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The relationship between pro-environmental behavior, subjective well-being, and environmental impact: a meta-analysis

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Abstract

A substantial change towards more pro-environmental behavior (PEB) is essential to reach the required reduction in greenhouse gas emissions and mitigate climate change. These behavior changes will have consequences on people's daily lives and thus might affect their well-being. Previous research generally finds positive correlations between PEB and well-being. This meta-analysis explores whether the relationship between PEB and well-being depends on the environmental impact of the performed PEB. Overall, the paper finds a small but significant positive relation between PEB and well-being. When accounting for the environmental impact of the PEB, however, the positive relationship only remains for low-impact PEB. The meta-analysis does not provide any evidence that engaging in high-impact PEB relates to well-being. Consequently, these findings demonstrate that there is more ambiguity in the relationship between PEB and well-being than previously described in the literature and that the environmental impact of PEB matters when evaluating its relationship with well-being. These findings have important implications for policy-making trying to facilitate mitigation efforts that ultimately aim to balance the well-being of the current and future generations.

1. Introduction

Climate change mitigation is one of the dominating global challenges of the following decades and one of the biggest threats to the well-being of the planet and future generations (Intergovernmental Panel on Climate Change 2022). The overall reduction of greenhouse gas emissions requires swift global policy efforts, including demand-side solutions to transform the lifestyle and consumption patterns of individuals and private households (Creutzig *et al* 2022), which can be linked to almost two-thirds of global greenhouse gas emissions (Ivanova *et al* 2016). The share of these emissions is distributed unequally worldwide, both within and between countries (Ivanova and Wood 2020, Chancel 2022). It is, therefore, essential that high-emitters substantially change towards more pro-environmental behavior (PEB), which includes engaging in behaviors that benefit the environment (e.g. switching to a car with renewable fuels) and reducing or omitting behaviors that harm the environment (e.g. avoiding meat or dairy; Steg and Vlek 2009, Lange and Dewitte 2019). These behavior changes will not only reduce people's environmental footprint but may also lead to changes in how they eat, travel, and spend their daily lives, and thus, may have consequences on their well-being.

In the coming years, the need for climate change mitigation will challenge decision-makers to balance the rights and well-being of future generations with the well-being of citizens today. Consequently, aiming to implement measures that achieve large greenhouse gas emission reductions while minimizing adverse effects on the well-being of those directly affected. To facilitate successful environmental behavior change and implement effective climate policy, gaining a better understanding of the relationship between PEB and well-being is imperative. This paper contributes to this research area using a meta-analytical approach to explore whether the relationship between PEB and well-being depends on the environmental impact of the behavior.

Recent studies find that demand-side climate change mitigation can be compatible with human well-being and explore how both can be achieved simultaneously (e.g. Millward-Hopkins *et al* 2020, Vogel *et al* 2021, Creutzig *et al* 2022). In these studies, well-being is often defined objectively and measured by evaluating the fulfillment of basic human needs, such as access to healthy food and water, or level of education and income. While these basic human needs are fundamental to human well-being, they explain only parts of the variation in life evaluations (Tay and Diener 2011). Especially in high-emitting contexts, where basic human needs tend to be satisfied, a more subjective perspective on well-being may be helpful. Alongside structural barriers (e.g. lack of sustainable options or infrastructure), many factors hindering environmental behavior change are psychological (e.g. reluctance to change one's lifestyle or personal priorities; Lorenzoni *et al* 2007). This study, thus, approaches well-being from a subjective perspective. Subjective well-being (SWB), combining cognitive and affective measures (Diener 2000), focuses solely on the individual's perspective: Somebody experiences high well-being only if they perceive their lives as satisfactory and worthwhile and feel many positive and few negative emotions. SWB has gained increasing significance for policy-makers and within policy research as a measure of human welfare beyond the gross domestic product (e.g. Cavalletti and Corsi 2018, Stiglitz *et al* 2018).

There are several ways in which more PEB could affect SWB. On the one hand, climate change mitigation requires individuals to change their behavior in different areas of their lives, including their diet, mobility, and housing (Ivanova *et al* 2016, 2020). These behavior changes are often accompanied by personal costs, e.g. time, money, effort, and loss of comfort or pleasure (see, e.g. Kaiser *et al* 2021). In fact, PEB is often perceived as a sacrifice that needs to be made for the greater good (Kaplan 2000, Prinzing 2020), suggesting a negative effect on one's SWB. On the other hand, the effect of PEB on SWB could also be positive. Studies have shown that performing actions that benefit somebody else or the greater good can elicit an internal emotional reward—i.e. a *warm glow* that makes us feel good (Andreoni 1990, Menges *et al* 2005, Taufik *et al* 2015, Van Der Linden 2018). The prerequisite for this phenomenon is perceiving a behavior as meaningful or the 'right thing' to do, as is often the case for behaviors aiming at mitigating climate change (Venhoeven *et al* 2020). Voluntarily performing these meaningful behaviors can act as a self-signal that one is an 'environmentally friendly and thus good person' (Venhoeven *et al* 2016, p 1)—which boosts one's self-image, elicits positive emotions, and consequently enhances well-being levels (Taufik *et al* 2015, Venhoeven *et al* 2016). Consistent with this line of reasoning, previous research generally finds overall positive correlations between PEB and SWB (see Zawadzki *et al* 2020 for a meta-analysis), suggesting that people who engage more in PEB could be, in fact, happier and more satisfied with their lives than people who do less for the environment.

However, most research investigating the relationship between PEB and SWB does not consider the *impact* of the studied behaviors on greenhouse gas emissions or carbon footprints (Nielsen *et al* 2021). Environmental psychology studies predominantly measure PEB using scales designed to detect underlying pro-environmental intentions and their antecedents (Lange and Dewitte 2019). They are, however, not necessarily informative about the environmental impact of the behaviors included (common behaviors measured are, e.g. stopping the water while brushing one's teeth or bringing a bag to the grocery store). While the intention to act environmentally friendly is an important driver of engaging in PEB (Bamberg and Möser 2007), it does not necessarily translate to lower ecological footprints (Csutora 2012, Moser and Kleinhückelkotten 2018, Nielsen *et al* 2022). To mitigate climate change, engaging in low-impact PEBs will likely not suffice—instead, a focus on high-impact behaviors is needed (Nielsen *et al* 2021). It is thus critical to understand whether the previously identified positive relationship between PEB and SWB remains when considering the environmental impact of the behavior.

This paper follows a meta-analytical approach to examine the current evidence on the relationship between PEB and SWB in light of its relevance for mitigating climate change and answers the following research question: *Does the relationship between PEB and SWB differ depending on the environmental impact of the PEB?*

2. Methods

A meta-analysis was conducted to answer the research question and assess the relationship between PEB, SWB, and environmental impact. This section outlines the procedure, including the search for articles, the article screening and coding, the effect size measures and additional variables, the data structuring, and the meta-analytic procedure.

2.1. Article search

The search strategy aimed to identify studies investigating the relationship between PEB and SWB. Because environmental behaviors are studied in many contexts, some of which with no relation to the environment (e.g. studying vegetarian diets in a health context), four complementary PEB search strategies

Table 1. PEB search strategies.

Search strategy	Description
Pro-environmental	Studies investigating behaviors specifically termed as pro-environmental (including similar terms)
Climate change	Studies investigating behaviors in the context of climate change mitigation and greenhouse gas emission reduction
Reduction	Studies investigating behaviors that generally reduce consumption levels (e.g. low consumption or frugal lifestyles)
High-impact	Studies investigating behaviors with particularly high environmental impact on climate change mitigation in the consumption areas of diet, mobility, and housing (Tukker and Jansen 2006, European Environment Agency 2013, Ivanova *et al* 2016, Dubois *et al* 2019). Specifically, behaviors included in the search were reducing or avoiding animal products (Vita *et al* 2019), switching to low-carbon travel modes (Wynes and Nicholas 2017, Vita *et al* 2019, Brand *et al* 2021), and energy-saving behaviors as well as switching to renewable energy (Wynes and Nicholas 2017, Moran *et al* 2020).

were created to retrieve as many relevant studies as possible, irrespective of their framing (see table 1).

Based on these four search strategies, appropriate search terms were developed in an iterative process, discussing and adjusting the terms based on peer feedback. These search terms were then structured in a Boolean search string (see supplemental material A), which was used to identify studies in six literature databases: Academic Search Elite, Business Source Complete, EconLit, PsycINFO, Scopus, and Web of Science. The search string was applied on a title-, abstract-, and keyword level. No time restriction was implemented (the cut-off was January 2020, when the search was performed). The accuracy of the search strategy was tested using five benchmark articles selected after an initial literature search (see supplemental material B). In addition to the search in literature databases, the bibliographies of literature reviews and included articles were also screened for additional relevant studies.

2.2. Article screening

After the article search, duplicates were removed, and the collected articles were screened for eligibility in three stages: on a title, abstract, and full-text level. For this process, inclusion and exclusion criteria were defined, covering the study population, measurement of PEB and SWB, and study methodology, which are portrayed in table 2. In sum, studies that provided a statistical effect size (e.g. correlation coefficient or group mean difference) characterizing the relationship between PEB and SWB on an individual or private household level were included.

The corresponding authors were contacted in cases where a study design indicated an appropriate effect size, but the necessary information was missing from the article. All six contacted authors responded to the request in a proper timeframe, and three out of them were able to provide additional data. Additionally, three articles were excluded because they were not written in English, and three were excluded because the full text was not retrievable. The article screening was performed using Rayyan, an online tool specifically designed for the screening process of systematic literature reviews and meta-analyses (Ouzzani *et al* 2016). Figure 1 illustrates a flow diagram describing all steps of the search and screening process and the number of studies included and excluded at every step. The final sample is composed of 61 articles containing 71 separate studies (see supplemental material C for a complete list of articles).

In order to extract information from the sample of articles, the articles were manually coded, and the data was documented in a Microsoft Excel sheet. Data were extracted on an article- and study level. The citation reference, publication type, and outlet were coded for each article. For each individual study, the following information was recorded: (a) measurement of PEB, (b) measurement of SWB, (c) effect size and type of effect size, (d) sample size, and (e) summary statistics. Additionally, information on methodology and study characteristics was extracted, which was used to test the robustness of the meta-analytical results.

2.3. Effect sizes

In line with previous work (e.g. Zawadzki *et al* 2020), Pearson's product-moment correlation coefficient—r_{xy}—was used as this meta-analysis's primary effect size measure. Correlation coefficients are standardized, enabling comparisons across different scale ranges (Borenstein *et al* 2009). In cases where other effect size measures were reported in the original study, they were converted to Pearson's r_{xy} (Peterson and Brown 2005, Borenstein *et al* 2009, Fritz *et al* 2012, Lakens 2013). These include Spearman's r, mean differences, Cohen's d, log odds ratios, Mann–Whitney-U tests, and standardized regression coefficients. Supplemental material D further discusses the inclusion of different effect size measures and provides a sensitivity analysis. Two studies were

Table 2. Eligibility criteria.

	Inclusion	Exclusion
Population	Individuals and private households	Populations other than individuals and private households (e.g. countries or organizations); Samples with specific illnesses and health problems; Participants under 18 years
Measurement of PEB	PEB (e.g. self-reported or observed) or behavioral outcomes (e.g. individual greenhouse gas emissions or carbon footprint)	Exclusive measurement of antecedents of PEB (e.g. environmental attitudes, environmental awareness, or behavioral intention); opportunities to behave more or less environmentally friendly
Measurement of SWB	Measurement of SWB or parts of SWB (cognitive or emotional component)	Measurement of economic well-being, physical health, or domain satisfaction (e.g. travel satisfaction)
Methodology	Empirical articles that report a statistical effect size of the relationship between PEB and SWB (e.g. correlation coefficient) or that report necessary information to calculate an effect size myself	Theoretical, conceptual, or review articles; Articles that do not report statistical effect sizes or necessary information to calculate the effect size (e.g. qualitative studies)

Note: Framework for inclusion and exclusion criteria adapted from PICO criteria (Collaboration for Environmental Evidence 2018).

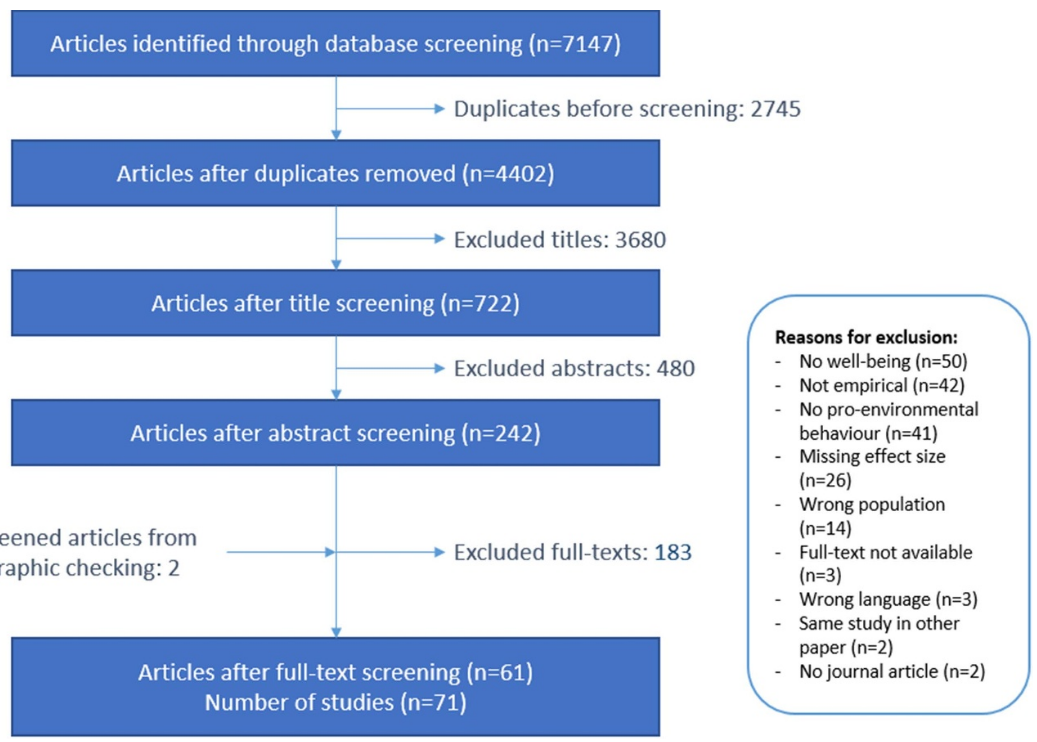

Figure 1. Flow diagram of the search and screening process.

excluded because standardized regression coefficients exceeded the recommended interval between −0.5 and 0.5 (Peterson and Brown 2005). In case a study reported a correlation coefficient as well as an additional effect size measure, the correlation coefficient was chosen. In case one study reported more than one regression model with different constellations of independent and control variables, the most parsimonious model with the lowest number of variables was chosen. In cases where one study contains multiple effect sizes (e.g. when more than one PEB is measured or the components of SWB are measured separately), the effect sizes and environmental impact codes were averaged, and the sample size was adjusted (Borenstein *et al* 2009).

In order to account for the non-normality of the distribution of Pearson's r and inaccurate estimates of sampling variance, the raw correlation coefficients were transformed using Fisher's z variance-stabilizing transformation before performing the

Table 3. Environmental impact assessment protocol.

	High impact	Moderate impact	Low impact
Mobility	Fewer cars in a household[2,3] Use the car less (shift to public transport, walk or bike)[1] Car share/carpooling[1] Buy a fuel-efficient car[1,3] Fuel-efficient driving style[1,3] Less flights[3]		
Food	Avoid or reduce animal products[1,2,3] Avoid food waste[1]	Manage food waste properly (e.g. compost)[1]	Seasonal produce[1,2] Organic produce[2] Local/regional products[1,2]
Energy	Switch to green energy[3] Make building more energy-efficient (e.g. insulation)[1]	Conserve energy at home (e.g. switch off lights, turn appliances off, turn down air conditioning)[1,3] Energy-efficient appliances[1] Reduce room temperature (less heating)[1,3] Only wash full loads[1] Do not use dryer[1]	Save water[3]
Product choice			Eco-label or environmentally-friendly products[1,3] Recycled products[1]
Product usage		Extend the lifetime of products (e.g. wear clothing longer)[1] Reuse and repair products[1,2,3] Reduce the number of (new) purchases[3]	
Waste			Less packaging[3] Less plastic[1,3] Less paper[1,3] Recycle[1]

Note: Assessment based on [1]Moran *et al* (2020), [2]Vita *et al* (2019), and [3]Wynes and Nicholas (2017). The protocol only includes PEBs occurring in the sample of this meta-analysis and is therefore not exhaustive of all possible PEBs.

analyses (Fisher 1925, Borenstein *et al* 2009). The *z*-values are converted back to Pearson's r to interpret the results. The interpretation of effect sizes is based on the widely used thresholds established by Cohen (Cohen 1988, Durlak and Lipsey 1991). An effect size of 0.1 is considered small, 0.24 is medium, and 0.37 is large.

2.4. Environmental impact assessment

In order to test whether the relationship between PEB and SWB differs depending on environmental impact, the environmental impact potential of each PEB measured was systematically evaluated. This environmental impact assessment was performed from the perspective of the potential to reduce individual greenhouse gas emissions. Based on environmental impact assessment studies (Wynes and Nicholas 2017, Vita *et al* 2019, Moran *et al* 2020), a detailed protocol was created for coding the articles (see table 3). Based on this protocol, environmental impact potential was coded as $1 = \text{high}$, $0.5 = \text{moderate}$, and $0 = \text{low}$. If an article does not report the individual items used to measure PEB, the corresponding authors were contacted to receive additional information on the scales used. All six authors responded to the request in an appropriate timeframe, and four of them provided additional data. In case additional data was not retrieved, a study's environmental impact assessment remained empty and was thus excluded from the corresponding analysis. Please find additional details on the environmental impact coding as well as several sensitivity analyses in supplemental material D.

In case a study measures PEB with a scale comprising multiple behaviors and only provides a mean score of the scale, the environmental impact of each behavior was evaluated individually and then averaged for the whole PEB scale. Therefore, the environmental impact coding of a PEB scale can be construed as a relative measure of the proportion of medium- and high-impact behaviors within a scale: The higher the environmental impact coding of a PEB scale, the more medium- and high-impact behaviors are included. Because a considerable share of studies uses PEB scales measuring multiple behaviors, the environmental impact variable was treated as continuous in the range of zero to one in the analysis. Please find a sensitivity analysis addressing the handling of PEB scales in supplemental material D.

Beyond environmental impact, the studies in this sample differ in methodology and measurement of PEB and SWB. Several control variables were coded to account for these differences and increase the robustness of the meta-analytical results: PEB type, SWB conceptualization, the inclusion of control variables, sample characteristics, data type, and study methodology. A detailed description of the control variables can be found in supplemental material E.

2.5. Structuring the data

In order to perform the meta-analysis, several datasets were created (Krumm 2023). First, the studies were separated depending on whether they measured the engagement in specific PEBs (*behavior* dataset, e.g. 'I recycle plastic packaging') or a behavioral outcome (*outcome* dataset, e.g. individual carbon footprint). The reason for this separation is that behavioral outcome measures do not indicate the engagement in specific behaviors but rather provide an overall assessment of the environmental *impact* of every behavior a person does or does not engage in. The main *behavior* dataset contains 67 studies, and the *outcome* dataset contains six. Two studies include measurements for both and are, therefore, part of both datasets. Due to the small sample size of the *outcome* dataset, the explanatory power of the meta-analytical results is limited. The analysis results of the *outcome* dataset and more detailed information can be found in supplemental material G.

The results presented in this article are based on the *behavior* dataset. To perform additional robustness checks, this dataset was further split into 14 subsets based on the following variables: environmental impact, PEB type, and SWB conceptualization. The procedure of creating these subsets and the analysis results can be found in supplemental material F.

2.6. Meta-analytic procedure

To estimate the strength and direction of the relationship between PEB and SWB, random-effects meta-analyses were conducted in R using the metafor package. For the moderation analyses and robustness checks, meta-analytical regression analysis (MARA) models were used (see, e.g. Borenstein *et al* 2009). No minimum number of studies was imposed to run a meta-analysis model. If the number of studies in a model is below $k = 5$, the result is flagged, and caution is advised when interpreting the effect size (following, e.g. Zawadzki *et al* 2020).

To detect outliers in the sample, which potentially affect the precision and robustness of the effect size, the recommended procedure was followed (Viechtbauer and Cheung 2010). One outlier was removed from the main behavior dataset. Lastly, the risk of publication bias for this meta-analysis was assessed using funnel plots and asymmetry tests, failsafe n tests, and trim-and-fill procedures. Based on these instruments, no strong evidence for the existence of publication bias was found. For more information on the outlier and publication bias analyses, see supplemental material H.

3. Results

These meta-analyses overall aggregate the results of 71 studies from 61 articles (see Supplemental Material A for a list of included articles). The combined sample size amounts to 391 379 study participants from 22 countries. The majority of studies have been performed in Europe (35 studies), followed by Asia (15 studies) and North America (11 studies). The PEBs measured in this sample are categorized into eight PEB types: mobility, food, energy, product choice, product usage, waste management, environmental agency, and multiple/generic. Forty-six percent of effect sizes are assessed as low-impact, 15% are moderate-impact, and 38% are high-impact. An overview of all the studies in this dataset, their effect sizes, and confidence intervals is presented in figure 2.

3.1. The relationship between PEB and SWB

First, the overall relationship between PEB and SWB in the main behavior dataset is analyzed without the addition of moderating or control variables. The results reveal a small positive association with an effect size of $r = 0.081$ (see table 4). Overall, engaging in PEB is associated with higher levels of SWB: People who act more environmentally friendly are happier or more satisfied with their lives than those who act less environmentally friendly.

3.2. The moderation effect of environmental impact

The primary goal of this meta-analysis is to assess whether the relationship between PEB and SWB

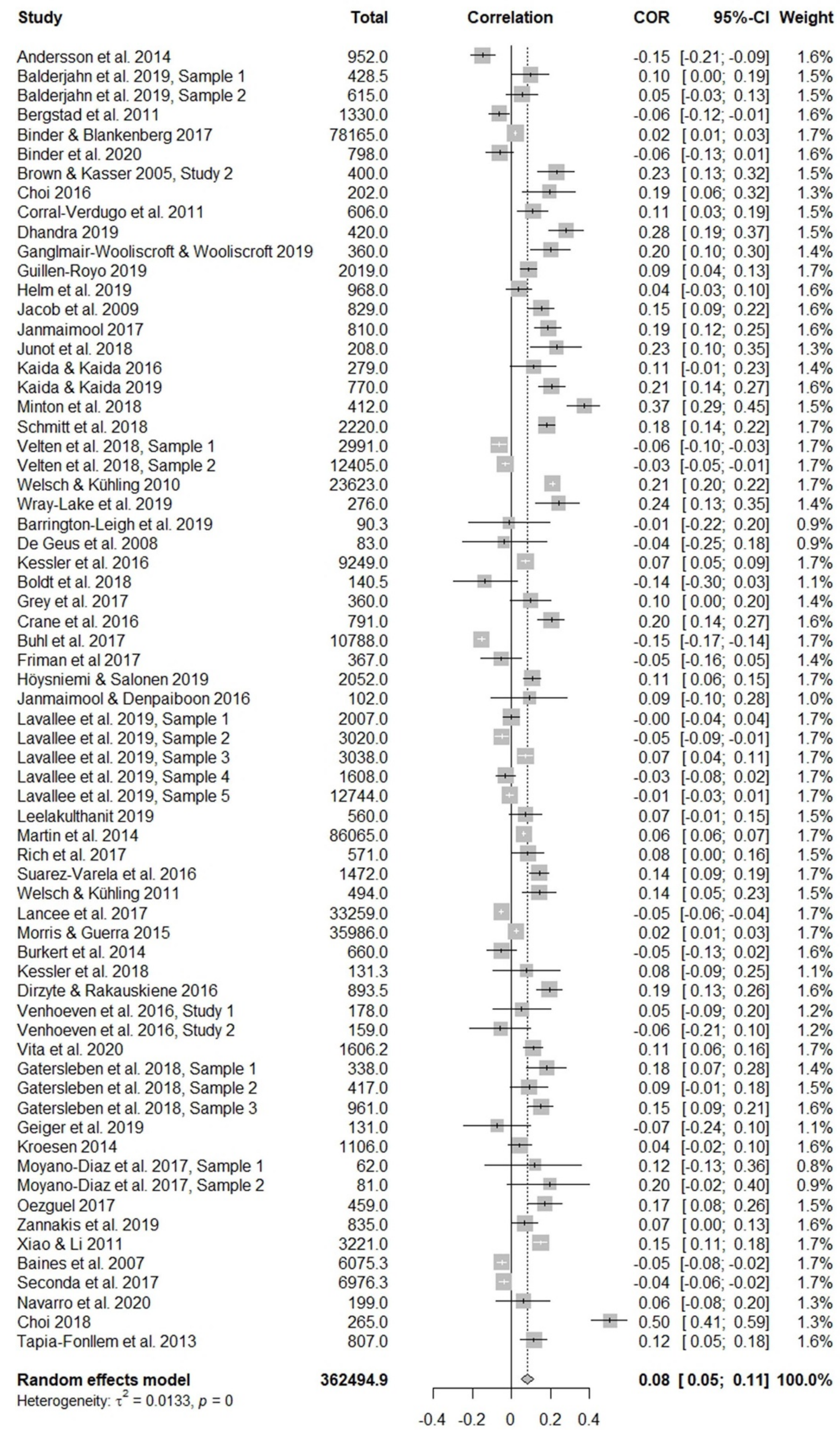

Figure 2. Forest plot of the main behavior dataset.
Note: Total = number of participants in each study, COR = effect size: Pearson's *r*, 95%-CI = 95% confidence interval of the effect size, weight = weight of the study in the meta-analysis.

depends on the environmental impact of the PEB measured. The results of a moderation analysis in the main behavior dataset show that environmental impact negatively moderates the relationship between PEB and SWB ($B = -0.163$, $p < 0.0001$, see model 1 in table 5). This negative moderation effect indicates that the higher the environmental impact of a PEB, the weaker its connection to SWB (see figure 3).

Table 4. Summary of statistics for the meta-analysis of the main behavior dataset.

	k	N	R	95%-CI	Q	T^2	I^2	p
Overall	67	362 495	0.081	[0.052, 0.111]	2272.62	0.0133	98.45%	<0.0001

Note: k = number of studies with one outlier removed, N = total number of participants, R = effect size: Pearson's r, 95%-CI = 95% confidence interval of the effect size, Q = total variance, T^2 = between-study variance, I^2 = proportion of variability due to heterogeneity between studies.

Table 5. Hierarchical MARA moderation analyses.

Variables	(1) Impact		(2) Impact, PEB & SWB		(3) All variables	
Intercept	0.160***	(0.019)	0.201***	(0.054)	0.182**	(0.062)
Environmental impact	−0.163***	(0.028)	−0.204***	(0.045)	−0.193***	(0.051)
PEB type						
Mobility			*Reference*		*Reference*	
Food			−0.165**	(0.058)	−0.188**	(0.069)
Energy			0.051	(0.083)	0.227	(0.174)
Product choice			−0.112	(0.081)	−0.103	(0.087)
Product usage			0.024	(0.064)	0.052	(0.072)
Multiple/Generic			−0.055	(0.045)	−0.053	(0.049)
SWB conceptualization						
SWB Index			*Reference*		*Reference*	
Cognitive			0.043	(0.030)	0.049	(0.031)
Affective			−0.003	(0.042)	0.018	(0.044)
Mental health			0.130*	(0.063)	0.171*	(0.071)
Control variables						
No controls					*Reference*	
Controls					−0.022	(0.027)
Sample characteristics						
Convenience					*Reference*	
Representative or random					0.033	(0.027)
Unclear					0.032	(0.045)
Data type						
Cross-sectional					*Reference*	
Longitudinal					−0.027	(0.037)
Study methodology						
Correlational					*Reference*	
Intervention					−0.203	(0.157)
k	65		65		65	
R^2	39.66%		47.00%		46.44%	

$^*p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

DV = Pearson's r for the relationship between PEB and SWB.

Note: The table depicts meta-regression coefficients B, standard error in parentheses, k = number of studies, R^2 = Amount of heterogeneity explained by the model. Refer to supplemental table J1 for an extended version of model (3), augmented with the following variables: study location, year of publication, sample size, and participants' mean age.

The meta-analysis model predicts a significant and positive, albeit small, correlation of $r = 0.159$ between low-impact PEB and SWB (95%-CI = [0.122, 0.195], see supplemental material I) and a non-significant correlation of $r = -0.003$ between high-impact PEB and SWB (95%-CI = [−0.036, 0.031]; see supplemental material I). Thus, the environmental impact of a behavior explains a considerable amount of heterogeneity between effect sizes, with an R^2 of 39.66%.

3.3. Robustness checks

The studies in this sample differ not only in the environmental impact of the PEB measured but also in other variables, such as PEB type, SWB conceptualization, and study characteristics, which could confound the results. To account for the heterogeneity of the studies, a step-wise approach adding different control variables to the environmental impact MARA model presented above is used. The results of this procedure are depicted in table 5.

First, PEB type and SWB conceptualization are considered. To test whether different measurements of PEB and SWB confound the moderating effect of environmental impact, the two variables are added to the MARA model (see model 2 in table 5). In this model, the significance of environmental impact remains the same while the strength of the moderating relationship increases ($B_1 = -0.163$, $p_1 < 0.0001$, $B_2 = -0.204$, $p_2 < 0.0001$). PEB type

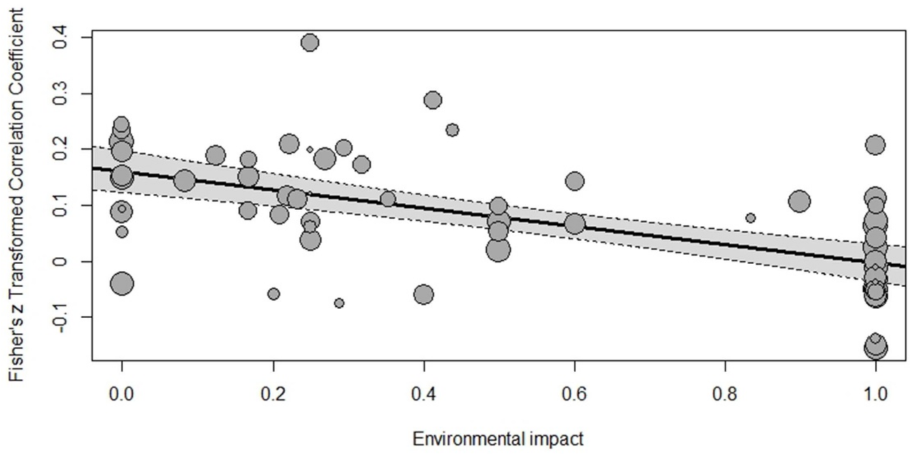

Figure 3. Moderation effect of environmental impact on the PEB-SWB relationship.
Note: Each dot represents one study in the meta-analysis, the size of the dot points toward the study's sample size and, consequently, the weight in the analysis.

and SWB conceptualization explain a further 7.34% of the heterogeneity between effect sizes, with the R^2 increasing from 39.66% to 47.00%. See Supplemental Material I for effect size predictions for each type of PEB and each conceptualization of SWB.

As a next step, it is considered whether differences in methodological choices and study characteristics could confound the moderating effect of environmental impact (see model 3 in table 5). To test this, the following variables are added to the MARA model: control variables, sample characteristics, data type, and study methodology. In this model, the significance and strength of the moderating effect of environmental impact remain similar to model 2 ($B = -0.193$, $p = 0.0001$). This step did not further increase the model's explanatory power ($R^2 = 46.44\%$). These analyses demonstrate that the negative moderation effect of environmental impact on the relationship between PEB and SWB is robust with regard to different model specifications. Further sensitivity and subset analyses are provided in supplemental materials D and F.

4. Discussion

Understanding how environmental behaviors relate to human well-being is critical when aiming for necessary individual and private household behavior changes and targeting and prioritizing effective climate mitigation policies with minimal adverse effects on well-being levels today. Overall, this meta-analysis finds a small but significant positive relationship between PEB and SWB, in line with previous research (see Zawadzki *et al* 2020 for a meta-analysis). People who act more environmentally friendly seem happier or more satisfied with their lives compared to those who act less environmentally friendly. When accounting for the environmental impact of the PEB measured, however, a positive relationship is only observed for low-impact behaviors. The meta-analysis does not find evidence that high-impact PEB relates to well-being: The well-being levels of people engaging in high-impact PEB, such as eating a vegetarian diet or commuting via public transport, do not significantly differ from people not engaging in such behaviors. The distinction between low- and high-impact PEB is critical, as precisely the engagement in high-impact PEBs is needed to mitigate climate change (Nielsen *et al* 2021). Consequently, this finding demonstrates that there is more ambiguity in the relationship between PEB and SWB than previously expected in the literature. This paper shows that the environmental impact of PEB matters when evaluating its relationship with SWB.

Previous research identified that engagement in PEB and well-being are positively related (e.g. Brown and Kasser 2005, Corral-Verdugo *et al* 2011, Venhoeven *et al* 2016, Capstick *et al* 2022), corroborated by a recent meta-analysis (Zawadzki *et al* 2020). Zawadzki and colleagues find an average effect size of $r = 0.243$ for the relationship between PEB and SWB, which considerably exceeds the effect size found in this paper ($r = 0.081$). The search strategy of the two meta-analyses differs in two main points: first, Zawadzki and colleagues apply a narrower definition of PEB, focusing specifically on studies conducted in an environmental context. Applying a broader PEB definition, as in this paper, increases the likelihood of identifying studies beyond traditional PEB disciplinary boundaries and allows for a closer investigation of the relationship between SWB and high-impact PEB, which has not been the main focus when measuring PEB in an environmental context (Nielsen *et al*

2021). Second, Zawadzki and colleagues use a broader SWB definition, which includes eudaimonic well-being and warm glow measures. These well-being measures are linked to perceiving one's life as meaningful and show a particularly positive relationship with PEB. In contrast, this paper specifically focuses on cognitive and affective SWB measures, also including mental health measures, which are more prevalent in health-related disciplines. SWB index and cognitive measures show the strongest relationship to PEB, while mental health is not significantly related (see supplemental table F4).

This paper finds a difference in the relationship between PEB and SWB depending on the environmental impact of the PEB. It is, however, not able to explain *why* this difference occurs. The environmental impact of the behavior itself or a person's knowledge about the high versus low environmental impact of the behavior is unlikely to drive this difference. Based on existing theories, if a PEB is performed with the intention to protect the environment or to help fight climate change, then being aware that the behavior is high-impact should increase a potentially positive effect on one's well-being. After all, engaging in high-impact behavior makes a more meaningful difference to one's carbon footprint than lower-impact ones. In contrast, if a behavior is performed for a different reason than environmental protection, well-being levels should be insensitive to the environmental impact of the behavior. Additionally, prior research indicates that individuals often struggle to accurately assess the environmental impact of a range of PEBs (Truelove and Parks 2012, Cologna *et al* 2022). It is thus implausible that knowing about the environmental benefits of high-impact behaviors is the theoretical link moderating the relationship between PEB and SWB.

This suggests that a systematic difference exists between low- and high-impact PEB. For instance, the predictors between high- and low-impact PEB could differ, potentially affecting their relationship with PEB. Previous research shows that PEB is often driven by environmental attitudes and intentions (see Bamberg and Möser 2007, for a meta-analysis). In contrast, high-impact PEB and, consequently, lower carbon footprints are often driven by socio-economic factors (Whitmarsh 2009, Moser and Kleinhückelkotten 2018). Furthermore, it is possible that individuals with more climate worry or anxiety are increasingly motivated to perform high-impact PEB (Bouman *et al* 2020, Sangervo *et al* 2022), which could explain lower levels of SWB (Schmitt *et al* 2018). Alternatively, high-impact behaviors could be more personally costly (e.g. in terms of money, time, or inconvenience) than low-impact behaviors, which could potentially counteract any positive effect between PEB and SWB. One indication of this is the differing relationships observed between well-being and different PEB types, which likely vary in magnitude and type of personal cost. Based on the analysis of PEB subsamples, behaviors in the mobility, food, energy, and waste categories are not significantly related to well-being. At the same time, the strongest relationships are found for agency, product choice, and the composite of behaviors from multiple categories (see supplemental table F3). Previous research has shown, for instance, that anticipated feelings of warm glow can motivate low-cost but not high-cost PEB (Van Der Linden 2018). Further research should ascertain how low-impact and high-impact PEB differ and why this difference is relevant for individual well-being to design effective interventions and achieve high-impact behavior change.

Because previous findings point to a positive relationship between PEB and SWB, environmental behavior change has often been portrayed as a win-win situation—enhancing both the protection of the environment and individual well-being (see, e.g. Zawadzki *et al* 2020). Assuming this to be true in general directly leads to the puzzling question why not more people follow environmentally friendly lifestyles with low GHG emissions. Some authors argue that one main reason why not more people engage in PEB is not that it negatively affects their lives but that public opinion and reporting frame PEB as a burden or sacrifice (Kaplan 2000, Prinzing 2020). This attributes the lack of PEB engagement to a misperception caused by inadequate framing and communication. The results of this meta-analysis propose that the reality is more complex. Engaging in PEB does not necessarily constitute a win-win situation. Focusing on strengthening high-impact PEB, in particular, may not involve a well-being benefit. So, while framing could play a role in preventing people from trying out environmental behaviors, it cannot explain the missing link between PEB and SWB for high-impact behaviors.

Promoting PEB as a mutually beneficial solution both for the environment and individual well-being may not only be misleading based on the results of this meta-analysis but could also hinder progress toward climate change mitigation. Effectively reducing greenhouse gas emissions requires extensive climate policies, structural changes, high-impact behavior change, and cooperation and commitment of all members of society (Dubois *et al* 2019, IPCC 2022). Promoting the narrative of environmental behavior change as a win-win solution that people might ultimately gravitate towards upon the realization of its benefits could prevent policy-makers and individuals from implementing necessary but unpopular changes, even if they yield substantial benefits in the long run. Individuals are likely to opt for behaviors that are comparatively easy to perform, such as packing their groceries in a reusable bag they brought themselves, yet still provide them with a sense of warm glow from contributing to the environment (Van Der Linden 2018). According to the moral licensing theory, these low-impact behaviors could paradoxically result in a rebound effect, ultimately fostering an uptick in environmentally detrimental actions in the future (e.g. Burger *et al* 2022). Simultaneously, focusing on a win-win narrative could prevent policy-makers from addressing the structural barriers that prevent meaningful environmental behavior change and citizens from supporting effective but potentially more costly climate policies. In contrast to this narrative, it may prove more productive to emphasize the significance of specifically high-impact behavior changes by educating both policy-makers and the general public. While this meta-analysis fails to uncover a positive correlation between high-impact PEB and SWB, it equally does not reveal a negative one—at least if the behavior is performed voluntarily.

This does not imply the general absence of a potential positive connection between certain high-impact PEBs and SWB, nor does it discount the potential for such a relationship to be nurtured through improvements in the structural environment and the implementation of constructive measures. A growing literature covers the co-benefits of an increased engagement in climate change mitigation behavior, both from a policy and an individual perspective (Bain *et al* 2016, Karlsson *et al* 2020). For instance, opting to cycle to work instead of driving reduces emissions and enhances one's overall health. From a climate policy perspective, it is thus essential to identify high-impact PEBs that offer well-being advantages. While certain high-impact PEBs and their relationship with well-being have received substantial research attention (e.g. adopting a vegetarian diet or using public transport), others remain relatively unexplored (e.g. avoiding air travel, insulating one's home, or downsizing to a smaller living space). The relationship between high-impact PEB and SWB may exhibit more variability than initially predicted. Some high-impact PEBs might potentially have adverse effects on well-being, whereas others could yield significant benefits. Therefore, it is worthwhile for future research to delve into the specific connections between various high-impact PEBs and SWB to identify behaviors with the most favorable well-being outcomes.

Further, it is important to note that this meta-analysis predominantly relies on studies investigating voluntary engagement in PEB instead of intervention- or policy-induced behavior change. To effectively mitigate climate change, voluntary behavior changes will likely not suffice (Dubois *et al* 2019). Introducing policies to induce behavioral shifts is imperative for greenhouse gas reduction. However, it is important to recognize that such enforced changes in behavior may have varying and potentially less positive associations with SWB. Currently, one theoretical basis for the positive relation between PEB and SWB indicates that engaging in environmentally friendly behaviors is perceived as meaningful, thereby increasing well-being by making a person feel good about themselves (Venhoeven *et al* 2016, Venhoeven *et al* 2020). This explanation relies on an intrinsically and voluntarily motivated decision to act. Should a behavior be prompted by policy, the potential positive impact on well-being may diminish or even vanish entirely. Consequently, future research should address how involuntary or policy-induced behavior change relates to SWB and how this relationship differs between policy instruments. Additionally, it may be interesting to explore the role of policy acceptance and support in this context (e.g. Bruno *et al* 2022).

Moreover, it is worth noting that the majority of effect sizes in this dataset are derived from correlational studies, preventing the drawing of conclusions regarding causal relationships between PEB and SWB. Most studies in this area suggest that (low-impact) PEB influences SWB, but it is also plausible that SWB influences (low-impact) PEB or that a third unaccounted-for variable simultaneously influences both (low-impact) PEB and SWB. Further, it is conceivable that all three causal directions hold true at the same time. There is a clear need for more longitudinal and experimental research into the relationship between PEB and SWB to ascertain any causal effects.

This study bears several limitations. First, it solely encompasses published studies, lacking access to unpublished data. While multiple tests have been conducted to assess the risk of publication bias (see supplemental material H), it remains challenging to completely eliminate this potential bias. Second, the vast majority of studies use self-report PEB measures. Kormos and Gifford (2014) find that while self-reported PEB measures correlate positively with observed PEB, they may not always predict actual behaviors accurately. Third, the studies exhibit heterogeneity, owing to the comprehensive PEB search strategy employed. There exists the possibility of systematic variations in the conceptualizations of PEB and SWB or in the methodologies used, which could introduce bias into the findings. To mitigate this risk, the meta-analytical models have incorporated diverse control variables. Notably, the results indicate the robustness of the moderating effect of environmental impact on the relationship between PEB and SWB.

5. Conclusion

Using a meta-analytical approach, this paper contributes to our understanding of the relationship between PEB and SWB. Specifically, it explores whether the relationship between PEB and SWB differs depending on the environmental impact of the behavior. Due to the importance of fostering high-impact behavior change, it is critical to understand whether the previously found positive relationship between PEB and SWB holds when factoring in environmental impact. The paper finds a small but significant positive relation between PEB and SWB overall. When accounting for the environmental impact of the PEB, the positive relationship only remains for low-impact PEB. The meta-analysis does not provide any evidence that high-impact PEB relates to SWB. Consequently, this finding demonstrates more ambiguity in the relationship between PEB and SWB than previously described in the literature. Specifically, it highlights a systematic difference between high- and low-impact PEB, which matters when evaluating its relationship with SWB.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: https://osf.io/qy5tg/?view_only=2b68255e0d8c46d9973306e4d8c1f881.

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