Does meditation training promote pro-environmental behavior? A cross-sectional comparison and a randomized controlled trial

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Highlights

- Long-term meditation training may increase environmental attitudes
- Long-term meditation training is not associated with pro-environmental behavior
- Short-term mindfulness training does not improve sustainability-related variables
- Active interventions may increase pro-environmental behavior relative to waitlist

Abstract

Meditation training may promote pro-environmental behavior and related variables, though limited research has tested this experimentally. We investigated whether short- or long-term meditation training were associated with pro-environmental behavior, environmental attitudes, and sustainable well-being (i.e., well-being per unit consumption). In a cross-sectional comparison, long-term meditators (*n*=31; mean=9,154 meditation hours) displayed greater environmental attitudes (*d*=0.63) but not pro-environmental behavior or sustainable well-being compared to meditation-naïve participants (*d*s=-0.14–0.27). In a randomized controlled trial (*n*=125), eight-week training in Mindfulness-Based Stress Reduction did not significantly improve target variables relative to waitlist or structurally-matched active control (*d*s=-0.38–0.43). However, relative to waitlist, randomization to *either* meditation or active control predicted increases in pro-environmental behavior (*d*=-0.40) and sustainable well-being (*d*=0.42), although the latter finding was not robust to multiple imputation. While meditation training may promote pro-environmental behavior and its antecedents, the training investigated here does not appear to be uniquely effective.

Keywords: meditation; mindfulness-based stress reduction; climate change; environment; attitudes; behavior; mindfulness; randomized controlled trial; clinical trial

Word count: 6,965

1. Introduction

In addition to systemic drivers of the anthropogenic climate crisis, there is evidence that individual behaviors have substantial impact on greenhouse gas emissions and environmental degradation (Bleys et al., 2018; Dernbach, 2008; Dietz et al., 2009; Lange & Dewitt, 2019). It has also been suggested that a “bottom-up” approach of promoting pro-environmental behavior at the individual level may indirectly compel changes at the systemic level (Leichenko & O'Brien, 2019). Individual behaviors are therefore a critical component of broader efforts to mitigate the climate crisis (Wamsler et al., 2021).

Pro-environmental behavior has been defined as behavior that intentionally seeks to benefit or reduce harm to the environment (Steg & Vlek, 2009, Stern, 2000b). There is debate regarding the best ways to measure pro-environmental behavior (Lange & Dewitte, 2019). One approach is to assess self-reported behaviors associated with concern for the environment (e.g., water and energy conservation, environmental activism; Alisat & Riemer, 2015; Kaiser, Wolfing, & Fuhrer, 1999; Markle, 2013). Others have questioned this approach, arguing that such measures are not associated with actual household carbon emissions and demographic factors such as education and income influence which specific behaviors best represent pro-environmental behavior (Huddart Kennedy, Krahn, & Krogman, 2015).

An alternative approach is to represent pro-environmental behavior based on the estimated *impacts* of one’s lifestyle on the environment (Bleys et al., 2018; Huddart Kennedy, Krahn, & Krogman, 2015). In this approach, respondents report on a range of specific behaviors (e.g., consumer choices, power usage, modes of transportation), which are then multiplied by objective estimates of CO_2 emissions to derive a measure of the person’s “carbon footprint” (Lange & Dewitte, 2019). One such measure is the Ecological Footprint calculator, which expands this concept to include additionally relevant behaviors (e.g., dietary choices, garbage production, water and land usage). As such, the concept of an ecological footprint is a particularly useful way to represent pro-environmental behavior, as it seeks to capture the multi-dimensional impacts of a person's overall lifestyle on the environment (Moran et al., 2008).

Researchers and activists have advocated various interventions to promote pro-environmental behavior (Steg, & Vlek, 2009; Thiermann & Sheate, 2020b). Many target extrinsic factors, such as social norms, persuasive information, or access and incentives regarding pro-environmental behavioral options (e.g., recycling programs, public transportation; Steg, & Vlek, 2009; Stern, 2000a; Unsworth, Dmitrieva, & Adriasola, 2013). Others have highlighted the importance of targeting intrinsic factors such as values, behavioral intentions, awareness, and agency (Klöckner, 2013; Wamsler, et al., 2021). Two intrinsic factors associated with pro-environmental behavior are environmental attitudes and eudaimonic wellbeing (Venhoeven, Bolderdijk, & Steg, 2013; Wamsler et al., 2021).

Among the various conceptualizations of *environmental attitudes*, one of the most prevalent emphasizes moral concern for the environment (Kaiser, Wolfing, & Fuhrer, 1999). From this point of view, positive environmental attitudes involve a worldview wherein the environment is seen as limited and vulnerable to devastation by human behavior, in contrast to a dominant worldview in which humans are believed to have natural supremacy over an unlimited environment (Dunlap et al., 2000). Environmental attitudes are a key predictor of individual pro-environmental behavior (Kaiser, Wolfing, & Fuhrer, 1999; Klöckner, 2013). The environmental attitudes of a population also influence the success or failure of key policy and social reforms (Clayton et al., 2016; Semenza et al., 2008). Thus, environmental attitudes are an important variable to measure when seeking to promote pro-environmental behavior (Kollmuss &

Agyeman, 2002; Klöckner, 2013), particularly because changes in environmental attitudes may preceed pro-environmental behavior change (Geiger et al., 2020).

Another relevant intrinsic factor is *sustainable well-being*, also called "sustainable happiness" (Kjell, 2011; O'Brien, 2012). Sustainable well-being seeks to characterize the degree to which one's well-being is dependent on environmentally harmful behaviors (Marks, 2006). One may be said to have high sustainable well-being if their eudaimonic well-being (i.e., well-being derived from a sense of meaning and the embodiment of one's virtues, regardless of circumstances or affective state; Ryff, 2014) is generally not dependent upon environmentally costly behaviors (O'Brien, 2008). Some individuals may persist in environmentally harmful behaviors in part because these behaviors contribute to short-term increases in psychological well-being (Gilovich, Kumar, & Jampol, 2015; Venhoeven, Bolderdijk, & Steg, 2013). For example, an international vacation may produce excitement and pleasure at the expense of major carbon emissions. However, hedonic well-being (i.e., well-being derived from consistent experiences of pleasure and the absence of difficulties) is negatively associated with pro-environmental behavior (Venhoeven, Bolderdijk, & Steg, 2013). In contrast, eudaimonic well-being is positively associated with pro-environmental behavior (Venhoeven, Bolderdijk, & Steg, 2013). For example, the capacity to derive deep satisfaction from everyday activities may preclude the urge to engage in certain environmentally harmful behaviors (e.g., unnecessary consumerism or airline travel).

Meditation training has emerged as a potential means of promoting pro-environmental behavior through its effects on associated intrinsic factors such as environmental attitudes and eudaimonic well-being (Barrett et al., 2016; Geiger, Grossman, & Schrader, 2019; Thiermann & Sheate, 2020b; Wamsler et al., 2021). Among the many forms of meditation, mindfulness meditation has garnered substantial scientific endorsement and widespread interest in popular culture (Goldberg et al., 2021; Van Dam et al., 2018). Within the scientific literature, mindfulness is commonly defined as the intentional self-regulation of attention to the present moment, without judgment (Kabat-Zinn, 2013). Mindfulness has been defined as both a psychological disposition (i.e., dispositional mindfulness) and a family of mental techniques designed to increase dispositional mindfulness (Crane et al., 2017).

Various outcomes have been studied in both short-term meditators (e.g., participants in standardized eight-week interventions) and long-term meditators who have practiced meditation for years or decades. Both long-term and short-term meditation training have repeatedly been demonstrated to produce a wide range of physical and mental health benefits (Fox et al., 2016; Galante et al., 2021; Goldberg et al., 2021; Kaliman et al., 2014; Lutz et al., 2014; Lykins & Baer, 2009; Rosenkranz et al., 2016). In the West, the most widely studied and disseminated short-term mindfulness-based intervention is Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 2013). An eight-week intervention, MBSR has shown significant benefits for numerous mental and physical health variables in both clinical and non-clinical populations (Grossman et al., 2004; Khoury et al., 2015). As intended, meditation training (including MBSR) has been shown to produce increases in dispositional mindfulness (Goldberg et al., 2018).

There is growing evidence of a positive relationship between dispositional mindfulness and pro-environmental behavior (e.g., Dhandra, 2019; Fischer et al., 2017; Kasser, 2017; Wamsler et al., 2018). Dispositional mindfulness is also positively associated with environmental attitudes (Geiger, Grossman, & Schrader, 2019) and eudaimonic well-being (Chang et al., 2015). Long-term meditation training (i.e., ≥ three meditations per week for at least one year) has also been associated with increased pro-environmental motivations and pro-environmental dietary behaviors relative to less experienced meditators and non-meditators (Thiermann, Sheate, & Vercammen, 2020).

Such correlational evidence appears promising in light of theoretical models of how individuals come to adopt pro-environmental behavior. Several such models have been proposed (e.g., Klöckner, 2013; Thiermann & Sheate, 2020b), with increasing attention on intrinsic factors (Wamsler et al., 2021). One such model is the meta-analytically derived Comprehensive Action Determination Model (Klöckner, 2013). This model demonstrates empirically that environmental attitudes and perceived behavioral control (i.e., perceived ability to control a given behavior) are among the key factors that influence behavioral intentions, which in turn influence pro-environmental behavior. More recently, the Two-Pathway Model proposed by Thiermann and Sheate (2020b) expands upon Klöckner's (2013) model by identifying an additional *relational* pathway involving nature connectedness, empathy, and compassion, which may have distinct influences on a person's motivation and intentions to engage in pro-environmental behavior. Separately, other scholars have proposed that increasing eudaimonic well-being and promoting overall healthier lifestyles may also result in more pro-environmental behavior (Barrett et al., 2016; Geiger, Grossman, & Schrader, 2019; Venhoeven, Bolderdijk, & Steg, 2013).

Meditation training has been experimentally shown to produce changes on several intrinsic variables associated with perceived behavioral control, including increasing internal locus-of-control (Matchim & Armer, 2007) and value-behavior concordance (Franquesa et al., 2017; Warren & Wray-Lake, 2017) and decreasing automaticity (Kang, Gruber, & Gray, 2013; Ostafin, Bauer, & Myxter, 2012) and emotional reactivity (Britton et al., 2012; Hoge et al., 2013; Kral et al., 2018). It has been theorized that such changes may help to disrupt unsustainable habits and promote pro-environmental behavior (Wamsler et al., 2021). For example, increasing value-behavior concordance and decreasing automaticity may increase the likelihood that individuals already concerned about the environment will make more ecologically responsible consumer choices (Bahl et al., 2016). Similarly, reducing emotional reactivity through meditation training could help individuals respond more adaptively to anxiety-provoking information related to the climate crisis, such as by adopting more pro-environmental behavior (Gifford, 2011; Kasser, 2017).

Meditation training is also associated with increases in nature connectedness, empathy, and compassion, which represent a potentially critical pathway toward pro-environmental behavior (Thiermann & Sheate, 2020b). It has been theorized that feeling more connected with nature can lead people to feel more empathy and thereby compassion for the environment, which could in turn produce greater intention toward pro-environmental behavior (Thiermann & Sheate, 2020b). Meditation training has also been shown to produce increases in prosocial behavior (Donald et al., 2019), which could increase the likelihood that individuals will, for example, reduce their water consumption or carbon emissions, as such behaviors are linked to the well-being of others.

Importantly, meditation training may also help people derive greater eudaimonic well-being per unit consumption (i.e., increase sustainable well-being). There is both empirical and theoretical work showing that meditation training can foster an ability to engage in positive reappraisal of life experiences, leading to greater purpose, meaning, and engagement in life (Garland et al., 2015; Ryan & Deci, 2001; Ryff, 2014). Through such reappraisal, meditation training has been shown to produce increases in well-being even in the face of adversity (Garland et al., 2015). As noted, promotion of such eudaimonic well-being has direct bearing on pro-environmental behavior (Venhoeven, Bolderdijk, & Steg, 2013). Through this ability to help decouple psychological well-being from hedonic pleasure, meditation training may reduce reliance on material consumption to feel happy, with important implications for human impact on the environment.

Additionally, it appears meditation training could indirectly promote pro-environmental behavior by leading individuals to adopt overall healthier lifestyles (Barrett et al., 2016; Brown & Kasser, 2005; Geiger, Grossman, & Schrader, 2019; Kasser, 2017). For example, becoming more mindful of physical sensations may lead individuals to adopt a healthier diet or to begin bicycling rather than driving to work, with the unintended benefit of reduced impact on the environment. Results from a cross-sectional study ($N = 829$) provide support for this theoretical pathway, revealing significant positive associations between mindfulness meditation, well-being, and pro-environmental behavior (Jacob, Jovic, & Brinkerhoff, 2009). Thus, meditation training may have reciprocal “co-benefits” that enhance the health of both individuals and the environment (Barrett et al., 2016; Wamsler et al., 2021).

Despite the experimental evidence that meditation training improves these theoretically relevant variables, to our knowledge no randomized controlled trials have tested the causal role of meditation training directly on pro-environmental behavior (Fischer et al., 2017; Thiermann, 2020a). Among the notable efforts in this direction, the Mindful Climate Action program (Barrett et al., 2016) is an eight-week mindfulness-based intervention that integrates elements of MBSR with specific education around how individual behaviors impact the environment. Mindful Climate Action has shown promising feasibility (Grabow et al., 2018), but has yet to be tested in a randomized controlled design. More recently, an uncontrolled pre-post experimental study tested the effects of a modified version of MBSR on sustainability-related variables ($N = 137$; Geiger et al., 2020). The intervention adapted the core components of MBSR to include exercises designed to promote sustainable consumption behaviors (Stanszus et al., 2017). The intervention led to increases in mindfulness and well-being and decreases in materialistic values, which the authors speculated could have indirect benefits on long-term consumption behavior. However, the intervention produced no direct changes in environmental attitudes, pro-environmental behavior, or the attitude-behavior gap (Geiger et al., 2020). These findings may dampen enthusiasm for the potential of mindfulness-based interventions in addressing climate change; however, the lack of a control condition makes it impossible to rule out confounding variables (e.g., history effects).

Overall, there is a need for more rigorous empirical evaluation before meditation training can be recommended to reduce human impact on climate change (Geiger, Grossman, & Schrader, 2019). Knowing that it may take time for intrinsic factors such as environmental attitudes to influence pro-environmental behavior, it is important to examine the impact of both short-term (e.g., eight-week) and long-term training. To our knowledge, no randomized controlled trial has investigated the impacts of a traditional eight-week mindfulness-based intervention (e.g., MBSR) on pro-environmental behavior, nor have prior studies compared long-term meditators with meditation naïve individuals.

While it is typically not feasible to randomize individuals to long-term meditation training, randomized controlled trials are a particularly valuable method for investigating the causal influence of short-term meditation training. Ideally, such designs include both a waitlist control and an active control to allow isolation of effects due to meditation training, rather than non-specific factors (e.g., instructor attention, expectancy of benefit, social desirability; Wampold & Imel, 2015). The Health Enhancement Program (HEP) is a standardized eight-week intervention that was developed specifically as an active control condition for MBSR studies

(MacCoon et al., 2012). HEP provides the nonspecific treatment components of MBSR (e.g., social support, therapeutic alliance, positive expectancy). However, instead of meditation training, HEP includes activities such as increased physical activity, functional movement, nutrition education, diet planning, and the use of music and imagery (MacCoon et al., 2012). HEP may be especially relevant for evaluating the impact of MBSR on pro-environmental behavior given that HEP is designed to encourage healthier lifestyle choices and increase overall well-being, both of which may have positive effects on pro-environmental behavior.

1.1 Current Study

Meditation training may be a means of promoting pro-environmental behavior and its antecedents (Thiermann et al., 2019); however, limited research has tested this experimentally or examined it in relation to long-term meditation training. The current study aimed to investigate the effects of both short- and long-term meditation training on pro-environmental behavior, environmental attitudes, and sustainable well-being. We recruited a sample of long-term meditators (LTMs) and meditation naïve participants (MNPs) who were demographically matched, allowing cross-sectional comparisons between these groups. To experimentally test the effects of meditation training, the MNPs were then randomized to receive short-term meditation training (8 weeks of MBSR), a structurally-matched active control group (8 weeks of HEP), or to a waitlist control group. We tested the following hypotheses:

- H1. At baseline, LTMs will report significantly more pro-environmental attitudes and behaviors, and significantly greater sustainable well-being, than do MNPs.
- H2. Randomization to the MBSR condition will predict significant pre- to post-treatment increases in pro-environmental attitudes and behaviors, as well as sustainable well-being, relative to waitlist and active control conditions.

2. Methods

This study was approved by the University of [omitted for blind review] Institutional Review Board. Written consent was obtained from participants.

2.1. Participants and Procedure

A total of 156 adult participants were recruited as part of a larger study on "health and well-being" ([omitted for blind review]). A sample of 31 LTMs were recruited through meditation centers throughout the United States, and through related mailing lists, flyers, and newspaper advertisements. Primary inclusion criteria for LTMs included at least three years of Vipassana and compassion/loving-kindness meditation, with daily practice of at least 30 min, as well as three or more residential meditation retreats lasting at least 5 days each. LTMs reported an average of 9,154 lifetime hours of meditation practice (*SD* = 6,976; range = 1,439 to 32,613). A non-clinical sample of 125 MNPs were recruited from the general public in and around a mid-sized metropolitan city in the Midwest United States using flyers, online advertisements, and local media. The LTM and MNP groups were matched at baseline and did not differ by age, gender, race/ethnicity, or education (ps > .05). Participants in both groups were excluded if they had used psychotropic medications; had a psychiatric diagnosis in the past year; had a history of bipolar or schizophrenic disorders, traumatic brain injury, or seizures; or if they met exclusion criteria for the brain imaging components of the larger study (see [omitted for blind review]). Sample descriptive statistics can be found in Table 1.

After telephone screening, participants attended in-person laboratory visits (T1), during which informed consent was obtained and randomization occurred. Data collected at T1 were used for cross-sectional comparisons between LTMs and MNPs and served as baseline data for the experimental study. A random-number generator was used to assign MNPs to one of three conditions: 8 weeks of Mindfulness Based Stress Reduction (MBSR), 8 weeks of Health Enhancement Program (HEP), or a waitlist control. After randomization, participants in each of the three experimental groups did not differ on any variables of interest. Within four weeks of intervention conclusion, MNPs were again assessed on all variables during in-person laboratory visits (T2). See Figure 1 for a graphical representation of the study design. Participants were blind to research questions and research staff were blind to condition assignment until data collection was complete.

The parent study was powered to detect differences between groups (LTM vs. MNP, MBSR vs. HEP and waitlist) on various physiological indices that had previously shown moderate-to-large between group differences (e.g., differences on anterior activation asymmetry of $r = .53$, differences in insula response to emotional stimuli of $d = 0.74$). Adequate power (≥.80) was estimated to be achieved with a sample of 30 completers in each of the four groups. Anticipating attrition for the randomized arms, the parent study aimed to recruit ≥36 participants per group. For the current study, we had power ≥.80 to detect moderate-to-large between group differences when comparing LTMs and MNPs ($d \geq 0.57$), when comparing MBSR with HEP or waitlist ($d \geq 0.67$), and when comparing the active conditions with waitlist ($d \geq 0.58$).

2.2. Interventions

MBSR (Kabat-Zinn, 1994) is an eight-week intervention that includes instruction in both formal meditation and informal mindfulness practices (e.g., present-moment awareness during daily life). These practices are aimed at cultivating greater capacity to intentionally direct and sustains one’s attention to the present moment with an attitude of openness and curiosity, as well as greater awareness of and flexibility in responding to maladaptive mental habits (Kabat-Zinn, 1994). MBSR participants met as a group once per week for 2.5 hours and were assigned daily home practice, in addition to a single full-day immersive retreat. MBSR classes were facilitated by experienced MBSR instructors.

HEP is an eight-week intervention that was specifically developed as an active control condition for MBSR, matching the MBSR curriculum as closely as possible but without mindfulness instruction (MacCoon et al., 2012). Both MBSR and HEP were designed to improve psychological well-being through different empirically supported pathways. HEP shares the nonspecific treatment components of MBSR (e.g., social support, therapeutic alliance, positive expectancy). However, instead of meditation training, HEP's active ingredients are physical activity, functional movement, nutrition education, diet planning, and the use of music and imagery. As with those in the MBSR condition, HEP participants met as a group once per week for 2.5 hours and were assigned daily home practice, in addition to a single full-day immersive retreat. HEP classes were provided by experienced HEP instructors with no mindfulness training.

2.3. Measures

2.3.1. New Ecological Paradigm. Environmental attitudes were assessed using the New Ecological Paradigm Scale (Dunlap et al., 2000). The New Ecological Paradigm includes 15 items that are rated on a five-point Likert-type scale assessing values and beliefs regarding humanity's relationship with the natural world (e.g., Earth's ability to sustain current human activity, the degree to which humans can or should influence the natural world). New Ecological Paradigm total scores were used in analyses, where a higher total score indicates pro-environmental attitudes. The New Ecological Paradigm has adequate psychometric properties (Dunlap et al., 2000). Internal consistency reliability in the current sample was adequate (alpha = .80).

2.3.2. Ecological Footprint. Pro-environmental behaviors were assessed using the Ecological Footprint calculator[1] (Wackernagel, 1994; Moran et al., 2008). The Ecological Footprint calculator includes 17 items that either involve categorical responses or are rated on a visual analogue scale ranging from, e.g., "never" to "often." Items assess behaviors relevant to climate change, such as food choices, living conditions, and frequency of car and air travel. Based on the rate at which our planetary systems can renew themselves, a participant's Ecological Footprint total score is meant to represent the number of Earths that would be needed to sustain human life if all humans shared that participant's lifestyle. A lower Ecological Footprint score indicates more pro-environmental behavior. The Ecological Footprint calculator produces a total score that is not a simple sum of items, but rather is an estimate of the total environmental cost of a person's lifestyle based on available data regarding the actual contributions to climate change from each of the different factors assessed (Wackernagel et al., 2005); therefore, we did not compute internal consistency reliability.

2.3.3. Sustainable Well-being. Sustainable well-being is typically calculated as a ratio, with a measure of well-being in the numerator and a measure of the environmental cost of one's lifestyle in the denominator (e.g., Ecological Footprint; Abdallah et al., 2009; Index, 2016; Chambers, 2001; Costanza, 2000; Marks, 2006). We used the 18-item version of Ryff's Psychological Well-Being measure (PWB; Ryff, 1989) to assess the eudaimonic well-being component of sustainable well-being. PWB items are drawn from six domains of well-being, including personal growth, positive relations with others, purpose in life, autonomy, environmental mastery, and self-acceptance. Item responses range from 1 (totally disagree) to 6 (totally agree). Total scores were computed for analyses, where higher scores indicated higher

[1] For the Ecological Footprint calculator, visit: https://www.footprintnetwork.org/resources/footprint-calculator/

levels of well-being. The PWB has previously shown desirable psychometric properties (Ryff & Keyes, 1995). Internal consistency reliability in the current sample was adequate (alpha = .81). Sustainable well-being was then computed as PWB divided by Ecological Footprint. This ratio was viewed as an estimate of the degree to which a participant's psychological well-being was dependent on consumption of environmental resources, with higher scores indicating higher sustainable well-being (i.e., more well-being per unit consumption).

2.4. Data Analysis

Ordinary least squares regression was used to examine between-group differences at baseline and change over time in the three outcome variables of interest. For baseline comparisons, LTM status was entered as a dichotomous independent variable (i.e., MNP as the reference group). To examine change over time for the MNP conditions post-randomization, we included post-test scores as the dependent variables with group (i.e., MBSR, HEP, waitlist) and pre-test scores as independent variables (i.e., akin to analysis of covariance [ANCOVA]). A first model compared change in MBSR versus HEP and waitlist (i.e., MBSR as the reference group). A second exploratory model compared change in the two active conditions (MBSR and HEP combined) versus waitlist.

We conducted a sensitivity analysis to evaluate the impact of missing data at T2 (post-intervention) on the effects of short-term training. To do so, we first created 100 data sets with missing values imputed using the 'jomo' package in R (Quartagno & Carpenter, 2020) which uses a multivariate normal model fitted by Markov Chain Monte Carlo. Models were then fit across data sets and pooled according to Rubin's rules using the 'mice' package (van Buuren & Groothuis, 2011). Multiple imputation is capable of handling data that are missing at random (MAR; Graham, 2009).

3. Results

Means and standard deviations of variables of interest are provided in Table 2. Pre-post effect sizes, p-values, and 95% confidence intervals are provided in Table 3. To examine the possibility that the MNP sample may have started at higher levels of well-being than the general population, given their willingness to participate in a well-being RCT, we compared their baseline PWB scores with scores from Ryff and Keyes (1995) validation of the 18-item PWB scale. The average MNP baseline total PWB score of 88.0 was slightly lower than the score in the norming sample ($M = 89.6$, $d = -0.18$, $p = .050$). One hundred seven of the 125 randomized participants (85.6%) completed post-test, with no overall differences in rates of post-test completion across the three randomized groups ($F\ [2] = 2.02$, $p = .137$).

To test our first hypothesis, we compared LTM and MNP at baseline. As hypothesized, LTM group status predicted more pro-environmental attitudes ($d = 0.63$, 95% CI [0.22, 1.03], $p = .002$; see Table 3 and Figure 2). Contrary to expectations, LTM status did not predict more pro-environmental behavior ($d = -0.14$, [-0.52, 0.24], $p = .482$) or sustainable well-being ($d = 0.27$, [-0.11, 0.66], $p = .175$; see Table 3 and Figure 2).

To test our second hypothesis, we examined changes in MBSR relative to the active and waitlist controls. Contrary to expectations, randomization to the MBSR condition versus active control (HEP) did not predict post-test environmental attitudes ($d = -0.15$, [-0.57, 0.27], $p = .353$), pro-environmental behavior ($d = -0.04$, [-0.46, 0.38], $p = .970$), or sustainable well-being ($d = 0.05$, [-0.37, 0.47], $p = .954$; see Table 3 and Figure 3), when controlling for pre-test levels. Similarly, randomization to the MBSR condition versus waitlist control also did not predict post-test environmental attitudes ($d = 0.05$, [-0.39, 0.48], $p = .948$), pro-environmental behavior (d = -

0.38, [-0.82, 0.07], *p* = .101), or sustainable well-being (*d* = 0.43, [-0.02, 0.87], *p* = .088), when controlling for pre-test levels.

We then conducted an exploratory analysis examining the possibility that active interventions generally (i.e., random assignment to either MBSR or HEP combined) may positively impact sustainability-related variables relative to waitlist. When combined, participants receiving MBSR or HEP showed increased pro-environmental behavior (*d* = -0.40, [-0.79, -0.01], *p* = .033) and sustainable well-being (*d* = 0.41, [0.02, 0.80], *p* = .045), but not pro-environmental attitudes (*d* = 0.13, [-0.52, 0.25], *p* = .519; see Table 2).

Sensitivity analyses examined the effects of short-term training when replacing missing values via multiple imputation. Significance tests for all models were unchanged, with one exception. When implementing multiple imputation, active conditions (MBSR and HEP combined) no longer showed a significant increase in sustainable well-being relative to waitlist (*b* = 0.76, *p* = .075).

4. Discussion

While there has been increasing scholarship on mindfulness and sustainability-related variables, including pro-environmental behavior, few experimental studies and very few comparisons with long-term meditators exist (Thiermann & Sheate, 2020a). To our knowledge, this is the first randomized controlled trial to experimentally investigates the effects of standard (i.e., non-adapted) MBSR on pro-environmental behavior relative to both active and waitlist controls. We investigated the effects of both short- and long-term meditation training on pro-environmental behavior and two related constructs: environmental attitudes and sustainable well-being. Being a LTM was associated with moderately larger pro-environmental attitudes (*d* = 0.63) compared to MNPs. This supports the notion that long-term meditation training may impact some sustainability-related variables, but the lack of random assignment makes causal inferences impossible. While long-term meditation training may lead to more pro-environmental attitudes, it is also possible that those who are drawn to (and persist with) long-term meditation training are more likely to have pro-environmental attitudes to begin with. Furthermore, being an LTM was not associated with either pro-environmental behavior or sustainable well-being (*d*s = -0.14 to 0.27), suggesting that long-term meditation training may have little impact on behaviors that contribute to climate change or on the degree to which individuals' eudaimonic well-being is reliant upon environmentally harmful behaviors.

These null findings may be disappointing to advocates of meditation and may counter prior theoretical arguments that meditation can naturally give rise to better stewardship of the environment (Anālayo, 2019; Fischer et al., 2017; Thiermann, Sheate, & Vercammen, 2020). Long-term meditation practice appears to be associated with pro-environmental attitudes and has previously been associated with *motivation* to engage in pro-environmental behavior (Thiermann, Sheate, & Vercammen, 2020). However, these factors may not translate to actual pro-environmental behavior. While meditation training has been shown to increase value-behavior concordance generally (Franquesa et al., 2017; Warren & Wray-Lake, 2017), this may not be the case for pro-environmental behavior specifically. It may be that individuals have relatively less agency to change pro-environmental behaviors relative to other behaviors, given contemporary society's widespread reliance on fossil fuels and other environmentally harmful systemic factors. Alternatively, these findings may instead bolster recent assertions that some forms of mindfulness training might just as easily *decrease* pro-environmental behavior by strengthening one's focus on personal well-being and decreasing one's guilt when engaging in environmentally harmful behavior (Frank et al., 2021).

Nonetheless, when interpreting these null findings, it is important to avoid viewing LTMs or MNPs as homogenous groups. While some lifestyle factors associated with long-term meditation training may have benefits for the environment (e.g., vegetarianism, health behaviors; Cramer et al., 2017; Thiermann, Sheate, & Vercammen, 2020), other associated lifestyle factors may involve substantial environmental harm (e.g., air travel to attend meditation retreats). It is also important to acknowledge the risk of selection bias, as individuals who end up as LTMs may differ from MNPs in ways unrelated to meditation training. For example, it is theoretically possible that LTMs may be more aware of their climate-related behaviors or more inclined to report them accurately. It is also possible that individuals in the West who are most likely to persist in long-term meditation training may share certain demographics (e.g., White, relatively high socioeconomic status), which may be more proximal predictors of the most environmentally harmful behaviors (e.g., international air travel). Conversely, it is possible that some MNPs drawn to participate in a well-being study may do so to address ongoing mental or behavioral health challenges, some of which could in theory inhibit pro-environmental behavior.

We also failed to find evidence that short-term meditation training in the form of a standardized, eight-week MBSR course produced changes in pro-environmental behavior, environmental attitudes, or sustainable well-being relative to either active (*d*s = -0.15 to 0.05) or waitlist control (*d*s = -0.38 to 0.43). It is possible that eight weeks was simply not enough time to detect changes in pro-environmental behavior (Geiger et al., 2020; Lange, & Dewitte, 2019; Thiermann, Sheate, & Vercammen, 2020). However, given the largely null findings in the present LTM sample, it seems tenuous to suggest that merely increasing the dosage or duration of the practices taught in MBSR would produce larger effects on pro-environmental behavior. It is important to consider the content of MBSR when interpreting these null findings. Practices taught in MBSR primarily focus on directing attention non-judgmentally to present moment experiences (e.g., breath sensations, thoughts) and do not explicitly target one's relationship with the natural world. Such attention-based practices have been shown to have lesser impact on sustainability-related variables compared with compassion-based meditation practices (Bristow, Bell, & Wamsler, 2022; Condon & Makransky, 2020; Thiermann & Sheate, 2020b; Quaglia, Soisson, & Simmer-Brown, 2020). There are other contemplative practices which may ultimately be more impactful on sustainability-related variables. For example, other Buddhist meditation practices (e.g., *tonglen*, lovingkindness) and practices drawn from other wisdom traditions are designed specifically to strengthen a person's sense of interconnectedness with all beings and the environment. The impact of these other forms of contemplative practice on sustainability-related variables requires future study.

It is particularly important to recognize that MBSR and other mindfulness-based interventions have largely been extracted from their traditional ethical and cultural frameworks, which historically stressed the interdependence of all beings as a primary motivation for cultivating healthier habits (Dalai Lama, 2009; Harrington & Dunne, 2015). Throughout history, many Buddhist leaders have actively promoted the cross-cultural dissemination and secularization of meditation practices (e.g., Dalai Lama, 2001), knowing that the practices and their applications will evolve as they interact with new cultural contexts (Heirman & Bumbacher, 2007). However, it is possible that key elements relevant to pro-environmental behavior may be lost in translation as these meditation practices are adapted to promote *individual* health within a modern Western medical model. Some have argued that newer manifestations of Western mindfulness may even risk causing unintended harm by focusing solely on attentional training and coping skills outside of a broader ethical framework – a sort of distress-tolerance training that ignores the systemic, exploitative conditions driving much of people's distress in the first place, including the climate crisis (Purser & Loy, 2013). Others have suggested that these critiques incorrectly conflate mindfulness with the passive acceptance of one's circumstances, arguing that the practice of present-moment awareness is entirely compatible with critical thinking and the resistance of exploitative conditions (Anālayo, 2020). These authors contend that properly applied mindfulness can be a valuable tool in confronting, disrupting, and adapting to the climate crisis and other injustices (Anālayo, 2020; Walsh, 2016).

Regardless, it is reasonable to think that meditation training may have substantively different effects when intended as a practice to benefit all beings (i.e., the *bodhisattva* ideal; Dalai Lama, 2009) as opposed to a self-regulation skill to help individuals manage personal experiences of physical or psychological pain. Given that many secular mindfulness teachers (and some instantiations of MBSR) tend toward the latter approach, it is perhaps unsurprising that these practices do not appear to impact sustainability-related variables. It is plausible that meditation training (as well as other well-being practices) may produce larger effects on sustainability-related variables when the practices explicitly emphasize the interdependence of humans and the natural world (Bristow, Bell, & Wamsler, 2022; Condon & Makransky, 2020; Dunne & Manheim, 2022; Quaglia, Soisson, & Simmer-Brown, 2020).

A slightly different story emerges from exploratory analyses that compared the combined active conditions (MBSR and HEP) with the waitlist control. Here we saw that, relative to the waitlist, the active groups combined showed significant increases in both pro-environmental behavior (d = -0.40) and sustainable well-being (d = 0.43), although the effect on sustainable well-being was not robust in a sensitivity analysis with multiple imputation. Just as for MBSR alone, there were no significant effects on environmental attitudes when the active groups were combined and compared to waitlist (*d* = 0.13). One possible explanation for this pattern of findings could be that the nonspecific treatment components shared by MBSR and HEP (e.g., social support, therapeutic alliance, positive expectancy) play roles of equal or greater importance than treatment-specific components for impacting environmental outcomes (e.g., Canby et al., 2020). This possibility is consistent with evidence from the psychotherapy literature, where active treatments (including mindfulness-based interventions) show few differences from each other in their clinical effects but consistently out-perform waitlist conditions (Goldberg et al., 2018; Wampold & Imel, 2015; Wampold et al., 1997). As described in the contextual model of psychotherapy, these nonspecific factors may influence participants' engagement in health-promoting behaviors (Wampold, 2015), which may in turn increase both eudaimonic well-being and pro-environmental behavior (Barrett et al., 2016; Geiger, Grossman, & Schrader, 2018). An alternative explanation could be that both MBSR and HEP include specific treatment components (e.g., meditation practices for MBSR versus dietary and exercise coaching for HEP) that impact pro-environmental behavior, albeit through different pathways. Furthermore, the magnitude and direction of the MBSR versus waitlist effect sizes, though nonsignificant, are consistent with the hypothesis that MBSR may produce beneficial effects on pro-environmental behavior (*d* = -0.38) and sustainable well-being (*d* = 0.43), but not on environmental attitudes (*d* = 0.05). From this perspective, it is plausible that the lack of statistically significant differences for some outcomes is due to low statistical power (i.e., Type II error).

Taken together, results from the present study suggest that pro-environmental behavior may be responsive to short-term interventions generally designed to improve well-being; however, the types of meditation training included in this study do not by themselves appear to be uniquely effective in changing any of the variables assessed. Moreover, although long-term meditation was associated with pro-environmental attitudes, only short-term training in meditation *or other well-being practices* impacted pro-environmental behavior. While perhaps discouraging for proponents of meditation – particularly long-term intensive meditation – these results raise the encouraging possibility that general efforts to promote human well-being through various practices (including those represented by MBSR and HEP) may benefit the environment.

4.1. Limitations and Future Directions

There are several limitations to the current study. First, we relied exclusively on self-report measures to assess constructs which are vulnerable to social desirability and other biases. Second, the relatively small sample sizes of each study condition yielded modest statistical power, particularly for the comparisons between MBSR and the control conditions. Third, the lack of long-term follow-up measures precludes investigating long-term effects of these short-term interventions. Fourth, there are notable limitations for generalizing these results to other populations due to the self-selection biases already discussed, as well as the largely homogenous sample demographics (89.1% White, 88.4% with four or more years of college education). It is likely that other populations may have different understandings of what constitutes pro-environmental behavior and may have different degrees of access to such behavior (Song et al., 2020). Fifth, the use of a more recently developed and psychometrically valid self-report measure of pro-environmental behavior *per se* (e.g., the General Ecological Behavior measure; Kaiser & Wilson, 2000), versus its estimated effects, may have produced different results.

Nonetheless, the current results are intriguing. Future research should identify which specific meditation practices, well-being promotion practices (e.g., exercise, nutrition), and/or nonspecific treatment components produce change on sustainability-related variables. Future research should also identify the best ways to frame and contextualize these practices to have the greatest impact on sustainability-related variables. Western science has tended to focus on mindfulness in isolation, but in Buddhism cultivating mindfulness has historically been conceptualized as one aspect of a broader spiritual path which also includes the cultivation of, e.g., right view, right resolve, right conduct, and right effort (Bodhi, 2010). Similarly, the integration of specific meditation practices that target the human-environment relationship with educational material relating to ethics, sustainability, environmental justice, and overt calls-to-action (e.g., Mindful Climate Action; Barrett et al., 2016) may be more effective at engendering pro-environmental attitude and behavior change. At once, it would be intriguing to investigate whether the procedural learning acquired through meditation training could help to consolidate the declarative learning from such educational components, thus potentially producing larger impacts on pro-environmental behavior.

It would also be worthwhile to examine whether interventions routinely delivered to promote well-being (e.g., psychotherapy, pharmacotherapy) also impact pro-environmental behavior. With theoretical models asserting behavioral intentions as the most proximal predictor of pro-environmental behavior (e.g., Klöckner, 2013), it is of particular importance for future research to address the observed gap between pro-environmental attitudes and intentions on the one hand, and actual pro-environmental behavior on the other. Psychological factors such as self-efficacy or insight into one’s behavioral or mental habits may be critical components of more effective interventions (Venhoeven, Bolderdijk, & Steg, 2013; Wamsler et al., 2021).

Finally, considering the documented mental health benefits (Goldberg et al., 2021), it is possible that MBSR and other forms of meditation training may help to reduce psychological distress related to the climate crisis (e.g., climate anxiety; Verlie, 2019; Wamsler, 2018). Further research should test this empirically, given evidence that climate-related distress is a rapidly growing concern (Clayton, 2020; Doherty & Clayton, 2011; Searle and Gow, 2010) while inaction remains the norm (Gifford, 2011). There may be an optimal level of climate-related distress where too much can be overwhelming and debilitating but too little may reduce motivation to engage in pro-environmental behavior. Moreover, reducing the cognitive dissonance from holding pro-environmental attitudes but not adopting more pro-environmental behaviors (Wamsler et al., 2021) may be an important way to reduce climate-related distress.

An ideal follow-up study would include a large sample, a more targeted intervention with an active control condition, and objective or behavioral measures of environmental attitudes and pro-environmental behaviors (e.g., vehicle odometer readings, mobile phone location data, willingness to donate time or money to advance environmental causes).

5. Conclusion

As scientists, activists, and policymakers continue to search for ways to mitigate the climate crisis, it will be critical to disrupt and reimagine the large-scale, systemic drivers of climate change (e.g., a global economy fundamentally reliant on the exploitation and degradation of resources and people; Masson-Delmotte et al., 2021; Parr, 2014). At the same time, individual actions contribute substantially to our collective impact on the planet (Dernbach, 2008; Dietz et al., 2009; Semenza et al., 2008). This is both a cause for hope and a call to action; we each can and must take steps to reduce our individual contributions to the climate crisis. There is therefore an urgent need to develop interventions capable of promoting pro-environmental behavior. Meditation training has been proposed as such an intervention (Thiermann et al., 2020b; Thiermann, Sheate, & Vercammen, 2020), yet few studies have investigated this experimentally.

It is especially valuable to understand the effects of MBSR on such variables, given its widespread dissemination.

The current study addresses these gaps in the literature. The pattern of results – increased pro-environmental behavior associated only with combined short-term, active interventions (MBSR or HEP), and long-term meditation training associated with increased pro-environmental attitudes but not behaviors – provides mixed support for the possibility that meditation training may reduce human impact on the planet. Overall, findings lend support to the growing body of work suggesting that the most common forms of secular meditation training in the West – which primarily target individual wellness and generally do not emphasize ethical living or metaphysical interrelationships – may be unlikely on their own to produce meaningful pro-environmental behavior change. It may be that other forms of meditation training (e.g., compassion-based or analytical meditation) can increase awareness of human interdependence, which might in turn facilitate pro-environmental behavior change. It is also plausible that other techniques designed to promote general well-being and emotion regulation are equally or even more effective. Given the data and theories discussed in this paper, future large-scale research is warranted to experimentally investigate the impact of other types of meditation training and other wellness interventions on pro-environmental behavior (Thiermann & Sheate, 2020b; Wamsler et al., 2021).

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Table 1. Baseline characteristics by group.

	LTM (*n* = 31)	**MBSR** (*n* = 44)	**HEP** (*n* = 43)	**Waitlist** (*n* = 38)	**Total** (*N* = 156)
Age					
Mean (SD)	50.7 (10.1)	48.3 (9.86)	48.0 (12.2)	47.9 (10.3)	48.6 (10.6)
Median [Min, Max]	52.4 [28.3, 62.7]	47.8 [26.8, 65.7]	49.4 [26.5, 66.0]	49.0 [26.0, 65.3]	50.6 [26.0, 66.0]
Gender					
Female	17 (54.8%)	27 (61.4%)	26 (60.5%)	26 (68.4%)	96 (61.5%)
Male	14 (45.2%)	17 (38.6%)	17 (39.5%)	12 (31.6%)	60 (38.5%)
Ethnicity					
Not Hispanic or Latinx	31 (100%)	41 (93.2%)	41 (95.3%)	32 (84.2%)	145 (92.9%)
Hispanic or Latinx	0 (0%)	3 (6.8%)	2 (4.7%)	6 (15.8%)	11 (7.1%)
Race					
American Indian or Alaska Native	0 (0%)	2 (4.5%)	0 (0%)	0 (0%)	2 (1.3%)
Asian	2 (6.5%)	2 (4.5%)	1 (2.3%)	0 (0%)	5 (3.2%)
Black or African American	0 (0%)	3 (6.8%)	0 (0%)	0 (0%)	3 (1.9%)
White	28 (90.3%)	35 (79.5%)	41 (95.3%)	35 (92.1%)	139 (89.1%)
Prefer not to respond	0 (0%)	0 (0%)	0 (0%)	2 (5.3%)	2 (1.3%)
Missing	1 (3.2%)	2 (4.5%)	1 (2.3%)	1 (2.6%)	5 (3.2%)
Education					
High School or GED	1 (3.2%)	6 (13.6%)	2 (4.7%)	0 (0%)	9 (5.8%)
2-year college, trade or technical	2 (6.5%)	3 (6.8%)	2 (4.7%)	2 (5.3%)	9 (5.8%)
4-year college	13 (41.9%)	14 (31.8%)	22 (51.2%)	13 (34.2%)	62 (39.7%)
Graduate school	15 (48.4%)	21 (47.7%)	17 (39.5%)	23 (60.5%)	76 (48.7%)

Note: LTM = long-term meditators. MBSR = Mindfulness-Based Stress Reduction. HEP = Health Enhancement Program (active control). Gender does not sum to 100% because participants were able to select multiple categories. Race does not sum to 100% because participants were able to select multiple categories.

Table 2. Means and standard deviations of variables of interest.

Group	Variable	Timepoint 1			Timepoint 2		
		n	Mean	*SD*	*n*	Mean	*SD*
LTM	Environmental Attitudes	31	59.68	6.2	NA	NA	NA
LTM	Pro-environmental Behavior	31	4.72	0.7	NA	NA	NA
LTM	Sustainable Well-being	31	19.51	3.45	NA	NA	NA
MBSR	Environmental Attitudes	44	53.77	7.89	35	54.29	9.48
MBSR	Pro-environmental Behavior	44	4.89	0.81	34	4.70	0.74
MBSR	Sustainable Well-being	44	18.02	3.11	33	18.94	3.46
HEP	Environmental Attitudes	43	56.26	7.59	36	57.94	7.79
HEP	Pro-environmental Behavior	42	4.74	0.66	35	4.62	0.65
HEP	Sustainable Well-being	42	19.44	3.35	35	20.28	3.88
Waitlist	Environmental Attitudes	38	54.76	7.99	36	55.58	7.96
Waitlist	Pro-environmental Behavior	38	4.85	0.69	34	4.91	0.78
Waitlist	Sustainable Well-being	38	18.38	3.22	34	18.32	3.82
Active	Environmental Attitudes	87	55.00	7.80	71	56.14	8.80
Active	Pro-environmental Behavior	86	4.81	0.74	69	4.66	0.69
Active	Sustainable Well-being	86	18.71	3.29	68	19.63	3.71

Note: LTM = long-term meditators. MBSR = Mindfulness-Based Stress Reduction. HEP = Health Enhancement Program (active control). Active = MBSR + HEP combined. Environmental Attitudes assessed using the New Ecological Paradigm scale. Pro-environmental behavior assessed using the Ecological Footprint calculator. Sustainable Well-being assessed as Ryff Scales of Psychological Well-being divided by Ecological Footprint.

Table 3: Between-group effect sizes, 95% confidence intervals, and p-values.

Comparison		Timepoint(s)	Outcome	Cohen's d	95% CI
Hypothesis 1	LTM vs. MNP	Pre	Environmental Attitudes	0.63**	0.22, 1.03
	LTM vs. MNP	Pre	Pro-environmental Behavior	-0.14	-0.52, 0.24
	LTM vs. MNP	Pre	Sustainable Well-being	0.27	-0.11, 0.66
Hypothesis 2	MBSR vs. HEP	Pre-post	Environmental Attitudes	-0.15	-0.57, 0.27
	MBSR vs. HEP	Pre-post	Pro-environmental Behavior	-0.04	-0.46, 0.38
	MBSR vs. HEP	Pre-post	Sustainable Well-being	0.05	-0.37, 0.47
	MBSR vs. Waitlist	Pre-post	Environmental Attitudes	0.05	-0.39, 0.48
	MBSR vs. Waitlist	Pre-post	Pro-environmental Behavior	-0.38	-0.82, 0.07
	MBSR vs. Waitlist	Pre-post	Sustainable Well-being	0.43	-0.02, 0.87
Exploratory	Active vs. Waitlist	Pre-post	Environmental Attitudes	0.13	-0.52, 0.25
	Active vs. Waitlist	Pre-post	Pro-environmental Behavior	-0.40*	-0.79, -0.01
	Active vs. Waitlist	Pre-post	Sustainable Well-being	0.41*	0.02, 0.80

Note: LTM = long-term meditators. MNP = meditation-naïve participants. MBSR = Mindfulness-Based Stress Reduction. HEP = Health Enhancement Program (active control). Environmental Attitudes assessed using the New Ecological Paradigm scale. Pro-environmental behavior assessed using the Ecological Footprint calculator. Sustainable Well-being assessed as Ryff Scales of Psychological Well-being divided by Ecological Footprint. Cohen's d computed as the standardized mean difference in baseline scores (Hypothesis 1) or pre-post change scores (Hypothesis 2, Exploratory). * $p < .05$, ** $p < .01$, *** $p < .001$

Fig 1. Consort diagram.

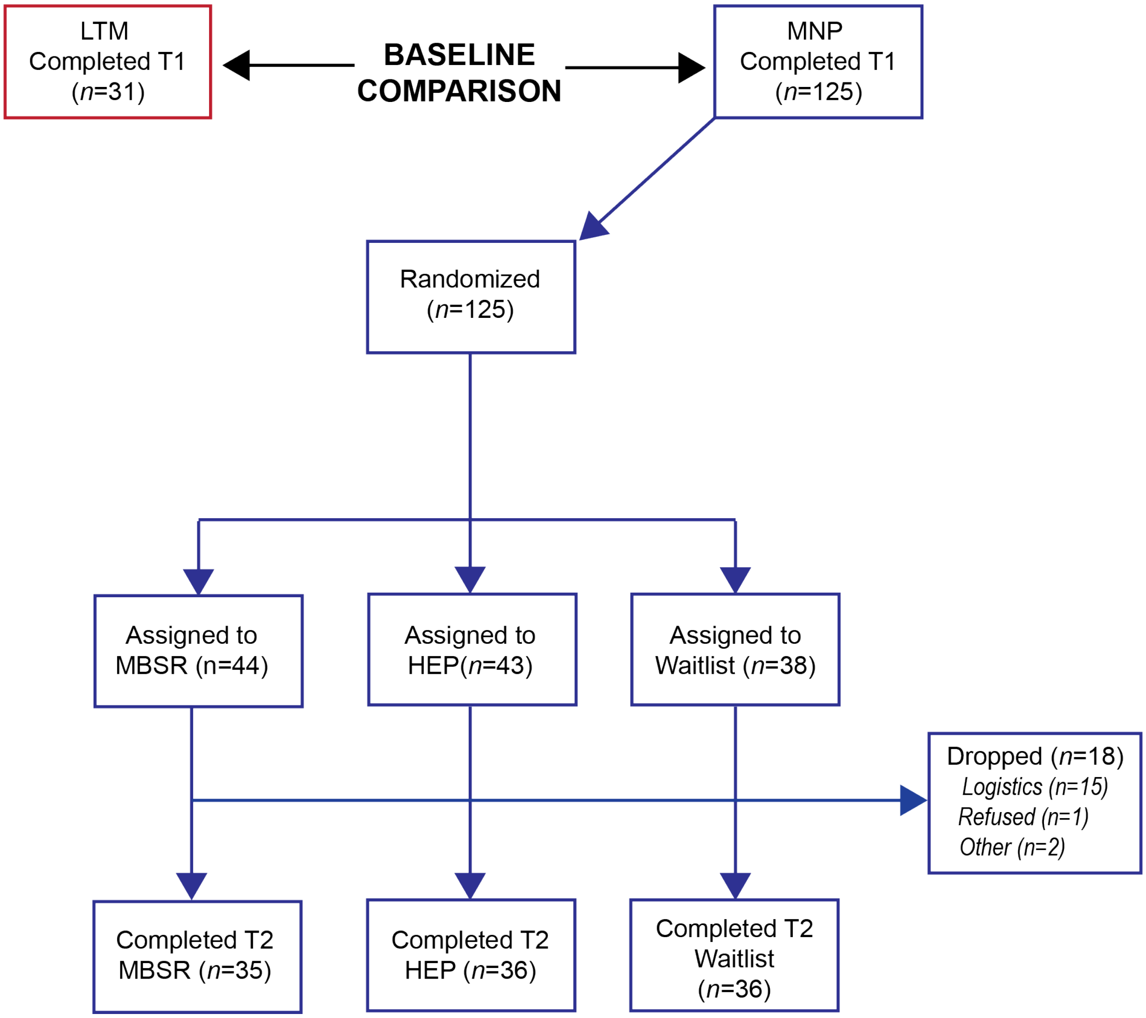
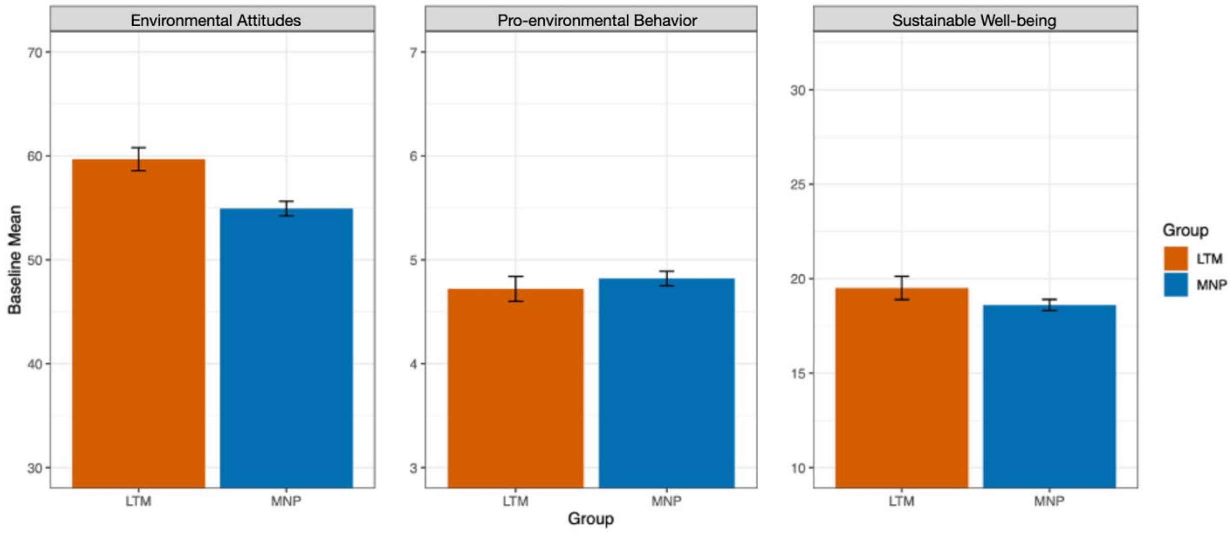
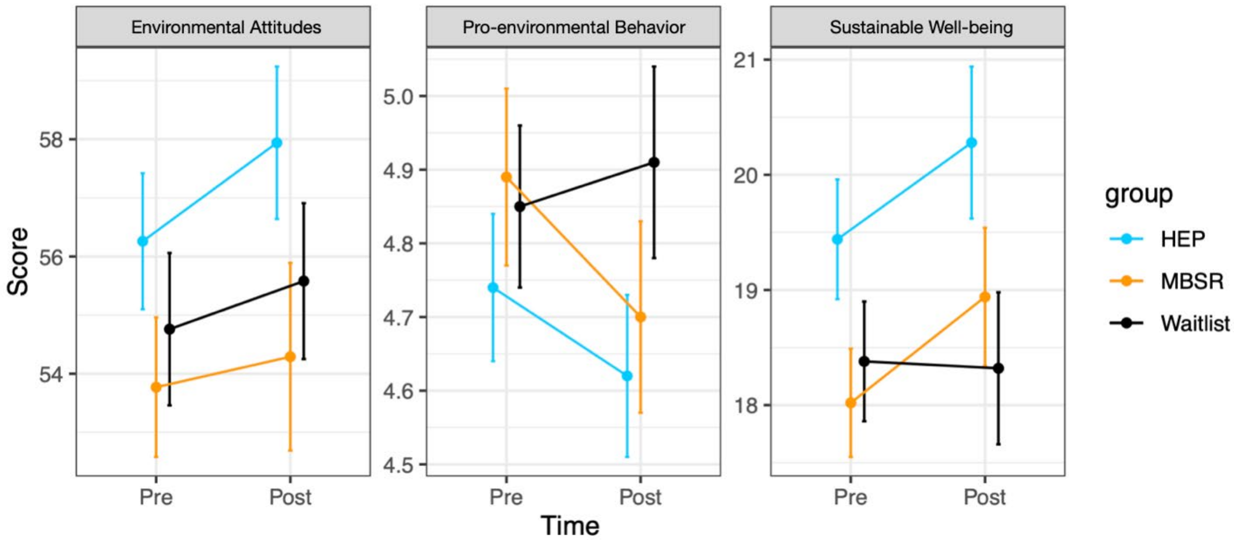


Figure 2: Between-group baseline comparisons on variables of interest.



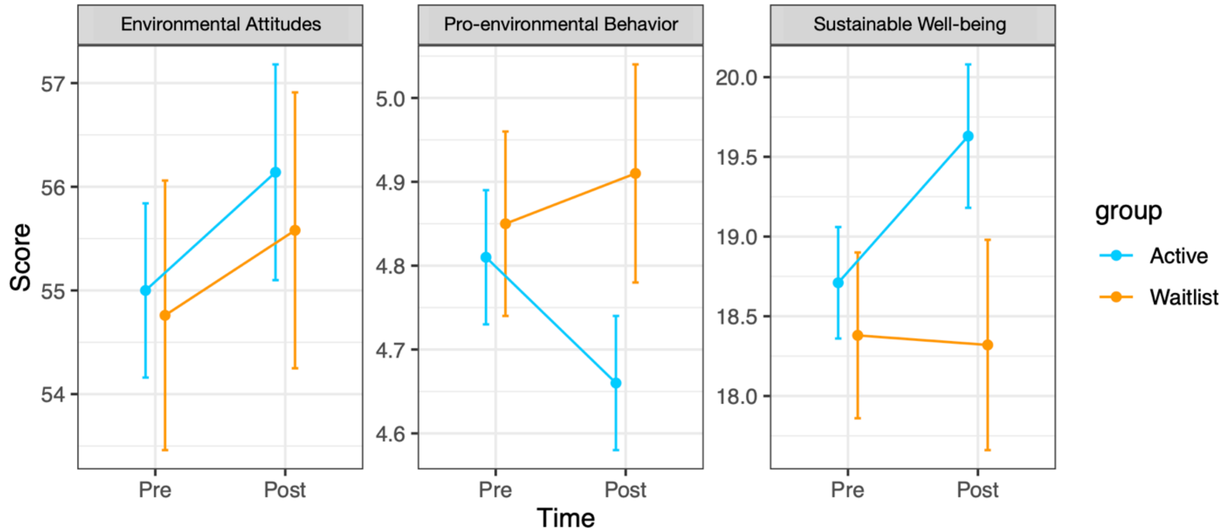
Note: LTM = long-term meditators. MNP = meditation-naïve participants. Environmental Attitudes assessed using the New Ecological Paradigm scale. Pro-environmental Behavior assessed using the Ecological Footprint calculator. Sustainable Well-being assessed as Ryff Scales of Psychological Well-being divided by Ecological Footprint. Error bars represent one standard error. *n* = 125.

Figure 3: Within-group change on variables of interest.



Note: HEP = Health Enhancement Program (active control). MBSR = Mindfulness Based Stress Reduction. Environmental Attitudes assessed using the New Ecological Paradigm scale. Pro-environmental Behavior assessed using the Ecological Footprint calculator. Sustainable Well-being assessed as Ryff Scales of Psychological Well-being divided by Ecological Footprint. Error bars represent one standard error. *n* = 125.

Figure 4: Within-group change for combined active conditions versus waitlist.



Note: Active = combined Health Enhancement Program (active control) plus Mindfulness Based Stress Reduction. Environmental Attitudes assessed using the New Ecological Paradigm scale. Pro-environmental Behavior assessed using the Ecological Footprint calculator. Sustainable Well-being assessed as Ryff Scales of Psychological Well-being divided by Ecological Footprint. Error bars represent one standard error. n = 125.