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# Leveraging the link between pro-environmental behaviour and well-being to encourage sustainable lifestyle shifts

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Four studies investigated whether awareness of links between pro-environmental behaviour (PEB) and well-being can motivate sustainable lifestyle shifts. We find that most US adults believe most PEBs do not affect well-being. Yet, when people do expect such benefits, they tend to have more positive attitudes and intentions regarding PEBs and enact more PEBs. We also find that messages about how PEB can increase well-being consistently improved attitudes towards PEBs and made people more persuasive in their subsequent efforts to encourage others to live sustainably. These effects were especially pronounced among people who did not previously believe that PEB improves well-being. Effects on PEB intentions were inconsistent, however, and we found no effect on a revealed measure of PEB (i.e., seeking sustainability tips). Overall, these results underscore the importance of beliefs about PEBs' impact on well-being and suggest that public messaging about that relationship might help motivate sustainable lifestyles.

Mitigating and adapting to climate change and other environmental problems like pollution and biodiversity loss represent some of the greatest challenges facing humanity today. The Intergovernmental Panel on Climate Change predicts that it will not be possible to meet carbon emissions goals without substantial changes in household behaviour – particularly in high-emissions countries like the United States, Australia, Japan, and much of Europe<sup>1</sup>. Expert analysis of other environmental challenges also highlight the importance of lifestyle shifts<sup>2</sup>. Such shifts will likely require not only “command-and-control” initiatives from governments, such as carbon taxes, but also voluntary action. Accordingly, researchers across many fields have called for more behavioural science research on the factors that lead to sustainable lifestyle shifts<sup>3–5</sup>.

One of the most robust and striking findings from existing research is that pro-environmental behaviours (PEBs) are associated with greater individual well-being. Dozens of studies, conducted around the world and encompassing tens of thousands of individuals, have consistently found that the frequency with which people voluntarily engage in PEBs is positively correlated with positive psychological outcomes, like happiness and life-satisfaction<sup>6,7</sup>. Moreover, this link remains even after controlling for a host of potential confounds<sup>6</sup>, and recent experimental evidence indicates that instructing people to incorporate more PEB into their daily routines leads to subsequent increases in their well-being<sup>8</sup>.

Past research points to several likely pathways from PEB to well-being. One is through improved health, which might result from PEBs that involve exercise (e.g., walking or biking instead of driving) or eating a primarily

plant-based diet<sup>9–11</sup>. Another pathway might be through improved social connection, resulting from PEBs that involve more frequent interactions with others (e.g., carpooling or volunteering for environmental organisations)<sup>12</sup>. Other potential routes from PEB to well-being include reputational benefits from observable, status-enhancing PEBs like owning solar panels or electric vehicles<sup>13,14</sup>, and the intrinsic satisfaction, or “warm glow,” that can come from doing something good for the environment<sup>15</sup>.

The finding that PEB is positively related to well-being is all the more striking given that PEBs are often depicted as onerous and unpleasant, both in popular media<sup>16–18</sup>, and social scientific research<sup>19,20</sup>. Past research has found, unsurprisingly, that the more individuals expect PEB to be personally costly (in terms of money, time, comfort, and convenience), the less they engage in it<sup>21</sup>. Yet, the more that people anticipate feeling positive emotions as a result of engaging in PEBs, the more likely they are to engage in them<sup>22</sup>. This suggests that the (likely mistaken) narrative that engaging in PEBs has a net negative effect on one's well-being may act as a motivational barrier to pro-environmental action, and that highlighting the potential well-being benefits (as opposed to, e.g., financial costs) of PEB could be a powerful motivational tool<sup>23–25</sup>. Uncovering effective, novel communication strategies is of particular importance given the evidence of the limited and waning efficacy of extant messaging efforts<sup>26,27</sup>.

In four studies, we investigated people's beliefs about the impact of PEBs on individual well-being, how these beliefs relate to engagement in PEBs, and whether messages aimed at influencing these beliefs can encourage people to incorporate more PEB into their lifestyles. (See Table 1

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**Table 1 | Overview of studies**

Study	Design	N	Research Question
1	Observational (Representative sample of USA)	511	<ul style="list-style-type: none"> <li>•What do Americans believe about how PEBs affect well-being?</li> <li>•Do these beliefs predict the frequency with which people engage in PEBs?</li> </ul>
2	Experimental (Convenience sample of USA)	327	<ul style="list-style-type: none"> <li>•Do personal narratives about how PEB can increase well-being lead to more positive attitudes towards PEB?</li> <li>•Do they strengthen intentions to engage in PEB?</li> </ul>
3	Experimental (Convenience sample of USA)	501	<ul style="list-style-type: none"> <li>•Do summaries of research about how PEB can increase well-being lead to more positive attitudes towards PEB?</li> <li>•Do they strengthen intentions to engage in PEB?</li> <li>•Do they make people more persuasive in their subsequent communication about PEB?</li> <li>•Do they make people more likely to seek out tips on living sustainably?</li> </ul>
4	Experimental (Representative sample of USA)	366	<ul style="list-style-type: none"> <li>•Do combined messages (including narrative and research elements) about how PEB can increase well-being lead to more positive attitudes towards PEB?</li> <li>•Do they strengthen intentions to engage in PEB?</li> <li>•Do they make people more persuasive in their subsequent communication about PEB?</li> <li>•Do they make people more likely to seek out tips on living sustainably?</li> <li>•Are any of these effects moderated by prior beliefs about how PEB affects well-being?</li> </ul>

for summaries of each study and the research questions that they address.) Study 1 was an observational study using a representative sample of United States adults ( $N = 511$ ; proportionally matched to the US Census in terms of age, sex, and political orientation). We assessed participants' beliefs about whether a range of PEBs affect well-being and if so how. We also assessed the frequency with which participants engage in those behaviours. Studies 2-4 (combined  $N = 1,196$ ) were randomised, controlled experiments, in which we presented participants with different kinds of messages about how PEBs can increase a person's well-being and tested for effects on pro-environmental outcomes. In Study 2, the messages were personal narratives. In Study 3 they were summaries of relevant research. And in Study 4 they were combined messages, with both narrative and research elements. In Study 4, we recontacted participants from Study 1, enabling us to investigate how their pre-existing beliefs about the relationship between PEB and well-being (assessed approximately two weeks before) shape the impact of a message about that very relationship.

We examined a range of outcomes indicative of pro-environmental motivation and action. According to a venerable social psychological theory<sup>28</sup>, behaviour is shaped by a person's attitudes towards the relevant behaviours and intentions to enact those behaviours. Accordingly, in each experiment, we asked participants to report on their attitudes towards, and intentions to engage in, PEBs. Alongside these self-report outcomes, in Studies 3-4, we included two behavioural measures. We presented participants with a link to a website with information and guidance about how to incorporate PEBs into one's lifestyle and tracked whether participants visited the website. This provides a revealed PEB measure – i.e., an immediate, concrete action aimed at living more sustainably. Additionally, we asked participants to write messages aimed at encouraging *others* to adopt more environmentally friendly habits. These participant-written messages were then evaluated for persuasiveness. In Study 3 the participant-written messages were rated by an independent sample of participants ( $N = 100$ ). We then used these ratings as training data for a generative pre-trained transformer, which we used to rate the participant-messages in Study 4 (see Method for details). The idea behind this final measure was to investigate whether telling people about how PEB can increase well-being might contribute to broader societal shifts in the way that people think and talk about PEB. In other words, could messages about the PEB-well-being relationship have “ripple effects,” influencing not just those directly exposed to the messages, but also the people they subsequently interact with?

## Results

### What do Americans believe about the effects of pro-environmental behaviour on well-being?

In Study 1, we assessed participants' beliefs about whether and how PEBs affect a person's happiness and satisfaction with life. For 14 out of 21 PEBs, a majority of participants indicated that they did not think that the behaviour affects individual well-being. The exceptions were walking or biking instead of driving, eating organic food or food from a home garden, reducing

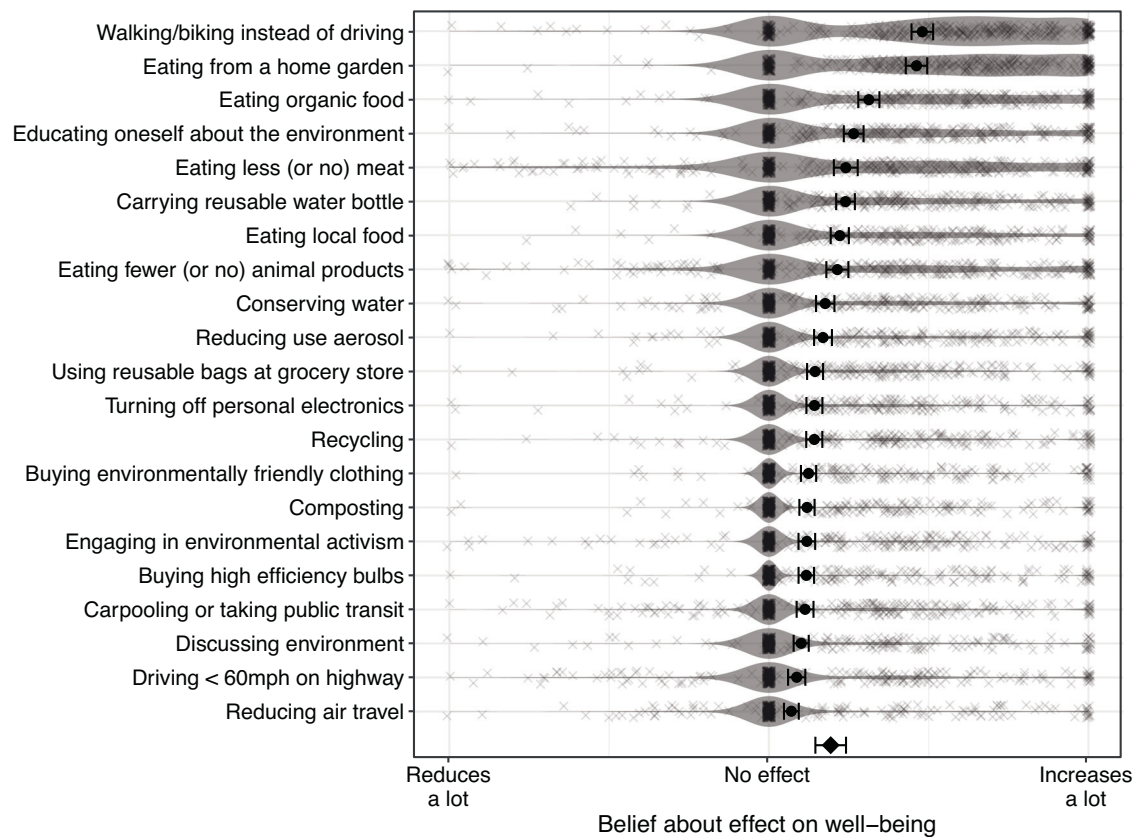
consumption of meat and animal products, and educating oneself about the environment. For these specific behaviours, at least half of the participants indicated a belief that there is some effect on a person's well-being. Turning to the question of *how* PEBs are believed to affect well-being, as Fig. 1 shows, the average for all 21 PEBs was positive. Contrary to how PEBs are often portrayed in the media, when people believe PEBs to have any effect on well-being, they tend to believe that the behaviours *increase* well-being. (See Table S1 in the Supplemental Information for complete descriptive statistics.)

### Do such beliefs predict how often people enact pro-environmental behaviours?

In Study 1, we also assessed how frequently participants enact each of these PEBs. We used a multilevel model, with repeated observations nested within participants, to test whether beliefs about the well-being effects of PEBs predict the frequency with which people engage in them. The dependent variable in this model was frequency (i.e., how often participants reported enacting each PEB), and the independent variables were belief (i.e., the effect, if any, that participants think the PEB has on well-being), behaviour type (i.e., a 21-level categorical variable reflecting the specific PEB in question), and their interaction, while allowing for a random effect of participant. This revealed significant effects of belief,  $\chi^2(1) = 409.45$ ,  $p < 0.001$ , behaviour type,  $\chi^2(20) = 2022.58$ ,  $p < 0.001$ , and an interaction,  $\chi^2(20) = 102.59$ ,  $p < 0.001$ . We decomposed this interaction using simple slopes analysis<sup>29</sup>, which enables us to examine the link between belief and frequency at each level of behaviour type. Figure 2 illustrates these results (see also Table S2 in the Supplemental Information). In every case, more favourable beliefs predicted more frequent engagement. These associations were not particularly large (standardised coefficients ranged from 0.10 to 0.38, with a mean of 0.26). Yet the finding that the association was significant and positive for all 21 behaviours points to a highly robust link. The more that people think a PEB has positive effects on a person's well-being, the more often they enact that PEB. (In an exploratory sensitivity analysis, we added demographic covariates – including age, gender, race, income, education, and political orientation – to this model. This had no effect on the pattern of results. Correlations between sociodemographic variables and person-means for PEB beliefs and frequency of enactment are presented in the Supplemental Information, Table S3.)

### Do messages about the effects of pro-environmental behaviours on well-being motivate pro-environmental action?

In Studies 2-4, we randomly assigned participants to read either a message about how PEB can increase well-being (Well-Being condition) or a control message (Control condition). In Study 2, the messages were first-person narratives about a person who decides to incorporate more PEB into their lifestyle. In the Well-Being condition, the narrator describes how PEBs are “good for me,” whereas the narrator in the Control condition described PEBs as feeling “burdensome,” but also “morally right” and “vital for the



**Fig. 1 | Beliefs about how pro-environmental behaviours affect individual well-being (Study 1).** Points and error bars indicate means and 95% confidence intervals for each behaviour. The diamond at the bottom indicates the average across

behaviours. Grey Xs represent individual observations, and shaded regions indicate probability densities. Participants responded using slider scales ranging from “reduces a lot” (coded as -5) to “no effect” (0) to “increases a lot” (5).

sake of the planet.” In Study 3, the messages were summaries of research on PEB (framed as excerpts from a popular science magazine). In the Well-Being condition, the message summarized research on how PEB can increase well-being. In the Control condition, the message summarized research on how a carbon tax might effectively and efficiently address climate change. Finally, in Study 4, the messages included both a personal narrative and summary of research. In this case, however, the research summary in the Control condition was not about carbon taxes, but about how environmental problems like climate change and biodiversity loss are largely attributable to developed nations.

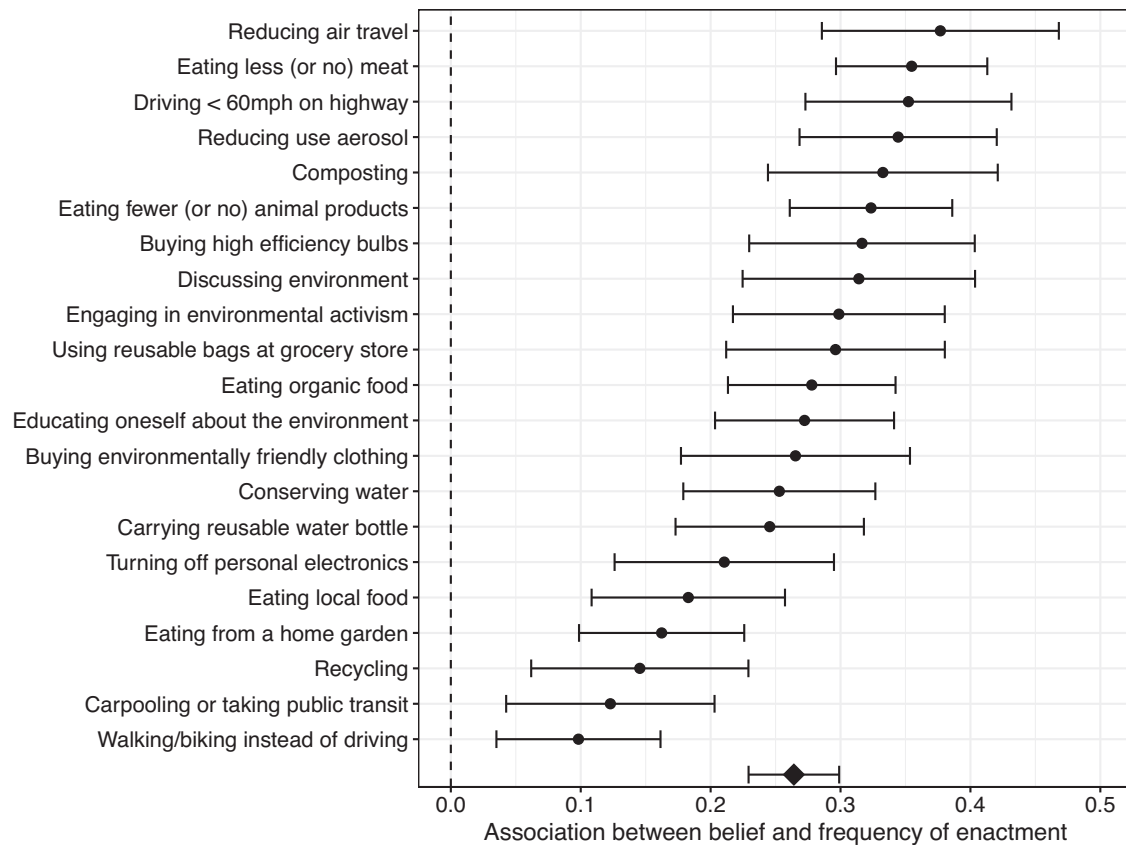
In each study, the well-being messages highlighted some of the potential pathways from PEB to well-being that were mentioned in the introduction: improved health, improved social connection, and intrinsic satisfaction. For example, in the Study 2 message, the narrator stated that, “...getting outside and walking (instead of driving) has improved my mood and energy levels. By talking with coworkers about office sustainability, I’ve made some new friends.”

Figure 3 presents the results for all four of the dependent variables that we examined. (Additionally, Table S4 of the Supplemental Information reports the complete results for all regression models mentioned in this subsection.) Across the three experiments, we consistently found that participants in the Well-Being condition reported more positive attitudes towards PEB. We observed similar effects from a personal narrative, in Study 2,  $t(325) = 2.63, p = .009, d = .29, 95\% \text{ CI}: [.07, .51]$ , and a summary of relevant research, in Study 3,  $t(499) = 2.13, p = .034, d = .19, 95\% \text{ CI}: [.01, .37]$ . In Study 4, we tested whether this effect was moderated by participants’ prior beliefs about how PEB affects well-being (assessed approximately 2 weeks before). A regression model revealed significant main effects of experimental condition,  $b = .19, 95\% \text{ CI}: [.02, .35], p = .025$ , and prior beliefs,  $b = .36, 95\% \text{ CI}: [.24, .48], p < .001$ , as well as a marginally significant

interaction,  $b = -.16, 95\% \text{ CI}: [-.325, .003], p = .054$ . The negative sign of the interaction term indicates that the effect of the message on attitudes towards PEB is larger for participants who were previously less inclined to believe that PEBs increase well-being.

Turning to intentions, Studies 2-3 used broad measures that asked participants how strongly they intended to maintain “environmentally friendly habits” or a “sustainable lifestyle” in general. A significant effect of the personal narrative emerged in Study 2,  $t(325) = 2.36, p = .019, d = .26, 95\% \text{ CI}: [.04, .48]$ . However, Study 3 did not reveal an effect of a summary of research on PEB and well-being,  $t(499) = -.70, p = .487, d = -.06, 95\% \text{ CI}: [-.24, .11]$ . In Study 4, we used a much more fine-grained measure, asking participants how strongly they intended to engage in 21 specific PEBs (the same behaviours as in Study 1). We tested for an effect of the experimental intervention and whether this effect was moderated by prior beliefs. Using a multilevel model, we treated each behaviour as a distinct observation, nesting these repeated observations within participants. Thus, the analysis included 7,686 total observations (i.e., 21 observations from 366 participants). We found no effect of condition,  $b = .04, 95\% \text{ CI}: [-.17, .25], p = .714$ , a significant effect of prior beliefs,  $b = .16, 95\% \text{ CI}: [.12, .19], p < .001$ , and no interaction,  $b = .03, 95\% \text{ CI}: [-.02, .08], p = .207$ . Thus, although beliefs about how PEBs affect well-being appear to shape people’s intentions to engage in those PEBs, our combined narrative and research message did not influence PEB intentions.

Participants in Studies 3-4 were asked to write messages encouraging people to adopt environmentally friendly habits. These messages were then scored for persuasiveness by humans (Study 3) and a large language model (Study 4). In Study 3, we used a multilevel model to regress persuasiveness ratings on experimental condition, while allowing for a random effect of judge. This revealed that the judges considered the messages written by participants in the Well-Being condition more persuasive than messages



**Fig. 2 | Association between beliefs about effects on well-being and frequency of enactment (Study 1).** This figure plots the standardised coefficients for the associations between individuals’ beliefs about how PEBs affect individual well-being and the frequency with which those individuals enact each PEB. Points and error

bars indicate means and 95% confidence intervals for each behaviour. The diamond at the bottom indicates the average across behaviours. The response scales for the frequency measure were: “never” (coded as 0), “rarely” (1), “sometimes” (2), “often” (3), and “always” (4).

written by participants in the Control condition,  $b = 7.53$ , 95% CI: [3.28, 11.78],  $p < .001$ . In Study 4, we were also able to test whether the effect of experimental condition was moderated by participants’ prior beliefs. A regression model indicated a significant effect of condition,  $b = 7.99$ , 95% CI: [1.67, 14.31],  $p = .013$ , no effect of prior beliefs,  $b = 3.46$ , 95% CI: [-1.17, 8.08],  $p = .142$ , and a marginally significant interaction,  $b = -5.86$ , 95% CI: [-12.22, 0.50],  $p = .071$ . The negative sign of the interaction term indicates that, as with attitudes towards PEB, the effect of the message may have been larger for participants with less favourable prior beliefs about PEB.

Finally, in Studies 3-4, at the end of the survey we presented participants with a link to a website where they could find information and guidance about how to incorporate more PEB into their daily lives. As a measure of revealed PEB, we tracked which participants clicked on this link. (This measure was pre-registered in Study 4, but exploratory in Study 3.) Only a small number of participants clicked on the link ( $n = 32$ , or 6% of the sample in Study 3;  $n = 48$ , or 13% in Study 4). In Study 3, a logistic regression model revealed no effect of the experimental intervention,  $b = .44$ , 95% CI: [-0.29, 1.20],  $p = .245$ . In Study 4, there was no effect of the experimental intervention,  $b = -.37$ , 95% CI: [-1.04, 0.26],  $p = .252$ , a significant effect of prior beliefs,  $b = .48$ , 95% CI: [.11, .86],  $p = .010$ , and no interaction,  $b = -.12$ , 95% CI: [-.68, .43],  $p = .662$ . Hence, although beliefs about the effects of PEB on well-being were associated with a greater likelihood of visiting a website with sustainability tips, our attempt to alter these beliefs with brief text-based messages did not increase this likelihood.

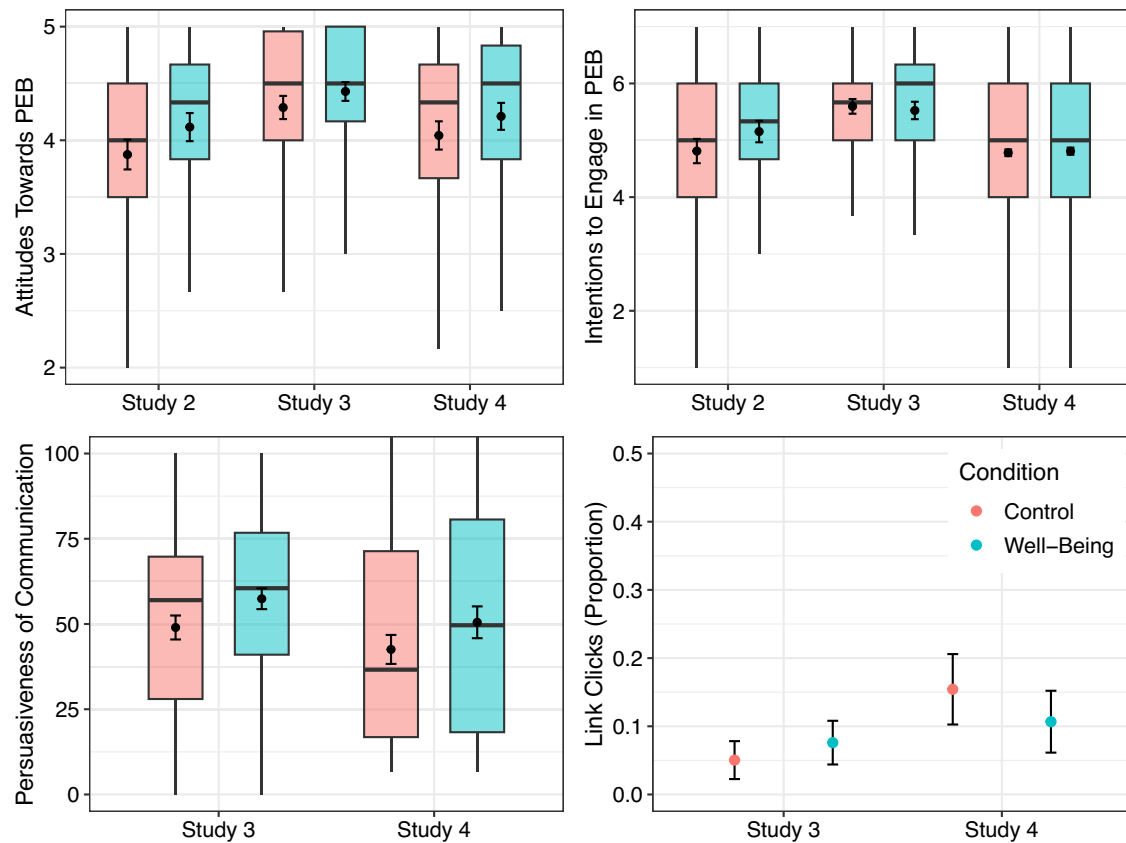
## Discussion

Research consistently points to a positive relationship between PEB and individual well-being<sup>7,8</sup>, contrary to the oft-presented narrative that engaging in PEB reduces one’s well-being<sup>20–23</sup>. This raises the question of whether

the positive relationship between PEB and well-being can be leveraged to encourage sustainable lifestyle shifts. To address this overarching question, we investigated how people typically think about the relationship between PEB and well-being, how beliefs about this question relate to people’s pro-environmental attitudes and behaviours, and whether messages about how PEB can increase well-being might motivate greater pro-environmental action.

Our findings from Study 1 indicate that most Americans think that most PEBs do *not* affect well-being, whether positively or negatively. When people do expect some effect on well-being, they tend to expect positive impacts. For all 21 of the PEBs we examined in Study 1, the average expectation was that the behaviours will have a modest, positive effect on a person’s well-being. Importantly, however, these expectations varied across behaviours and individuals. A minority of people (ranging from approximately 1% to 10%, depending on the behaviour) anticipate negative impacts. Additionally, we found that these perceptions are associated with people’s attitudes towards PEBs and intentions to engage in them (Study 4), as well as the frequency with which they do engage in PEBs (reported in Study 1 and revealed in Study 4).

In Studies 2-4 we attempted to influence perceptions of the PEB-well-being relationship using brief, text-based messages that highlighted some of the potential pathways from PEB to well-being that we discussed above (e.g., improved health and social connection). On one hand, we found only inconsistent evidence for effects on intentions to engage in PEB (a positive and significant effect in Study 2, but null effects in Studies 3 and 4) and no evidence that they influence a revealed measure of PEB (Studies 3-4). This suggests that short, written messages about PEB and well-being may be too “light-touch” – at least on their own – to have substantial downstream impacts on behaviour. On the other hand, we found that these messages did



**Fig. 3 | Effects of messages about how pro-environmental behaviour can increase well-being (Studies 2-4).** This figure presents the condition means and 95% confidence intervals for each dependent variable in each randomised experiment. Box

plots indicate the median and interquartile range, with vertical lines showing the highest and lowest observed values within 1.5 times the interquartile range.

consistently enhance attitudes towards PEB (Studies 2-4) and led people to be more persuasive in their subsequent efforts to encourage others to live sustainably (Studies 3-4).

The observed effects were not especially large (median  $d = .26$ ), though they were not far from the norm in psychological research more generally (median  $d = .32$  among pre-registered studies)<sup>30</sup>. As other researchers have argued<sup>31</sup>, psychological outcomes are determined by a very large number of factors, meaning that the effect of manipulating any one factor in isolation is likely to be small. Yet, small effects can have important consequences when aggregated across individuals and over time – analogous to the way that individuals’ contributions to large-scale environmental problems are very small, though the problem itself arises from the aggregation of such small effects. Moreover, in Study 4, we found that people’s pre-existing beliefs moderated the effect of the messages. Those who were previously less inclined to think that PEB can increase well-being showed larger effects, suggesting that, if messages about how PEB can improve well-being would be particularly effective if directed towards such individuals.

Another way to increase the magnitude of the effects might be to create messages focused on how specific PEBs could increase one’s well-being. One limitation of the present studies is that, although the messages mentioned a handful of specific behaviours (e.g., walking or biking to work and eating more plant-based meals, and reducing home power consumption), they also referred to PEBs in general terms. Moreover, the measures of attitudes towards and intentions to engage in PEB referred to “environmentally-friendly actions” and “sustainable lifestyles,” rather than individual behaviours. The only exception was the PEB intentions measure in Study 4, which assessed participants’ intentions to engage in 21 specific PEBs. In an exploratory (i.e., not pre-registered) analysis, we examined the effects of the experimental intervention on each behaviour individually (see Table S5 in the Supplemental Information). Although none of these behaviour-specific

effects were significant, the effect-size estimates were largest for behaviours that were mentioned in the experimental message (e.g., reducing meat consumption, walking, biking, and carpooling instead of driving). Hence, focusing messages and measures on individual behaviours could potentially lead to larger and more consistent effects on attitudes, intentions, and behaviour.

Strengths of the present work include large and (in Studies 1 and 4) representative samples, as well as pre-registered replications of the experimental findings. Limitations include the brevity of the studies and the narrowness of the behavioural (i.e., non-self-report) measures. Future work could follow up with participants days or weeks after they are exposed to messages about the relationship between PEB and well-being. This will be important for determining the longevity of the impacts of such interventions. Additionally, our revealed measure of PEB was fairly limited (involving participants’ decisions to visit a website with information and guidance about sustainable lifestyle choices). Future research might be able to use a wider range of revealed measures of PEB to provide further insights. Finally, although we examined the way in which the impacts of our messages were shaped by pre-existing beliefs about the PEB-well-being relationship, future research could test for interactions with other theoretically relevant factors, such as baseline levels of well-being, trust in science, or beliefs about climate change.

In sum, our results suggest that individuals’ beliefs about how PEB affects a person’s well-being could help drive sustainable lifestyle changes. We found clear and consistent evidence that such beliefs are related to pro-environmental action and that messages designed to shift these beliefs can promote more positive attitudes and conversations around PEB. Moreover, these effects may be especially powerful among those less inclined to expect positive effects of PEB on well-being. Numerous past experiments, using a variety of stimuli, have failed to elicit *any* effects on pro-environmental

attitudes, intentions or behaviours<sup>26,32,33</sup>, leading some to conclude that individuals' beliefs, attitudes, and intentions regarding PEB are quite fixed<sup>26</sup>. However, the results of the present research suggest that messages about the personal benefits of PEB are an exception to this trend. Our finding that messages about PEB and well-being make people more persuasive and motivating in their communication about PEB is perhaps the most noteworthy. It points to the potential for “ripple effects” – i.e., ways in which messages about the personal benefits of PEB may have effects beyond the individuals directly exposed to them. Such messages could potentially begin to reshape the way that people think and communicate about PEB, and thereby help contribute to sustainable lifestyle shifts.

## Methods

All participants provided informed consent. The protocols for Studies 1 and 4 were approved by the board at the London School of Economics and Political Science (#253852), and the protocols for Studies 2–3 were approved by the institutional review board at Yale University (#2000033354). All studies were pre-registered. The pre-registration forms, full materials, data, and analytic code are all available online <https://osf.io/g3pu2/>. All participants were recruited through Prolific (<https://www.prolific.co/>). All *p*-values reflect two-sided tests.

### Study 1

**Participants.** We recruited a sample of 518 adults from across the United States. Due to a technical error, several ( $n = 4$ ) responses were duplicates (i.e., participants completing the survey a second time) and therefore deleted. As pre-registered, we also excluded ( $n = 3$ ) responses that failed an attention check, leaving an analysis sample of  $N = 511$ .

The sample was representative of US adults in terms of age, sex, and political affiliation. (Unfortunately, at the time, Prolific did not allow researchers to recruit samples that are simultaneously representative of race/ethnicity and political affiliation. Hence, given that climate change and environmentalism are heavily politicised topics in the United States<sup>34</sup>, we opted for political representativeness over racial representativeness. That said, overall, the proportions for race/ethnicity were relatively similar to the US Census.) The mean age was 46.44 ( $SD = 16.03$ ). Of the 511 participants, 49% identified as men, 50% women, 1% other or decline to state; < 1% identified as American Indian or Alaska Native, 5% Asian or Asian American, 9% Black or African American, 5% Hispanic or Latine/Latinx, 73% White or European American, 6% mixed race/ethnicity, < 1% other. Median annual household income was reported to be between \$50,000 and \$99,999. About half of the sample (54%) reported having a bachelor's degree or more education.

**Procedure and measures.** We first presented participants with a list of 21 PEBs, based on a measure used in prior research<sup>15</sup>. The instructions read: “On the next page is a list of things that people sometimes do as a part of their daily activities. We would like to know if you think any of these behaviours affect a person's well-being – that is, their happiness and satisfaction with life.” On the following page, we asked, “Do you think that any of the following affect a person's well-being, either positively or negatively? Please select any that apply.” On the following survey page, for any selected behaviours we asked, “In what way do you think these behaviours affect a person's well-being? Do you think that they *increase* or *reduce* an individual's well-being? By how much?” The response scales were sliders ranging from “reduces a lot” (coded as  $-5$ ) to “increases a lot” (coded as  $5$ ). The default position for each slider was in the centre of the scale ( $0$ ). Finally, we assessed the frequency with which participants engage in these same 21 behaviours, asking: “How often do you personally engage in these behaviours? Please do not indicate what other people might like for you to do, or what you would like to do. Simply indicate what you *normally* do.” The response scales were 5-point Likert scales ranging from “never” to “always.” The presentation order for the behaviours was randomised.

### Study 2

**Participants.** We recruited a convenience sample of  $N = 327$  participants from across the United States ( $M_{\text{age}} = 34.84$ ,  $SD_{\text{age}} = 12.25$ ; 50% identified as men, 48% women, 1.8% other gender or decline to state; 10% identified as Asian, 5% Black or African American, 7% Hispanic or Latinx/Latine, 69% White, 7% mixed race/ethnicity, 1.5% other or decline to state).

**Procedure and Measures.** We randomly assigned participants to read one of two versions of “a short story about a person's decision to make a change to their lifestyle.” Both were entitled, “Why I decided to ‘go green.’” The first two paragraphs were identical across conditions and described various actions that the narrator had taken to live more sustainably (e.g., reducing driving, conserving electricity, organising colleagues to promote sustainability at work). The only difference between conditions was the stated motivation for these actions. In the Control condition ( $n = 162$ ), the narrator stated that, although PEB feels burdensome, it is “morally right” and “vital for the sake of the planet.” In the Well-Being condition ( $n = 165$ ), the narrator described how, alongside benefits to the environment, PEB improved his well-being.

After reading the narrative, participants reported their attitudes towards PEB and intentions to engage in PEB. Drawing on past research<sup>28</sup>, we asked participants whether, for them, an environmentally friendly lifestyle would be: worthwhile, good, wise, silly, pointless, and awful. Presentation order was randomised, and the response scale was a 5-point Likert scale ranging from “Not at all” to “Extremely.” We reverse-scored the three negative adjectives (silly, pointless, awful) and took the average as a measure of attitudes towards PEBs. This measure displayed excellent internal reliability (coefficient  $\omega = .90$ ). We assessed PEB intentions by asking participants for their agreement ( $1 = \text{“Strongly disagree”}$ ,  $7 = \text{“Strongly agree”}$ ) with the statements: “I intend to maintain environmentally friendly habits”; “I will try to live a sustainable lifestyle”; “I am committed to living in an environmentally friendly way.” We took the average of the three as a measure of intentions to engage in PEBs. This measure also displayed excellent internal reliability (coefficient  $\omega = .95$ ).

### Study 3

**Participants.** We recruited a convenience sample of  $N = 503$  participants from across the United States. As pre-registered, we excluded  $n = 2$  participants who responded to an open-ended question with nothing, nonsense, or clearly irrelevant information. This left  $N = 501$  participants in the primary sample ( $M_{\text{age}} = 38.74$ ,  $SD_{\text{age}} = 14.01$ ; 49% identified as men, 50% women, 1.4% other gender or decline to state; 6% identified as Asian, 5% Black or African American, 3% Hispanic or Latinx/Latine, 79% White, 5% mixed race/ethnicity, < 1% other or decline to state).

We also recruited  $N = 100$  additional participants to evaluate the persuasiveness of messages written by participants in the primary sample ( $M_{\text{age}} = 32.83$ ,  $SD_{\text{age}} = 12.19$ ; 50% identified as male, 50% female; 7% identified as Asian, 5% Black or African American, 11% Hispanic or Latinx/Latine, 64% White, 8% mixed race/ethnicity, and 5% other).

**Procedure and Measures.** We told participants in the primary sample that they would be reading an excerpt from an article that appeared in a popular science magazine and randomly assigned participants to read one of two messages. In the Well-Being condition ( $n = 263$ ), participants read a message that described “growing scientific evidence... that pro-environmental behaviour has personal benefits”, improving a person's well-being. In the Control condition ( $n = 238$ ), participants read an excerpt that described a carbon tax and how such a policy could be an effective way to incentivize people to live more sustainably. The rationale for this control condition was to ensure that all participants read a message about academic research. The carbon tax was selected as a command-and-control policy that many economists argue is an effective and efficient way to address climate change<sup>35</sup>.

After participants read the messages, we asked them to write persuasive messages. The instructions read: “Your goal in this message is to encourage

people to adopt environmentally friendly habits. Give reasons or arguments. Feel free to mention points made in the article and/or personal examples from your life or people you know. Your message should be about 4 sentences.” After writing their messages, participants reported their attitudes towards, and intentions to engage in, PEB. We used the same measures as in Study 2, which again showed excellent internal reliability (coefficient  $\omega$  = 0.90 and 0.94 for attitudes and intentions respectively). Finally, we presented participants with a link to a website where they could find guidance and tips about how to live more sustainably and tracked whether participants clicked on the link. This last outcome was pre-registered as exploratory.

After collecting the primary sample data, we showed participants' messages to the independent sample of judges. We gave the judges the following instructions: “We want to know how persuasive you find the following messages. Do they make you more or less motivated to adopt or maintain environmentally friendly habits? (These messages were written by participants in a prior study. Please ignore typos, spelling and grammatical errors, etc.)” Each judge rated five messages, randomly selected without replacement from the pool of messages written by the primary sample. Judges used a 100-point slider scale, ranging from “Not at all persuasive” to “Extremely persuasive,” to respond to the question, “How persuasive is this message? Does it motivate you to adopt or maintain environmentally friendly habits?”

#### Study 4

**Participants.** Approximately two weeks after conducting Study 1, we invited the participants from that study to return for a different study. This enabled us to take advantage of the representativeness of the original sample and to test whether the effects of the experimental intervention were moderated by prior beliefs (reported in Study 1) about the effects of PEBs on well-being. We received 388 complete responses. As pre-registered, we excluded,  $n = 22$  responses that failed an attention check or spent less than 5 seconds on the survey page that presented the message, leaving an analysis sample of  $N = 366$ . The mean age was 47.92 ( $SD = 15.92$ ). Of the total participants, 47% identified as men, 52% women, 1% other or decline to state; < 1% identified as American Indian or Alaska Native, 4% Asian or Asian American, 10% Black or African American, 5% Hispanic or Latine/Latinx, 74% White or European American, 6% mixed race/ethnicity, < 1% other. The median reported annual household income was between \$50,000 and \$99,999. About half of the sample (55%) reported having a bachelor's degree or more education.

To verify the representativeness of this sample, we tested whether any observed variables influenced participants' likelihood of returning for this study after they completed Study 1. In a series of logistic regression models, we regressed a dummy-coded variable (0 = did not return, 1 = did return) on sociodemographic factors (age, race, gender, income, education, political orientation), beliefs about PEBs, and the frequency with which participants engage in PEBs (for these latter two, we averaged across the 21 specific PEBs). The only significant predictor was age, with older participants being somewhat more likely to return,  $b = .02$ ,  $p = .001$ . As the variables of interest in the study (PEB beliefs and frequency) did not predict likelihood of returning, and the age distribution was only trivially different between Study 1 ( $M = 46.44$ ,  $SD = 16.03$ ) and Study 4 ( $M = 47.92$ ,  $SD = 15.92$ ), we conclude that the Study 4 sample can be treated as nationally representative to the same degree as the Study 1 sample.

**Procedure and Measures.** We randomly assigned participants to read one of two messages (Well-Being,  $n = 178$ , or Control,  $n = 188$ ), which included an abbreviated version of the personal narratives from Study 2 (i.e., with simplified language and one fewer examples), followed by short research summaries. Complete materials are available online: <https://osf.io/g3pu2/>. Afterwards, participants wrote short persuasive messages in response to the same prompt as in Study 3. They then reported on their intentions to engage in PEBs. The instructions read: “Do you intend to engage in any of these behaviours? Please do not indicate what other people might like for you to do, or what you would like to do. Simply indicate what you *actually* plan to do. I intend to...” This stem was then completed by the

same PEBs from Study 1. The response scale was a 7-point Likert ranging from “strongly disagree” to “strongly agree.” Participants completed the same 6-item attitudes measure as in Study 2. Finally, as in Study 3, we presented participants with a link to guidance and tips about how to live more sustainably and tracked whether they clicked on the link. The presentation order for items in each measure was randomised.

We used a generative pre-trained transformer (GPT) model to rate the persuasiveness of the participant-written messages. Recent work has shown that ratings from GPT models can very closely mirror those of human judges<sup>36</sup>. However, to further strengthen the validity of this measurement approach, we used the ratings provided by the human judges in Study 3 as training data. Specifically, we divided the 500 ratings from Study 3 into a training dataset (a randomly selected  $n = 400$ ) and a test dataset (the remaining  $n = 100$ ). We created a “fine-tuned” version of OpenAI's GPT-3.5 (<https://platform.openai.com/finetune>), which we iteratively queried using their application programming interface (<https://platform.openai.com/docs/api-reference>). For improved measurement reliability, we used three different prompts. One simply included the participant-written message. One prefaced the message with, “Does this message motivate you to adopt environmentally-friendly habits?” And another prefaced the message with, “Does this message draw you towards living a more environmentally-friendly lifestyle?” The scores resulting from these three prompts were correlated with each other ( $0.45 \leq rs \leq 0.69$ ), and we aggregated them into a single persuasiveness rating using a confirmatory factor analysis (see Fig. S1 in the Supplemental Information). The prompt files are available online, alongside the rest of the online materials.

#### Data availability

Data are available online: <https://osf.io/g3pu2/>.

#### Code availability

Analytic code is available online: <https://osf.io/g3pu2/>.

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### Author contributions

Conceptualization: M.P. & K.L.; Methodology: M.P. & K.L.; Formal analysis, M.P.; Visualization, M.P.; Writing, M.P. & K.L. Both authors read and approved the manuscript.

### Competing interests

The authors declare no competing interests.

### Additional information

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