation between pro-environmental behavior and subjective wellbeing. Specifically, we sought to determine the direction of the relation (positive, negative, or no relation), its relative strength (weak, moderate, or large), and the conditions under which this relation might be stronger or weaker (e.g. depending on how pro-environmental behavior and subjective wellbeing are conceptualized; and on study design and characteristics, such as who comprises the sample, how the data was collected). To those ends, we conducted one overarching and nine smaller, focused meta-analyses of published and unpublished studies. In doing so, we provide key insights into the strength, direction and robustness of the relation between pro-environmental behavior and subjective wellbeing, and the conditions under which the relation may be stronger or weaker.

1.1. How and why pro-environmental behavior is associated with subjective wellbeing

Although subjective wellbeing may affect the likelihood that people perform pro-environmental behaviors (Lyubomirsky *et al* 2005, Lengieza *et al* 2019), in this paper, we focus on how pro-environmental behavior may affect wellbeing, and under which conditions this relationship may be strongest. It is often assumed that pro-environmental actions can be costly, effortful, or otherwise unpleasant to do, and therefore negatively impact subjective wellbeing (e.g. Epstein 2015, Noori Farzan 2019). This suggests that there is a negative relation between pro-environmental behaviors and subjective wellbeing. Yet, a growing body of literature suggests the opposite may be true, and that overall, acting pro-environmentally might increase people's subjective wellbeing (Kasser 2017). Indeed, despite the possible inconvenience, cost, or discomfort which are sometimes associated with pro-environmental behaviors, people appear to consistently associate pro-environmental behaviors with positive feelings rather than negative ones (Venhoeven *et al* 2020). Moreover, people anticipate that performing a pro-environmental behavior will make them feel good (Taufik *et al* 2016).

It has been theorized that the association between pro-environmental behaviors and subjective wellbeing may be positive because performing pro-environmental behaviors is perceived as *meaningful* (Venhoeven *et al* 2016, 2020). The meaningfulness of a behavior reflects the extent to which a behavior is perceived by someone as important, significant, and the morally right thing to do (van der Werff *et al* 2013, Venhoeven *et al* 2016, 2020). Performing meaningful behaviors makes people feel good about

themselves, which enhances their subjective wellbeing (Taufik *et al* 2015, Binder and Blankenberg 2017, Venhoeven *et al* 2020). Based on this, we hypothesized:

H1. Overall, more engagement in pro-environmental behavior will be associated with higher subjective wellbeing.

If pro-environmental behaviors indeed have a positive impact on subjective well-being because they are perceived as meaningful, we would assume that the more meaningful a pro-environmental behavior is perceived to be, the stronger its positive impact on subjective wellbeing will be. One factor that may make a behavior's meaning more or less clear, is the extent to which people are consciously engaging in that behavior. When people consciously perform behaviors, rather than automatically or habitually perform them, the characteristics of the behavior become more salient. Hence, we propose that people are more likely to reflect on the extent to which their actions are meaningful (in this case, because they benefit the environment) when decisions are made consciously (e.g. when purchasing an energy efficient appliance). In contrast, habitual behaviors are typically conducted without careful reflection or thought (e.g. recycling or turning off the lights when leaving a room), and so the meaning of such behaviors is likely to be muddled. Hence, we hypothesized that:

H2. Pro-environmental behaviors for which the meaning is more apparent at the time of action, like purchase decisions, will be more strongly positively related to subjective wellbeing than behaviors for which the meaning is less apparent at the time of action, like turning off lights in an empty room.

Along similar reasoning, if meaning explains why pro-environmental behavior and subjective wellbeing are positively related, then the positive relationship would be stronger for indicators of subjective wellbeing which more strongly reflect meaning. Within the domain of pro-environmental behavior, researchers typically conceptualize subjective wellbeing in one of four ways: hedonic happiness, evaluative happiness, eudaimonic happiness, and warm glow. Importantly, indicators vary in the extent to which they reflect meaning. Specifically, compared to hedonic and evaluative happiness, warm glow and eudaimonic happiness more clearly reflect meaning than hedonic happiness and evaluative happiness.

Hedonic happiness reflects how happy people are in a given moment and is not linked to specific actions or meaning (Watson *et al* 1988). *Evaluative happiness* is a long-term positive state, which reflects the extent to which individuals feel satisfied with their lives as a whole (Diener *et al* 1985), and also is not explicitly linked to specific actions

or meaning. Hence, both hedonic happiness and evaluative happiness do not inherently reflect the extent to which people feel meaningful. Therefore, we expect both to be positively, but not very strongly, related to pro-environmental.

Eudaimonic happiness is a long-term positive state that reflects the extent to which people perceive their lives in general as meaningful (Steger *et al* 2006). *Warm glow* reflects a momentary, positive affective state which people experience after performing or while anticipating the performance of a behavior which can be meaningful to them (Taufik *et al* 2015, 2016, van der Linden 2018), such as the extent to which someone feels good, happy, or proud of themselves when acting in a way that helps the environment (e.g. Wang and Wu 2016). As both eudaimonic happiness and warm glow reflect the extent to which people feel meaningful (in general or about a behavior, respectively), we expect that the relation between pro-environmental behavior and subjective wellbeing is stronger for eudaimonic happiness and warm glow, than for hedonic and evaluative happiness. We further expect that pro-environmental behavior will be more strongly and positively related to warm glow than to eudaimonic happiness, as warm glow reflects feelings elicited by a pro-environmental behavior specifically, while eudaimonic happiness may also depend on other meaningful actions or events in people's life.

In sum, we hypothesized:

H3a. Warm glow and eudaimonic happiness will be more strongly positively associated with pro-environmental behaviors than hedonic and evaluative happiness.

H3b. Pro-environmental behavior will be more strongly and positively related to warm glow than to eudaimonic happiness.

1.2. Does the relation depend on study characteristics?

Additionally, we wanted to explore how robust the relation between pro-environmental behavior and subjective wellbeing might be against a variety of study characteristics, as to investigate the consistency and robustness of this relationship. Specifically, we examined whether the effect size would differ depending on the samples used within each study, the mode of data collection, whether the study employed a correlational or experimental design, and explored whether the relationship would differ depending on whether pro-environmental behavior or subjective wellbeing was measured first. These study characteristics can all influence the relations observed, potentially impacting an individual study's generalizability (e.g. sampling biases from different modes of data collection or sampling methods; demand effects in experiments; question framing, order, and other survey context effects; Umbach 2005). The less

variation we find across these study characteristics, the more robust and generalizable the relation between pro-environmental behavior and subjective wellbeing is likely to be.

2. Method

Below we summarize how we acquired published and unpublished studies and the criteria we used to assess them for potential inclusion in our analysis. We also report the manner in which we structured and processed the resulting data for synthesis and a descriptive summary of the data obtained through this process. Figure 1 provides an overview of the multi-stage screening process with the number of studied collected and screened at each stage.

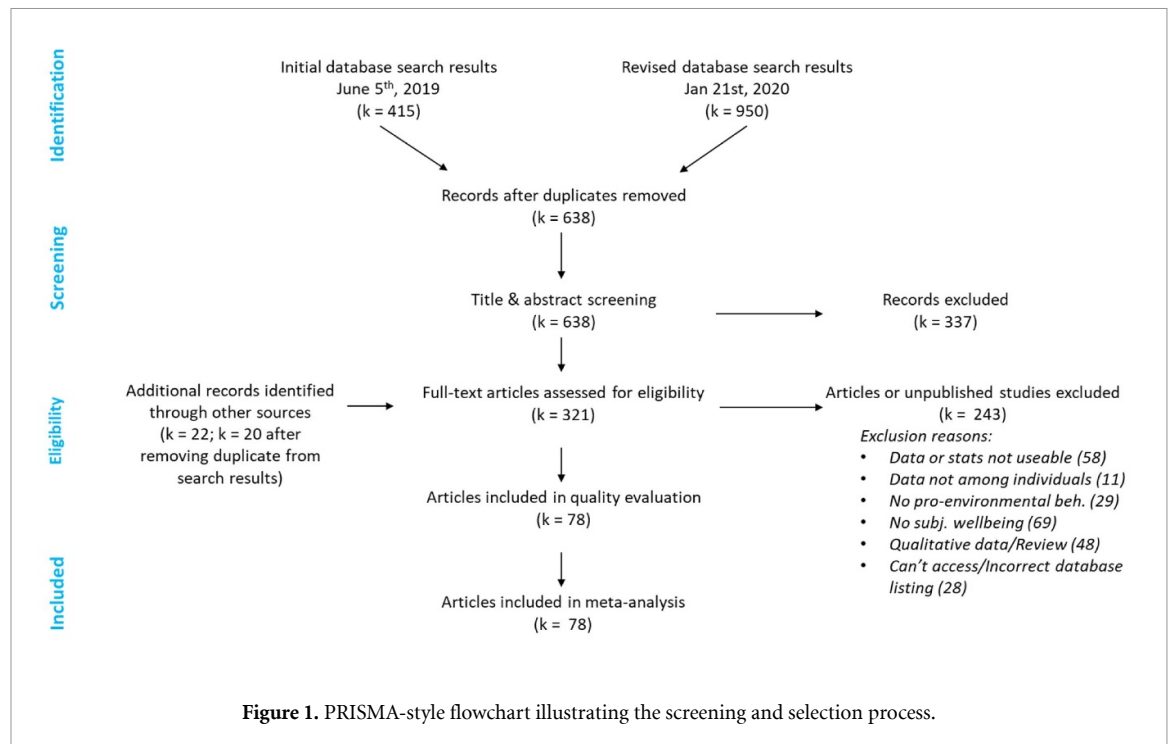
2.1. Study retrieval

2.1.1. Database search

Our study benefited from the literature search being conducted in two stages (both in English). Specifically, the first initial database search was performed in June 2019 in five databases: PsychINFO, PsychArticles, Green File, SocINDEX, and Web of Science. This protocol was then peer-reviewed. Based on the feedback received from peer-review, we added a sixth database, Scopus, and refined our search terms to further improve comprehensiveness and avoid spelling biases (e.g. including both forms of wellbeing and well-being). Our final search terms were: ('life satisfaction' OR 'subjective wellbeing' OR 'subjective well-being' OR wellbeing OR well-being OR 'positive affect' OR 'positive emotions' OR 'hedonic happiness' OR happiness OR eudaimonia OR 'meaning in life' OR 'eudaimonic happiness' OR 'warm glow') AND ('pro-environmental behavior' OR 'environmental behavior' OR 'pro-environmental intentions' OR 'environmental intentions' OR 'pro-environmental' OR 'ecological intentions' OR 'ecological behavior' OR 'carbon footprint' OR 'eco footprint' OR 'ecological footprint' OR 'sustainable behavior' OR 'sustainable consumption'). The final search replicated and expanded the initial results, adding articles which had either been missed the first round, published since the first round was conducted, or were only available in Scopus.

2.1.2. Additional sources

We employed four techniques for retrieving unpublished literature (all were in English). First, we sent notices on three widely read professional email lists, targeted at researchers who study pro-environmental behavior: the American Psychological Association's Division 34 (Society for Environmental, Population, and Conservation psychology) list; the International Environmental Psychology list; and the Virtual Community on Sustainability and Consumption's newsletter. We received nine studies for consideration of inclusion via these lists. Second, we directly



contacted researchers via email who recently published in this field, which produced another nine studies. Third, we included two unpublished datasets collected by the authorship team from which correlations could be calculated from relevant measures. Finally, we included data from the European Social Survey 8 (2016), an open data source which is comprised of representative samples from 23 countries and contains measures of pro-environmental behavior and subjective wellbeing; to our knowledge the correlations from the relevant measures in this dataset have not yet been published.

2.2. Inclusion criteria

The inclusion criteria for screening were that the study must contain quantitative data about the relation between pro-environmental behavior and subjective wellbeing. Additionally, the study must quantify the relation in a form that can be statistically converted to express a correlation (e.g. Pearson's r , Spearman's r , and regression coefficients; or t - and F -tests using Lakens' methods of conversion; Lakens 2017). For five studies, the relation was not reported in a useable manner but it was clear the data would be appropriate to calculate correlations from, so we contacted the correspondence author to request the relevant statistics and heard back from four of them (80% response rate). In the cases when we obtained datasets in lieu of reports for unpublished studies, our lead author calculated the required effect sizes.

2.3. Data processing

2.3.1. Obtaining effect sizes

We calculated each study's effect size in the following way. First, most studies obtained in our search

contained multiple relevant effect sizes for our meta-analyses. For example, say a study examined how performing two separate pro-environmental behaviors, energy use and recycling, contribute to a person's evaluative happiness. This implies that two separate correlations could be obtained from the same sample. In such cases, the correlations could not both be included individually within the same meta-analysis, as this would violate our analyses' assumption of independence of observations (Borenstein *et al* 2009). And so, if more than one effect size was reported in a study, the effects were averaged into one aggregated effect size within each meta-analysis. If the sample sizes within these studies with multiple measures varied due to missing data, the average sample size was calculated and used¹.

Next, if effect sizes were reported in a form other than Pearson's r , they were converted using standard conversion statistical practices for meta-analyses (for a detailed list of equations used, see van Valkengoed and Steg 2019). Lastly, because of the inherently restricted range of Pearson correlation coefficients which causes the distribution of correlation effect sizes to be non-normally distributed, we followed standard transformation procedures for meta-analyses: prior to conducting the meta-analyses, we transformed the effect sizes using Fisher's z variance-stabilizing transformation (Fisher 1925). The transformed coefficients (r_z) were used to conduct the

¹ This is a necessary adjustment because meta-analysis weights studies' individual observed correlations relative to their sample size when calculating the aggregated correlation estimates (Borenstein *et al* 2009).

meta-analyses before using the inverse transformation back to Pearson r for interpretation and reporting (Borenstein et al 2009).

For all analyses, effect sizes were interpreted for practical meaningfulness using the cut-offs suggested by Cohen (1988). We selected Cohen's (1988) standards for interpreting correlations because they are commonly employed within the social and behavioral sciences and add critical practical value to the results of meta-analyses (Durlak and Lipsey 1991). Using these guidelines, a correlation of .10 is considered a small effect, .24 is a medium effect, and .37 or higher is a large effect.

2.3.2. Data structuring

First, we created an overall dataset, aimed at identifying an overall estimate of the relation between subjective wellbeing and pro-environmental behavior, regardless of the type of subjective wellbeing or behavior measured. Our overall dataset contained 78 studies (from 68 published papers and 5 unpublished datasets) for inclusion in our meta-analyses (see figure 2 for effect sizes and supplemental information (available online at stacks.iop.org/ERL/15/123007/mmedia) table 1 for study details). This dataset was also used to search for evidence of possible publication bias and explore whether effect sizes would differ depending on study characteristics.

Second, we created five data subsets to look into the extent to which the relation between pro-environmental behavior and subjective wellbeing varies across specific types of pro-environmental behaviors. In order to create these subsets, we followed common practice from other meta-analyses which suggest $k = 5$ as the minimum number of studies needed to conduct a meta-analysis (Hornsey et al 2016, van Valkengoed and Steg 2019). Many studies included a multi-faceted scale or index of many kinds of pro-environmental behaviors ($k = 53$). Hence, to address our research question, we only selected studies that targeted a specific behavior in this set of meta-analyses, which we explain below.

Purchasing behavior ($k = 20$) was the most commonly studied specific pro-environmental behavior we found in the literature. Most of the studies we found focused on large, one-time investments, such as purchasing an electric vehicle (e.g. Rezvani et al 2017) or an energy efficient household appliance (e.g. European Social Survey 2016).

Food choices ($k = 7$) were typically measured via self-reported frequency of consuming eco-friendly or organic labeled food options (e.g. Zannakis et al 2019).

Energy use ($k = 8$) was most commonly conceptualized as self-reported energy demand reduction, or the extent to which people try to save energy (e.g. European Social Survey 2016).

Collective action ($k = 7$) was typically measured by asking people about whether or not they donate resources (i.e. time, money) to environmental causes (e.g. Suárez-Varela et al 2016) or participated in/collaborated with pro-environmental initiatives or groups (e.g. Janmaimool and Denpaiboon 2016).

Waste behaviors ($k = 7$) was typically measured as self-reported frequency of recycling, either alone or in combination with other waste-reduction behaviors (e.g. Jacob et al 2009).

In addition to these five specific pro-environmental behaviors, we identified five other specific pro-environmental behaviors for which there were too few studies to conduct separate meta-analyses: travel behaviors ($k = 2$), water use ($k = 3$), policy support ($k = 2$), workplace behavior ($k = 3$), and refusal to buy new items ($k = 2$). Despite not being useable for separate behavior-specific meta-analyses, all specific pro-environmental behaviors and multi-faceted scales were included in the overall meta-analysis.

Third, we created four data subsets to look into the extent to which the relation between pro-environmental behavior and subjective wellbeing varies across different indicators of subjective wellbeing. Again, these meta-analyses were only conducted when a minimum of five studies were available.

We found that all four indicators of subjective wellbeing had a sufficient number of studies to examine in separate meta-analyses. Seven studies included a multi-faceted composite of the subjective wellbeing indicators, and were therefore not included in subsets for specific indicators of subjective wellbeing (but were included in the overall dataset). Briefly, we describe the most commonly used operationalization for each indicator of subjective wellbeing we observed in the literature:

Hedonic happiness ($k = 28$) was most commonly, measured using the positive affect items from the Positive Affect Negative Affect Schedule (Watson et al 1988; e.g. Coelho et al 2017). If only using a single-item measure, hedonic happiness was most commonly measured by asking participants the extent to which they feel happy at the moment (e.g. Moreton et al 2019).

Evaluative happiness ($k = 34$) was the most commonly employed definition of subjective wellbeing we observed. To measure it, researchers most commonly used the Satisfaction with Life Scale (Diener et al 1985; e.g. Zannakis et al 2019) or a single-item asking participants the extent to which they are satisfied with their lives (e.g. Janmaimool and Denpaiboon 2016).

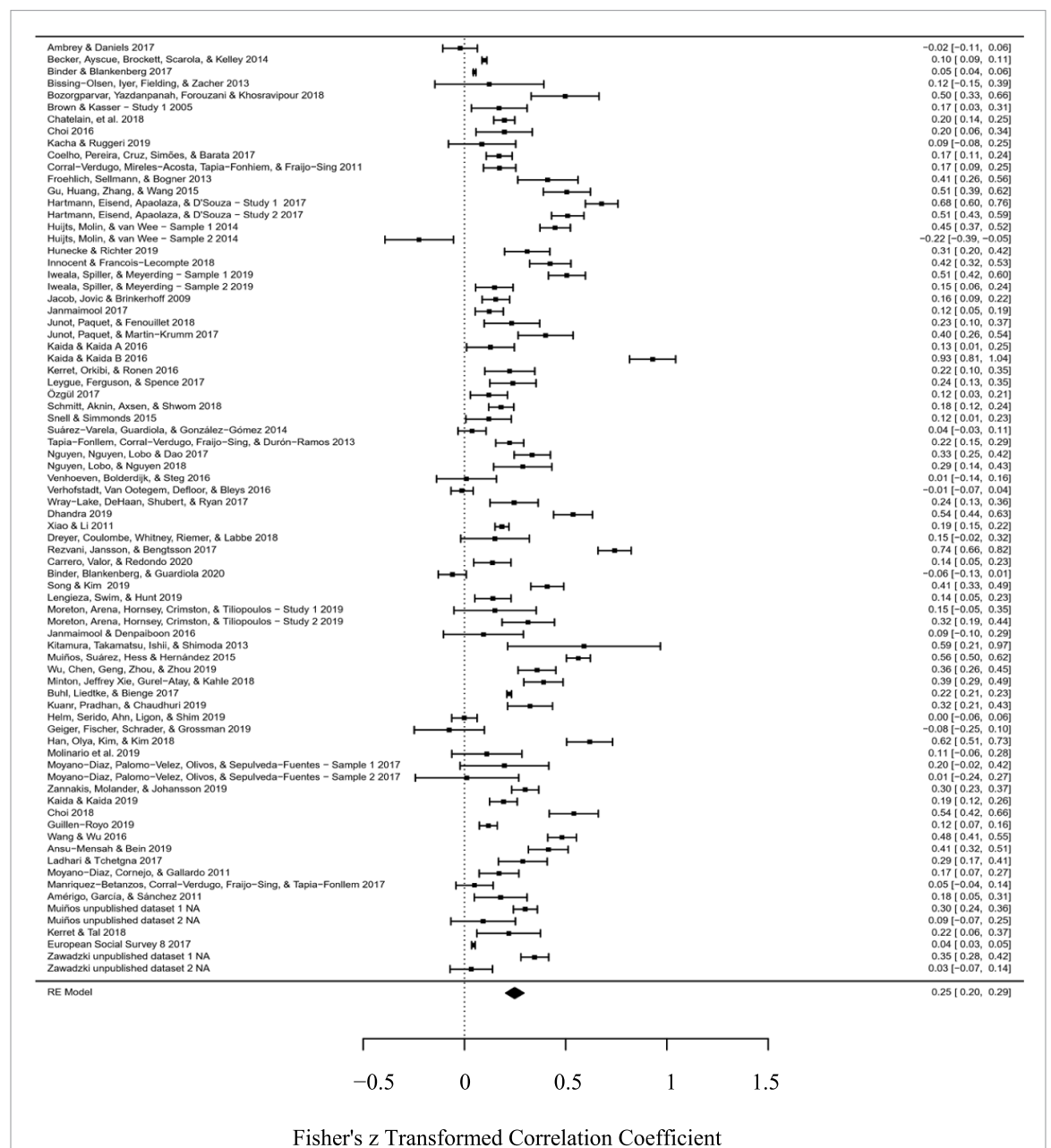
Eudaimonic happiness ($k = 12$) was typically measured using Steger et al's (2006) Meaning in Life scale (e.g. Molinario et al 2019).

Warm glow ($k = 12$) was typically measured via self-reported measures, asking participants the extent to which they felt a sense of happiness, pride, or

Table 1. Summary of statistics for all meta-analyses.

	<i>R</i>	95% LCI	95% UCI	<i>k</i>	<i>N</i>	<i>Q</i>	<i>T</i> ²	<i>I</i> ²	<i>z</i>	<i>p</i>
Overall	0.243	0.200	0.285	78	212 181.6	2851.73	0.038	98.81	10.723	<0.001
Pro-environmental behaviors										
Purchasing	0.332	0.224	0.431	20	54 198.3	1031.701	0.068	98.58	5.798	<0.001
Food	0.224	0.075	0.363	7	3244	76.309	0.039	94.45	2.918	0.004
Energy use	0.216	0.042	0.377	8	46 139.8	202.488	0.060	97.35	2.418	0.016
Collective action	0.146	−0.007	0.292	7	2823	88.131	0.039	93.48	1.876	0.061
Waste	0.138	0.058	0.215	7	30 108	39.928	0.009	89.24	3.377	<0.001
Subjective Wellbeing										
Hedonic	0.201	0.133	0.267	28	81 425	558.956	0.031	98.27	5.705	<0.001
Evaluative	0.213	0.145	0.278	34	169 934.5	1587.590	0.041	99.32	6.077	<0.001
Eudaimonic	0.240	0.140	0.335	12	4929.5	96.415	0.028	90.86	4.633	<0.001
Warm Glow	0.400	0.313	0.480	12	5695	157.556	0.029	93.03	8.323	<0.001

Notes: *k* = number of studies, *N* = number of participants, *Q* = total variance, *I*² = proportion of variability due to heterogeneity between studies rather than sampling error, *T*² = between-study variance, *p*-values are based on *z*-tests from reported *z*-statistics.

**Figure 2.** Forest plot of effect sizes in overall estimate of relation between subjective wellbeing and pro-environmental behavior.

self-respect when performing a specific or set of pro-environmental behaviors (e.g. Wang and Wu 2016).

2.3.3. Identification and handling of outliers

Following best practices for meta-analyses, we employed a two-stage check for outliers within each dataset (Viechetbauer and Cheung 2010). First, outliers were identified by examining plots of studentized deleted residuals for each effect size within each factor. Additionally, Cook's distance (or *Cook's d*) was calculated for each effect size to determine whether the outlier may have exerted sufficient influence to alter the obtained result (Cook and Weisberg 1982). This process identified outliers within the following meta-analyses: overall relationship environmental behavior and subjective wellbeing ($k_{\text{outlier}} = 1$), evaluative happiness, ($k_{\text{outlier}} = 1$), eudaimonic happiness ($k_{\text{outlier}} = 1$), collective action ($k_{\text{outlier}} = 2$), and waste behavior ($k_{\text{outlier}} = 1$). Some studies were outliers in multiple meta-analyses, although it was not always the same studies in every case. All effect size estimation and moderation analyses were run with and without outliers and no meaningful differences were found between outcomes. Therefore, the meta-analyses reported here are with outliers included. See Supplemental Information for more information on the studies flagged as outliers and details about effect size estimates with and without outliers.

2.4. Description of final data set

An examination of the release year for published papers suggests this is a relatively new literature, with the earliest study conducted in 2005, while 77% of articles published on this topic were published within the past 5 years (2016 or later; see figure 3). The studies represent data collected in 37 countries on five continents (see figure 4), suggesting this literature is somewhat geographically representative. However, much of Africa, the Middle East, Central and South America and most island nations are absent. The countries with the most representation in our studies are the United States ($k = 14$), Spain ($k = 8$), and Australia ($k = 7$).

3. Results

All meta-analyses were conducted in R using the metafor package (version 2.4-0). Each factor was fitted with a random-effects meta-analysis model.

3.1. Overall estimation of the relation between pro-environmental behavior and subjective wellbeing

Our primary research question was to determine the direction and strength of the relation between individuals' pro-environmental behavior and their subjective wellbeing. Overall and as predicted (H1), we found a significant, positive relationship of medium effect size ($r = 0.243$, $p < 0.001$, 95%CI [0.200, 0.285];

see table 1 for additional statistics). This suggests more performance of more pro-environmental behaviors is associated with greater subjective wellbeing.

3.1.1. Publication bias

As significant results are more likely to be published than non-significant results, effect size estimates can be biased toward being stronger than they may actually be. We assessed the risk of publication biases to our overall meta-analysis by examining funnel plots and testing for asymmetry, conducting failsafe N tests, and running trim-and-fill procedures and found no clear evidence of publication bias. Additionally, as we included non-published research, we were able to explore if a study being published or not was a significant moderator, and it was not ($Q_M(1) = 0.897$, $p = 0.344$). Hence, overall, no strong evidence of publication bias was found to indicate it may have influenced the reported effect sizes. See Supplemental Information for full results of publication bias analyses.

3.1.2. Study characteristics

Next, we examined various study characteristics that may influence the strength of the relationship between pro-environmental behavior and subjective wellbeing, namely sample characteristics, study designs, modes of data collection, and order of measures. None of these factors significantly moderated the effect size, suggesting that strength of the relation between pro-environmental behavior and subjective wellbeing seems not to differ depending on who is in the sample, the method used to collect their data, the design of the study, and the order in which the measures were obtained (see tables 2a–2e). Please note that relatively few studies ($k = 19$) reported the order of their measures, and so conclusions from this analysis should be drawn with caution.

3.2. Testing whether the relation is stronger for pro-environmental behaviors and subjective wellbeing indicators with clear meaning

To determine if the relation between pro-environmental behavior and subjective wellbeing is stronger when the type of behavior and indicators of subjective wellbeing more clearly reflect meaning, we conducted a series of nine meta-analyses on subsets of the data. See figure 5 for an overview of all effects and table 1 for more statistical details.

3.2.1. Types of pro-environmental behaviors

For nearly all pro-environmental behaviors we found significant positive relations with subjective wellbeing. In order from largest to smallest effect size, we found: purchasing behavior ($r = 0.332$, 95%CI [0.224, 0.431], medium-strong effect), food choices ($r = 0.224$, 95%CI [0.075, 0.363], small-medium effect), energy use ($r = 0.216$, 95%CI [0.042, 0.377], small-medium effect), collective action ($r = 0.146$,

Tables 2a–2e. Summary of statistics for all moderator analysis conducted on the overall dataset.

Table 2a. Moderator: Sample		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)	
		Estimate	LCI	UCI			LCI	UCI			LCI	UCI	
					p -value	k	Table 2b. Moderator: Data Collection Mode			Estimate			p -value
													K
Students		0.202	0.094	0.306	<0.001	13	Pen and paper/mail-in			0.272	0.163	0.374	<0.001
Adult convenience/panel		0.282	0.207	0.353	<0.001	25	Face-to-face			0.253	0.139	0.361	<0.001
Representative sample		0.172	0.056	0.282	0.004	11	Online			0.283	0.216	0.348	<0.001
Specific target group		0.273	0.191	0.352	<0.001	22	Laboratory			0.220	−0.073	0.478	0.140
Other/unclear		0.206	0.059	0.344	0.006	7	Other/unclear			0.157	0.064	0.248	0.001
							Multi-modal			0.201	0.006	0.381	0.044
													4 ^a
Table 2c. Moderator: Method		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)	
		Estimate	LCI	UCI			LCI	UCI			LCI	UCI	
					p -value	k	Table 2c. Moderator: Measurement Order			Estimate			p -value
													K
Single-purpose survey		0.278	0.223	0.330	<0.001	47	SWB first			0.221	0.107	0.33	0.002
Multi-purpose survey		0.171	0.090	0.250	<0.001	22	PEB first			0.275	0.138	0.403	0.001
Experiment		0.240	0.068	0.399	0.007	5	Unknown/other			0.243	0.193	0.292	<0.001
Field study/quasi-experiment		0.252	0.061	0.426	0.01	4 ^a							58
Table 2e. Moderator: Publish Status		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)		Q_M	df	p -value (Q_M)	
		Estimate	LCI	UCI			LCI	UCI			LCI	UCI	
					p -value	k							
Unpublished		0.164	−0.010	0.329	0.065	5							
Published		0.249	0.204	0.292	<0.001	73							

Notes: Reference groups for Q_M statistics are first level of moderators listed in each table.^a Low k , estimates may be unreliable.

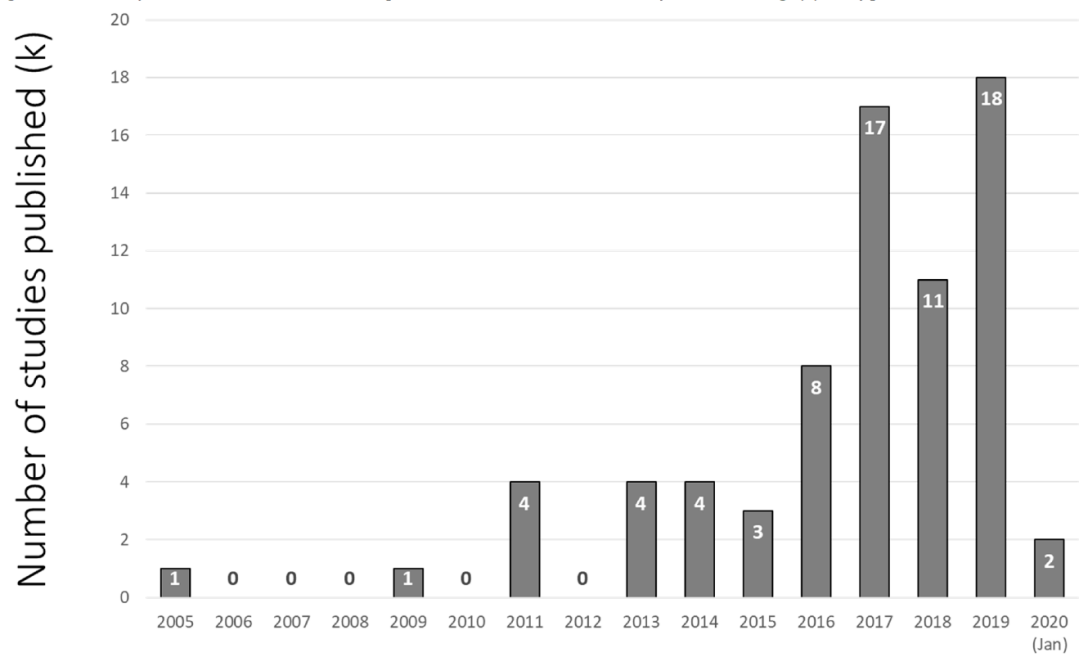


Figure 3. Number of studies on the relation between pro-environmental behavior and subjective wellbeing by year of publication.

95%CI $[-0.007, 0.292]$, non-significant small effect)², and waste behavior ($r = 0.138$, 95%CI $[0.058, 0.215]$, small effect). These results suggest that purchase decisions may be more strongly associated with subjective wellbeing compared to daily food choices, energy use, collective action, and waste behaviors, offering partial support for hypothesis 2. Specifically, the relation is generally stronger for types of pro-environmental behaviors which are more meaningful.

3.2.2. Indicators of subjective wellbeing

As expected, all four indicators of subjective wellbeing were significantly and positively related to pro-environmental behavior, but also as expected the relation was stronger for indicators of subjective wellbeing that more clearly reflect meaning. We observed a weak-to-moderate relation with hedonic happiness ($r = 0.201$, 95%CI $[0.133, 0.267]$, small-medium effect); a moderate relation with evaluative happiness ($r = 0.213$, 95%CI $[0.145, 0.278]$, small-medium effect); a moderate relation with eudaimonic happiness ($r = 0.240$, 95%CI $[0.140, 0.335]$, medium effect); and the largest effect size was found between pro-environmental behavior and warm glow ($r = 0.400$, 95%CI $[0.313, 0.480]$, strong effect). As

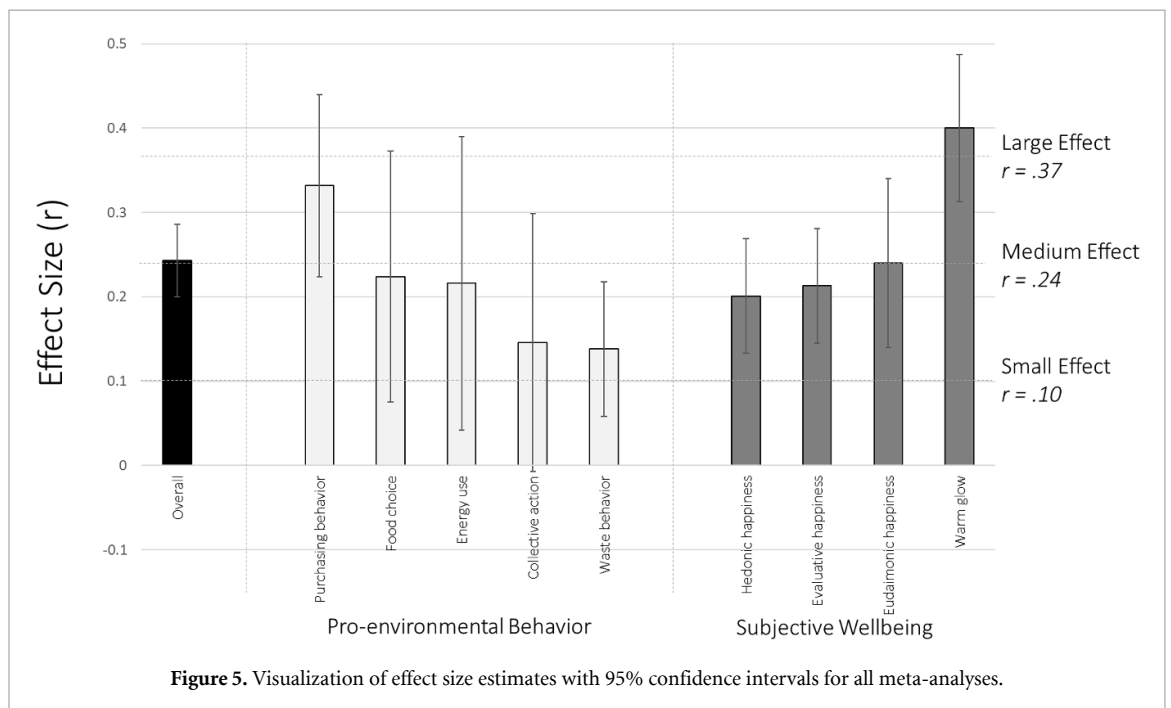
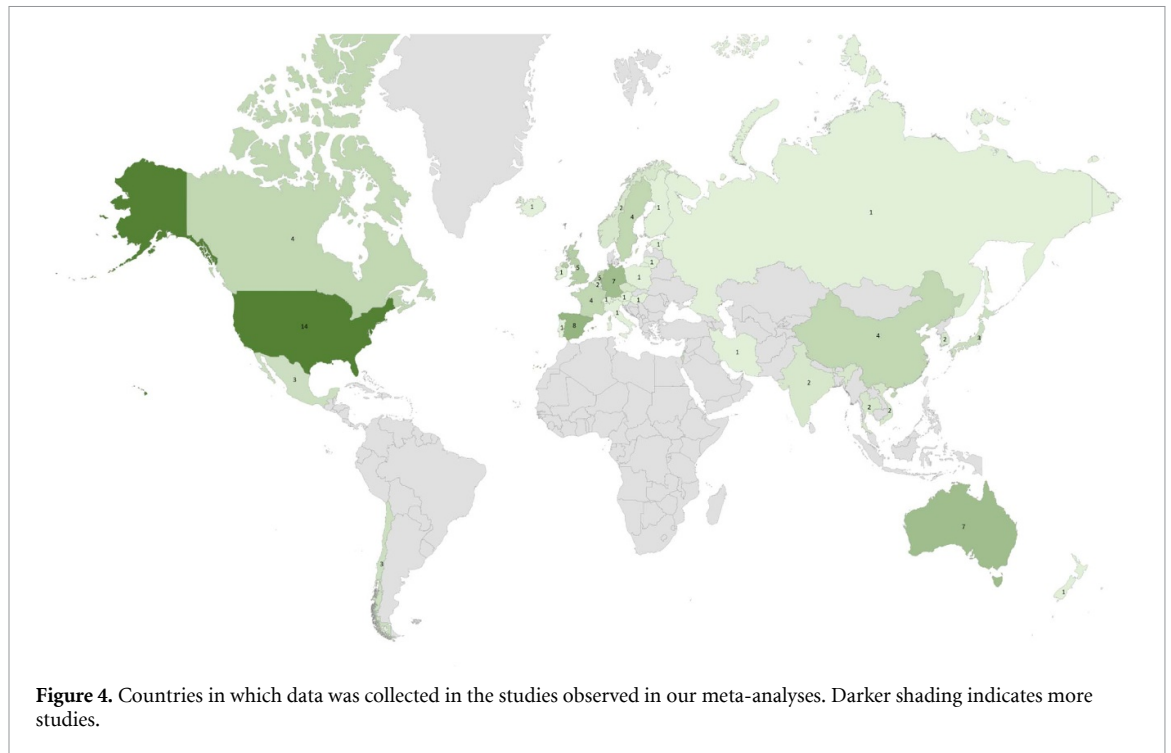
we predicted, this suggests pro-environmental behaviors was more closely linked to warm glow than to the other indicators of subjective wellbeing (H3b). Pro-environmental behaviors were only slightly more strongly related to eudaimonic happiness compared to hedonic and evaluative happiness (H3a).

4. Discussion

Our results support our reasoning that pro-environmental behavior is related to higher subjective wellbeing because acting pro-environmentally is meaningful. Specifically, we found the relation between pro-environmental behavior and subjective wellbeing is consistently positive, with a medium effect size (H1). Further, the confidence interval around our estimated effect was relatively small, which implies that we can be reasonably confident that the relation between pro-environmental behavior likely enhances subjective wellbeing. These findings contradict the common assumption that pro-environmental behaviors would reduce wellbeing because they are often costly, effortful, or otherwise unpleasant to do. Rather, overall, our findings suggest that pro-environmental behaviors are likely inherently meaningful to do (van der Werff *et al* 2013, Venhoeven *et al* 2016, 2020), and therefore make people feel positive about their behaviors (i.e. warm glow) and about themselves more generally (i.e. hedonic, evaluative, and eudaimonic happiness).

We also found support for our reasoning that the relationship between pro-environmental behavior and subjective wellbeing was stronger for pro-environmental behaviors that are likely to be more

² The collective action estimate contains two studies flagged as outliers, the highest ($r = 0.43$) and the lowest ($r = -0.22$) correlation observed within this small meta-analysis. Both of these studies were found in the same paper (Huijts *et al* 2014). When these outliers are removed the effect size remains roughly the same, but becomes statistically significant and the confidence interval no longer contains zero ($r = 0.134$, 95%CI $[0.061, 0.205]$, small effect).



meaningful, and for indicators of subjective wellbeing that more closely reflect meaning, again supporting our theorizing that pro-environmental behaviors enhances wellbeing because they are meaningful to do. Specifically, as predicted, we found that the relation between pro-environmental behavior and wellbeing was stronger for pro-environmental behaviors which are consciously decided and so the meaning clear at the time of performance (H2; i.e. purchase decisions that are likely to be consciously made), and for indicators of subjective wellbeing which more clearly reflect meaning (H3a; i.e. warm glow and

eudaimonic happiness). Further, as expected, the relation was strongest for warm glow indicators of subjective wellbeing, which explicitly reflects feeling meaningful about performing a behavior, rather than feeling meaningful in general (H3b). This finding makes sense theoretically, as when asked to evaluate more general aspects of their subjective wellbeing, like hedonic, evaluative, and eudaimonic happiness, people probably consider many aspects of their lives in addition to their pro-environmental behaviors.

Our finding that consciously-performed behaviors were more strongly related to subjective wellbeing

than behaviors which we reasoned are more likely to be performed without much conscious attention, supports our theoretical reasoning that meaning is likely an important driver of the positive relationship between pro-environmental behavior and subjective wellbeing relation. However, we found one behavior, collective action, which did not align with the consistent pattern we otherwise found. We would expect collective action, which usually involves deliberate conscious decision-making to perform, to be a relatively meaningful behavior to perform and therefore relatively strongly associated with subjective wellbeing. Yet this behavior had the weakest association of all behaviors we examined. Perhaps this weak relation is because some negative emotions might be important motivators for participating in collective action (van Zomeren *et al* 2008). Such a mix of positive and negative emotions associated with collective action can be reflected in our non-significant results. More research is needed to determine to what extent collective action is perceived as meaningful and whether meaning plays a mediative role in the relation between collective action and subjective wellbeing.

Despite the differences in relative strength of the relation between pro-environmental behavior and subjective wellbeing, the overall robustness and consistently positive direction of effects across different types of pro-environmental behaviors, indicators of subjective wellbeing, and different study characteristics is noteworthy. Importantly, we found that the positive association between pro-environmental behavior and subjective wellbeing does not appear to vary significantly based on study characteristics, such as study sample, design, mode of data collection, or order of measurements. Further, while we can never be fully sure of the potential influence of publication bias on our results, we found no evidence of publication bias. Thus, our results suggest the positive relation between pro-environmental behavior and subjective wellbeing is quite robust and will likely generalize across many people and contexts.

Although we find clear support for our reasoning that pro-environmental behaviors likely enhance subjective wellbeing because they are meaningful, our conclusions are indirectly inferred by examining whether effect sizes are stronger for types of behaviors and indicators of meaning that more clearly reflect meaning (see Venhoeven *et al* 2020). That is, we *a priori* theorized that certain behaviors and indicators of subjective wellbeing are more closely linked to meaning than others. Yet, within the confines of this meta-analysis, we were unable to directly test this, as the studies included typically did not measure meaning. Therefore, future research could directly test the psychological process connecting pro-environmental behavior and subjective wellbeing. Specifically, future research could examine whether pro-environmental behavior enhances wellbeing because it is perceived to be meaningful, by including meaning as a mediator in

this relation. In doing so, both consciously and sub-consciously measures of meaning could be employed (see Venhoeven *et al* 2020, who employed implicit measures to examine the relation between pro-environmental behavior and subjective wellbeing).

Future research could further examine what makes pro-environmental behavior meaningful. A number of characteristics could enhance the meaning of pro-environmental behaviors, thereby making it more likely that the behavior would enhance subjective wellbeing. For example, a behavior may be considered more meaningful when it is seen as more costly or difficult to perform, socially unique or status-enhancing, clearly benefiting the environment, strongly enhancing someone's perceived self-image, or, as we suggest, when it is performed more consciously rather than automatically as a habit. Future research is needed to determine if these characteristics enhance the meaning of behavior, and whether this enhancement, in turn, makes it more likely that the relevant pro-environmental behavior enhances subjective wellbeing.

We found that the majority of studies in this field are correlational. Only 10% ($k = 8$) of our sample employed experimental or quasi-experimental methods and contained statistics suitable for inclusion in our meta-analysis. Therefore, we cannot make firm conclusions about the causal order of the relation between pro-environmental behavior and subjective wellbeing, and we cannot rule-out the possibility that pro-environmental behavior and subjective wellbeing are connected via an unaccounted-for third variable. Yet, the few experimental and quasi-experimental studies included in our review do provide support for a causal relation between the performance of pro-environmental behaviors and subjective wellbeing. Interestingly, most of these (quasi-)experimental studies ($k = 7$) suggest that the reverse causal order than we theorized may also occur (i.e. most of these studies induced a positive affective state and examined whether this would promote pro-environmental behaviors). This is both interesting and important, because it suggests that there is potential for creating a positive self-reinforcing cycle between pro-environmental engagement and subjective wellbeing, which may promote long-term environmental behaviors and enhanced subjective wellbeing (see van der Linden 2018). We recommend that future studies employ more experimental and longitudinal designs in order to systematically test the causal relation between pro-environmental behavior and subjective wellbeing, and to examine how this relation develops over time, as this may illuminate potentially powerful and exciting avenues for interventions.

Over the course of conducting our meta-analysis, we noticed a few limitations in reporting, which restricted some of our analyses (e.g. estimation of measurement order effects). In order to facilitate

future meta-analyses and the creation of a cohesive literature on the relation between pro-environmental behavior and subjective wellbeing, we recommend to improve consistency in reporting of study findings by explicitly stating the following information within all quantitative research in this domain.

First, it is important to have easily *identifiable and clearly stated definitions of core variables* (theoretical conceptualizations), as well as a *full overview of items for measures* (operationalizations). This information is critical to screen and code studies that could be included in a meta-analysis. In addition, we recommend researchers *state the order in which constructs were measured*, which 74% of the studies we encountered did not provide sufficient information on. While we found that order effects may be unlikely to affect results, our conclusions remain tentative in this regard because most studies did not mention measurement order. Lastly, we recommend researchers explicitly state *how the data was collected*, which 23% of studies included in our meta-analysis did not do.

Our findings have important practical implications. In order to successfully address today's environmental challenges like climate change, the general public has to engage in a range of pro-environmental behaviors. As pro-environmental behaviors can be costly or effortful, it is often assumed they may have negative implications for people's everyday lives, and therefore, for their subjective wellbeing. As a result, policy-makers may feel hesitant to implement policies which promote or enforce these types of behaviors for fear that it will make their constituents unhappy. However, our meta-analyses show evidence to the contrary: across many types of pro-environmental behaviors, no negative relations between pro-environmental behavior with different indicators of subjective wellbeing were found. In fact, we consistently found that pro-environmental behavior is positively related to subjective wellbeing. Importantly, even though our analyses included relatively costly behaviors, like buying an energy efficient appliance, our results suggest such behaviors are likely seen by people as personally meaningful and therefore feel rewarding to do. As such, the results of our meta-analyses suggest that pro-environmental behaviors not only benefit the environment, but may also enhance the subjective wellbeing of the individuals who engage in these behaviors. Therefore, our results suggest implementing policies to promote pro-environmental actions are unlikely to merely impede people's subjective wellbeing, and that interventions to promote pro-environmental behavior are likely to produce 'win-win' situations by also enhancing subjective wellbeing.

Importantly, as indicated above, there is the potential for the relation between behavior and subjective wellbeing to become a self-reinforcing

motivational feedback loop. People may perform an initial pro-environmental behavior, which may enhance their subjective wellbeing. This enhanced subjective wellbeing could, in turn, motivate them to perform more pro-environmental behaviors (van der Linden 2018), further enhancing their subjective wellbeing. This implies that it can be beneficial to ensure the pro-environmental meaning of a behavior is made clear. By highlighting the inherent meaning of pro-environmental behaviors, people may be more attuned to the resulting feelings of warm glow, eudaimonic happiness, and the other positive experiences they feel while performing pro-environmental behaviors. They may then be more inclined to perform similar behaviors in the future, anticipating these positive feelings (Taufik et al 2016). Moreover, it may be beneficial for policy-makers to emphasize how pro-environmental behaviors enhance, rather than detract from, people's subjective wellbeing to maintain public engagement with pro-environmental programs or policies. Future studies could test which strategies are most effective in emphasizing the meaning of pro-environmental behavior, and to make people aware of the beneficial effects of pro-environmental actions on subjective wellbeing.

5. Conclusion

Using a series of meta-analyses, we found a consistently positive relation between individuals' pro-environmental behavior and their subjective wellbeing, across different types of pro-environmental behavior, different indicators of subjective wellbeing, and different samples and study characteristics. Our results suggest that this may be because many pro-environmental behaviors are meaningful, which makes people feel good about themselves when they act pro-environmentally, enhancing subjective wellbeing. Specifically, we found that the more clearly a behavior or indicator of subjective wellbeing is linked with personal meaning, the stronger the relationship between pro-environmental behavior and subjective wellbeing is likely to be. The robust, positive relation we found between acting pro-environmentally and subjective wellbeing suggests that program and policy-makers can design environmental solutions that simultaneously enhance environmental quality and human wellbeing, addressing multiple Sustainable Development Goals (UN 2016).

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Authorship contributions

All authors contributed to the formulation of the research question, methodological approaches for the systematic review, and approved the final manuscript before submission. S J Z implemented the systematic review, conducted all statistical analyses, and led the drafting of the manuscript. T B and L S facilitated the implementation of the systematic review process and analyses and provided critical input for writing of the manuscript.

Conflict of interest

The authors declare no financial or non-financial competing interests.


Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors.

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