Seeing nature through a spiritual lens: An experimental test of the effects of a novel photo-taking task on environmental concern and well-being.

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Abstract

Previous research has shown that people who report a greater spiritual connection with nature ("ecospirituality") express a more highly moralized concern for its preservation. Other results also suggest a possible link between ecospirituality and subjective well-being. In order to test the causal nature of these relations, we created a novel intervention designed to temporarily boost ecospirituality and, in a high-powered preregistered study (N = 779), tested the effects of this intervention (compared to two control conditions) on measures assessing concern for the environment and well-being. Results on the effects of the ecospirituality intervention were inconclusive: Participants in all three conditions showed similar pre-intervention/post-intervention changes on the dependent measures, and also showed similar pre/post changes in self-reported ecospirituality (which served as a manipulation check). Exploratory correlational results showed that, across conditions, pre/post increases in self-reported ecospirituality predicted increases in both environmental concern and well-being. The correlational results replicate and extend prior findings—suggesting that ecospirituality may offer benefits to nature and to oneself—but additional research is required to establish causal evidence for this contention.

Keywords: ecospirituality, environmental concern, sustainability, well-being

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People who report a greater spiritual connection with nature ("ecospirituality") exhibit a more highly moralized concern for its preservation, independent of the effects of pro-environmental attitudes more generally. Prior research on this potential effect of ecospirituality have used correlational methods (e.g., Billet et al., 2023). Is there a truly causal impact of ecospirituality on inclinations to protect the environment? To address this question rigorously, experimental methods are required. This article reports the results of a well-powered preregistered experiment that implemented a novel intervention designed to temporarily enhance ecospirituality, and compared its outcomes to those of two control conditions.

Ecospirituality

Ecospirituality refers to a person's spiritual connection with nature. Spirituality involves the desire to connect with something sacred, often evoking feelings of awe and wonder, and a sense of being part of something larger (Fuller, 2007). Consequently, ecospiritual beliefs emphasize not merely the goodness of nature but the sacredness of nature, and manifest in feelings of awe and self-transcendence in the presence of nature's beauty. Ecospirituality takes many forms in many cultures, and includes the Hindu understanding of humans and nature as "the same divine spirit manifesting in different forms" (Selin, 2003), the beliefs of the Peoples of the Vaupés for whom rivers are "the link between the living and the dead" (Davis, 2009), and the attitudes of non-religious surfers who view surfing not merely as a recreational activity but as a spiritual endeavor within a natural environment that they perceive to be "powerful, transformative, healing, and sacred" (Taylor, 2009). As this last example illustrates, highly

ecospiritual people need not be highly religious. Religions leverage spirituality to create cultural belief systems (Norenzayan, 2016) and may shape the specific ways in which people conceptualize the natural environment, but adherence to a religious belief system is not a prerequisite for the perception that nature is sacred. Many people report high levels of ecospirituality without identifying as religious nor even identifying as highly spiritual people more generally (Billet et al., 2023).

Ecospirituality and Moral Concern for the Natural Environment

When nature is perceived to be sacred it is likely to viewed as something that should be cared for and protected. There is abundant correlational evidence of this relation: People who report greater levels of ecospirituality also report greater concern for the environment and its protection (Billet et al., 2023; Snell & Simmonds, 2015; White & Billet, 2024). Indirect support is found also in results from surveys and interviews with outdoor recreationalists, which reveal that spiritual experiences in nature are a common source of environmental concern (Hedlund-de Witt, 2013; Moore, 2011), and from studies linking environmental concern to constructs related to ecospirituality, such as self-reported spirituality (Cowie et al., 2016; Lockhart et al., 2019; Preston & Shin, 2022), awe-inspiring spiritual experiences (Kaplan et al., 2024; Paterniti et al., 2022; Yang et al., 2018), feelings of connectedness to nature (Martin et al., 2020; Mayer & Frantz, 2004; Whitburn et al., 2020), and time spent in nature (Aclock et al., 2020; Müller et al., 2009; Van Heezik et al., 2021).

People need not perceive nature to be sacred in order to care for it or to support its protection, but there is one particular form of environmental concern that—even above and beyond the effects of pro-environmental attitudes more broadly—may be uniquely promoted by ecospirituality: A moral obligation to protect nature. Entities that are endowed with spiritual

significance are often viewed through a moralized lens—which implies a kind of concern that cannot be reduced to an instrumental analysis of costs or benefits and instead rises to the level of a moral duty (Skitka et al., 2021). The implication is that people who have a highly ecospiritual connection with nature also perceive that there is a non-negotiable moral obligation to ensure its protection (Billet et al., 2023; Crimston et al., 2016).

In previous research, this highly principled moral perspective on environmental protection has been assessed with trade-off scenarios in which participants are asked to indicate how much economic benefit must be gained in order to justify some harm to nature. Principle-based decision-making is operationalized as the rejection of the premise that *any* amount of benefit might justify such harm. Consistent with the conceptual analysis summarized above, participants who scored higher on a measure of ecospirituality were more likely to reject requests to put a price on nature and to report that no amount of money could justify its harm (Billet et al., 2023). This effect held even when controlling for other variables that predict pro-environmental attitudes and actions (e.g., environmentalist identity, political ideology). More generally, across multiple studies and multiple measures, people who score more highly on a self-report measure of ecospirituality exhibit a greater moral concern for nature, and these associations persist even after accounting for associations with other measures assessing pro-environmental attitudes (Billet et al., 2023; White & Billet, 2024).

These previous results are correlational. While they are consistent with the hypothesis that ecospirituality exerts a causal influence on moral concern for environmental protection, correlational results cannot rule out other interpretations. To address this inferential limitation, it will be useful to employ experimental methods. In the experiment reported below, we did so. We implemented an intervention designed to temporarily increase a person's spiritual connection to

nature and tested whether that intervention, compared to control procedures (e.g., a procedure designed to promote a positive but non-spiritual perspective on nature), led to a more highly moralized concern for protection of the natural environment.

Ecospirituality and Subjective Well-being

While the primary purpose of this experiment was to test the effects of experimentally-manipulated ecospirituality on measures assessing moral concern for the natural environment, we also included measures that allowed us to test whether that same ecospirituality intervention might have implications for subjective well-being. This experimental test drew upon previous research linking experiences in nature to well-being.

Correlational studies show that spending time in nature predicts greater well-being (Capaldi et al., 2017; Cervinka et al., 2012; Howell et al., 2011, 2013) and experimental methods have also been employed to test whether spending time in nature actually exerts a causal influence on well-being. A recent review of these experiments (Folk & Dunn, 2023) suggests that, while there is a lack of well-powered preregistered studies, there is some evidence for a causal link between time in nature and well-being (Izenstark et al., 2021; McEwan et al., 2019; Passmore & Holder, 2017; Tyrväinen et al., 2014; Vert et al., 2020).

Might the well-being benefits of spending time in nature be amplified when these experiences have a spiritual quality? Available evidence is suggestive but hardly conclusive. One study found that well-being was correlated with mystical experiences in natural environments (Snell & Simmonds, 2015) and another study showed that the positive relationship between exposure to nature and well-being was partially mediated by self-reported spirituality (Kamitsis & Francis, 2013). Other conceptually relevant research has focused on awe, an emotion that is associated with spiritual experiences (Keltner & Haidt, 2003) and also with well-being

(Anderson et al., 2018; Monroy & Keltner, 2023; Rudd et al., 2012). One notable study showed that the experience of awe, over and above other emotions, accounted for the well-being benefits of exposure to nature (Anderson et al., 2018). These findings are consistent with the possibility that the well-being benefits of nature may be amplified among individuals who not only spend time in nature, but who do so in way that leads to a spiritual connection with nature. But these findings are correlational. No prior research has employed experimental methods to test whether a spiritual connection with nature exerts a causal influence on subjective well-being.

Study Overview

We conducted a well-powered preregistered experiment to test the effects of a novel ecospirituality intervention on measures assessing a moralized concern for the natural environment and on measures assessing subjective well-being.

Moral concern for the natural environment was assessed with two measures that assess different aspects of moral concern for nature. One measure employed a set of trade-off scenarios to assess principle-based decision-making about the environment (rejection of opportunities to trade environmental harm for economic gain). The other measure assessed the extent to which participants felt a moral obligation to care for and protect specific natural entities. Well-being was assessed with a measure designed specifically to assess psychological well-being (Diener et al., 2009) and, more indirectly, by a measure assessing the relative balance of positive and negative mood (Diener et al., 2009).

In order to provide a strong test of hypotheses about the causal impact of ecospirituality specifically, it is necessary to experimentally distinguish spiritual experiences in nature from (a) positive but non-spiritual experiences in nature and (b) spiritual experiences in other contexts. For this reason, participants were assigned to one of three experimental conditions. One

condition (the *Nature Spiritual* condition) included procedures designed to temporarily induce a spiritual connection to nature. Another condition (the *Nature Instrumental* condition) included procedures designed to induce a positive (but non-spiritual) perspective on nature. A third condition (the *Architecture Spiritual* condition) was designed to induce a spiritual connection to human-built environment (rather than the natural environment).

We obtained measures of the primary dependent variables (measures of environmental concern and well-being) both before and after introducing these experimental procedures, which allowed us to assess changes in these variables (i.e., differences between the pre- and post-intervention measure). Based on previous research on nature experiences and spirituality, we expected that some change in these variables would be observed in all three experimental conditions. But if indeed there is a unique causal impact of ecospirituality specifically, it would be expected to produce a change exceeding that of a positive (but non-spiritual) nature experience or a spiritual experience in a non-natural context. With these considerations in mind, we preregistered the following hypotheses:

Hypothesis 1: Pre/post changes on the measure of principled-based decision-making about the environment (the rejection of trade-offs) were expected to be greater in the *Nature Spiritual* condition (compared to the *Nature Instrumental* and *Architecture Spiritual* conditions).

Hypothesis 2: Pre/post changes on the measure of moral obligation to nature were expected to be greater in the *Nature Spiritual* condition (compared to the *Nature Instrumental* and *Architecture Spiritual* conditions). (Additionally, pre/post changes on this measure were expected to be greater in the *Nature Instrumental* condition, compared to the *Architecture Spiritual* condition).

Hypothesis 3: Pre/post changes on the two measures of psychological well-being were expected to be greater in the *Nature Spiritual* condition (compared to the *Nature Instrumental* and *Architecture Spiritual* conditions).

In addition to the primary outcome variables, we also obtained a self-report measure of ecospirituality (Billet et al., 2023), and did so both before and after the intervention procedures. Pre/post differences on this measure provided some evidence bearing on the effectiveness of the experimental manipulation. This measure was also used in additional exploratory correlational analyses.

We report below the results of preregistered hypotheses about the effects of the experimental manipulation. Results of additional preregistered analyses are reported in supplemental material.[1] All non-preregistered analyses are identified as "exploratory." The preregistration, materials, data, and analysis scripts are available on the Open Science Framework: https://osf.io/ux83n/

Methods

Participants

A preregistered power analysis using the R *pwr* package (Champely et al., 2020) suggested that each of the three experimental conditions would require 287 participants to detect a small between-groups effect (d = 0.23—a value chosen because, on the measure of principle-based decision-making, it corresponds to an effect in which the mean number of trade-offs rejected is one unit higher in one experimental condition compared to the other two conditions) with 80% power and an alpha of 0.05. To account for exclusions, we attempted to recruit 300 participants per condition.

[1] We have modified the wording of our preregistered hypotheses to enhance clarity. This choice is purely aesthetic and has no functional consequences for the analyses conducted to test those hypotheses.

A total of 900 students were recruited from the university's human subject pool to participate in the experiment between February 1st 2023 and November 3rd 2023. According to preregistered exclusion criteria, we excluded 37 participants who did not want their data analyzed, 2 participants whose experimental condition was not reported, and 1 participant who did not provide a unique identifier (which was required for linking data from pre- and post-intervention measures). Some participants had internet connection issues and entered the survey multiple times; therefore, only the first entry of multiple surveys were retained. Additionally, participants' data were retained only if they fully completed all measures and only if the unique identifiers that they provided actually allowed us to link their responses to pre- and post-intervention measures. These additional exclusions resulting in a final *N* of 779.

Participants were predominantly female (81%), young (M_{age} = 20.5, *SD* = 3.12), Asian (66%; 18% White), and politically liberal (*M* = 35.7 out of 100 on three-item conservatism composite). The sample was about equally split between nonreligious (53%) and religious participants, including Christians (19%), Hindus (6%), Buddhists (6%), Muslims (5%), Sikhs (3%), Jews (1%), Jain (<1%), and "Other" (6%).

Procedure

Participants signed up for a one-hour "Photography Study." A maximum of six participants signed up for each available timeslot, and all participants in a timeslot were assigned to the same experimental condition. Assignment was quasi-random: Seven experimenters each offered multiple timeslots throughout the week, individually cycling through experimental conditions, and participants signed up for a timeslot without knowledge of this underlying process[2].

[2] We employed this assignment procedure to limit the possibility that specific experimental conditions might, by chance, be disproportionately associated with specific experimenters. (Experimenters played a prominent role in

After arriving in the lab, participants completed a brief entrance survey which included pre-intervention measures of the primary dependent variables. They were then led by the experimenter to an outdoor location to complete a 10-minute photo-taking task—the specific nature of which varied across the three experimental conditions. After completing that task, and while still in the outdoor location, they completed an exit survey which included post-intervention measures of the dependent variables.

Experimental Manipulation (Ecospirituality Intervention)

To complete the 10-minute photo-taking task, participants walked (led by the experimenter) to one of two different outdoor locations on campus. The location varied according to experimental condition.

In two of the experimental conditions (*Nature Spiritual* and *Nature Instrumental*) participants walked to a nearby forested area on campus, where they were provided instructions to photograph nature (see details below). In a third condition (*Architecture Spiritual*) participants walked to an Indigenous Longhouse on campus, where they were provided instructions to photograph the building. (The Longhouse was selected because it has spiritual significance, although it does not have a direct connection to nature.) Before independently completing the task, participants were provided instructions—which the experimenter read from a script—describing the goals of the photo-taking task. (See supplemental materials for full script).

In the *Nature Spiritual* condition, the instructions were intended to promote an ecospiritual perspective on nature. Participants were instructed to take "photos that show this

administering the procedures and, given the nature of these procedures, could not be blinded to participants' experimental condition). A small relation was observed between experimenter and experimental condition (group sizes varied across sessions, leading to differences in the number of participants in each condition), $\chi^2 = 30.04$, $p < 0.001$, Cramer's $V = 0.098$. We also tested for relations with temporal variables that reflected experimenters' different schedules. There was no statistically significant relation between time of day and experimental condition ($\chi^2 = 2.47$, $p = 0.29$, Cramer's $V = 0.040$); there was a small relation between day of week and experimental condition, $\chi^2 = 16.70$, $p = 0.033$, Cramer's $V = 0.073$.

place as a spiritual resource, a domain of spirits, something sacred, something that is worshiped for its supernatural qualities—a place where people have intensely spiritual experiences."

In the *Nature Instrumental* condition, the instructions were intended to promote a positive but non-spiritual perspective on nature, by emphasizing the instrumental value of nature. Participants were instructed to take "photos that show this place as an instrumental resource, a provider of goods, something useful, something that is admired for its abundant utility—a place that people utilize to the utmost degree."

In the *Architecture Spiritual* condition, the instructions were intended to promote a spiritual perspective on the human-constructed environment (rather than the natural environment). Participants were instructed to take photos of the Indigenous Longhouse according to a prompt that was worded almost identically to that in the *Nature Spiritual* condition (differences in wording reflected that fact that the focus of this prompt was the Longhouse building, rather than a forest).

Manipulation Check and Dependent Measures

Five measures were assessed before and after the photo-taking task (i.e., pre- and post-intervention).

Ecospirituality

In order to assess the effectiveness of the ecospirituality intervention (the procedures employed in the *Nature Spiritual* condition), and to compare its intended effect with the effects of the procedures in the other two conditions, participants completed an 8-item self-report measure (Billet et al., 2023). Participants rated their agreement (on a 7-point scale; strongly disagree – strongly agree) with four items assessing the appraisal of nature's spiritual qualities (e.g., "Nature is a spiritual resource") and four items assessing the experience of nature's

spiritual qualities (e.g., "When I am in nature, I feel a sense of awe"). In line with prior studies (Billet et al., 2023; Billet et al., in press), the mean of these eight items was computed to serve as a measure of ecospirituality (Cronbach's α's = 0.87 and 0.90 for pre- and post-intervention measures, respectively).

Rejection of Trade-offs

Principled decision-making about the environment was assessed using a 13-item measure based on Graham & Haidt (2012)[3]. Participants were told to imagine doing environmentally harmful behaviors (e.g., "pour chemical waste down the drain") and to indicate "how much money someone would have to pay you (anonymously and secretly) to be willing to do each thing." (The instructions also stated that "nothing bad would happen specifically to you afterwards" and that "you cannot use the money to make up for or undo the described behavior.") In response to each proposed trade-off, participants could specify a monetary value between $0 and $1,000,000; additionally, participants could indicate the following response: "On principle, I would never do this for any amount of money." To compute an overall measure of participants' principled rejection of opportunities to trade environmental harm for economic wealth, we calculated the proportion of items on which participants chose the "On principle, I would never do this for any amount of money" response.

Moral Obligation to Nature

To assess moral obligation to care and protect nature, participants were presented with eight natural entities (old-growth forest, desert, mountains, ocean, Pacific Spirit Park, chimpanzee, fish, bee), and asked to indicate how strongly they felt an obligation to ensure the welfare of each. Responses were recorded on a moral expansiveness scale (Crimston et al., 2016)

[3] Adam Baimel and Catherine Li developed this measure in a yet-to-be-published series of studies.

consisting of three concentric circles denoting four regions of varying moral obligation: An inner moral circle ("You have a moral obligation to ensure their welfare and feel a sense of personal responsibility for their treatment"); an outer moral circle ("You are concerned about their moral treatment; however, your sense of obligation and personal responsibility is greatly reduced"); the fringes of moral obligation ("You are not morally obligated or personally responsible for their moral treatment"); and an area outside the moral consideration ("Feeling concern or personal responsibility for their moral treatment is extreme or nonsensical"). Responses within these four regions were scored 4, 3, 2, and 1, respectively. We computed the mean responses across all eight items, with higher values representing greater moral obligation to nature (Cronbach's α's = 0.93 and 0.94 for pre- and post-intervention measures, respectively).

(Participants also responded to six additional items asking about their moral obligation to six categories of people—family member, close friend, somebody from your neighborhood, foreign citizen, somebody from an opposing political party, and murderer. We computed the mean responses across these six items to create a measure assessing moral obligation to human beings [Cronbach's α's = 0.77 and 0.77 for pre- and post-intervention measures, respectively]. This additional measure was not germane to the primary purposes of this study, but it was included as a covariate in some exploratory analyses reported in the supplemental material.)

Psychological Well-being

Psychological well-being was assessed with an 8-item self-report measure (Diener et al., 2009) on which participants rated their agreement with statements such as, "I lead a purposeful and meaningful life" and "I am a good person and live a good life." Responses were recorded on a 7-point scale (strongly disagree – strongly agree). We computed the mean of these responses to

calculate an overall measure of psychological well-being (Cronbach's α's = 0.88 and 0.91 for pre- and post-intervention measures, respectively).

Emotion Balance

Participants completed a 12-item questionnaire (Diener et al., 2009) on which they rated how often they experienced six positive emotions (e.g., positive, happy, contented) and six negative emotions (e.g., negative, sad, angry) during a specified period of time. On the pre-intervention measure, the instructions specified that period of time as being "the past four weeks." On the post-invention measure, the instructions specified that period of time as being during "the experience you just had." Ratings were made on a 5-point scale (very rarely or never – very often or always). Consistent with prior research employing this measure (Diener et al., 2009), we computed a measure of emotion balance—with higher values indicating relatively more positive emotional experiences—by subtracting the mean rating on negative emotion items from the mean rating of positive emotion items (Cronbach's α's = 0.87 and 0.80 for pre- and post-intervention measures, respectively).

Other Measures

Participants also reported additional variables: The name of the experimenter who conducted the session (factor variable with 7 levels), group size (1 - 6), task engagement (1 = not at all engaged – 7 = completely engaged), the degree to which the weather affected each participant's experience (1 = made it much worse – 5 = made it much better), gender (factor variable with 3 levels), socioeconomic status (standardized mean of 2 measures: mean household income [1 = $0-$19,000 – 8 = Greater than $220,000]; subjective socioeconomic status on a 10-rung ladder), religiosity (mean of 3 items ["how religious are you", "how spiritual are you", and "how important to you is living a religious lifestyle"], each rated from 1 = not at all – 7 = very),

and political conservatism (mean of 3 items ["social issues", "economic issues", and "in general"], each rated from 0 = extremely liberal – 100 = extremely conservative).

Results

Table 1 reports mean pre-intervention and post-intervention scores on five key measures—the manipulation check (self-reported Ecospirituality), two measures of environmental concern (Rejection of Trade-Offs, Moral Obligation to Nature), and two measures of well-being (Psychological Well-Being, Emotion Balance)—within each of the three experimental conditions.

Manipulation Check (Ecospirituality)

The procedure in *Nature Spiritual* condition was designed to temporarily enhance participants' spiritual connection to nature. The procedures employed in the other two conditions were designed instead to make salient either the instrumental (rather than spiritual) value of nature, or the spiritual value of the human-constructed (rather than natural) environment. We therefore expected a greater pre-intervention/post-intervention increase in self-reported ecospirituality in the *Nature Spiritual* condition, relative to the other two conditions. Results did not meet this expectation: As shown in Table 1, mean post-intervention ecospirituality scores were virtually identical in the three conditions. Instead, there was simply a pre-intervention/post-intervention main effect, indicating an equivalent increase in self-reported ecospirituality in all three conditions ($b = 0.26$, 95% CI = [0.16, 0.35], $p < 0.001$). These results raise questions about the effectiveness of the ecospirituality intervention (discussed below, in the General Discussion). Regardless, we present the results of preregistered analyses testing the hypotheses identified above, followed by exploratory analyses.

Table 1

Means and standard deviations of key variables assessed both pre-intervention and post-intervention, within each of three experimental conditions.

	Nature Spiritual	**Nature Instrumental**	**Architecture Spiritual**
n	251	260	268
Pre-Intervention	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Ecospirituality	5.31 (0.83)	5.25 (0.98)	5.27 (0.94)
Rejection of Trade-Offs	0.29 (0.31)	0.28 (0.29)	0.29 (0.31)
Moral Obligation to Nature	2.43 (0.65)	2.49 (0.63)	2.44 (0.65)
Psychological Well-Being	5.46 (0.78)	5.38 (0.80)	5.39 (0.77)
Emotion Balance	0.79 (1.10)	0.68 (1.05)	0.75 (1.05)
Post-Intervention	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Ecospirituality	5.55 (0.87)	5.50 (1.03)	5.55 (0.89)
Rejection of Trade-Offs	0.41 (0.37)	0.39 (0.35)	0.39 (0.36)
Moral Obligation to Nature	2.65 (0.67)	2.68 (0.65)	2.64 (0.72)
Psychological Well-Being	5.61 (0.75)	5.55 (0.85)	5.55 (0.79)
Emotion Balance	1.51 (1.18)	1.47 (1.23)	1.53 (1.21)

Note. Measures are on the following scales: Ecospirituality (1 – 7), Reject of Trade-Offs (0 – 1), Moral Obligation to Nature (1 – 4), Psychological Well-Being (1 – 7), Emotion Balance (-4 – 4).

Preregistered Analyses

Analyses were conducted using a regression framework. The Rejection of Trade-offs measure is a proportion score, and so we modeled it as a quasibinomial distribution in a general linear model (which produces odds ratios rather than beta coefficients); analyses on other measures used Gaussian distributions.

To test Hypothesis 1, we regressed the post-intervention Rejection of Trade-offs score onto the pre-intervention score and experimental condition. The hypothesis was not supported. Results showed that, when controlling for pre-intervention scores, there was no statistically significant difference between the *Nature Spiritual* and *Nature Instrumental* conditions (OR = 0.85 [0.69, 1.04], p = 0.122), nor between the *Nature Spiritual* and *Architecture Spiritual* conditions (OR = 0.82 [0.66, 1.01], p = 0.057).

To test Hypothesis 2, we regressed the post-intervention Moral Obligation to Nature score onto the pre-intervention score and experimental condition. The hypothesis was not supported. Results showed that, when controlling for pre-intervention scores, there was no statistically significant difference between the *Nature Spiritual* condition and the *Nature Instrumental* conditions (β = -0.03 [-0.13, 0.07], $p = 0.537$), nor between the *Nature Spiritual* and *Architecture Spiritual* conditions (β = -0.04 [-0.14, 0.06], $p = 0.479$).

To test Hypothesis 3, we regressed the post-intervention Psychological Well-Being score onto the pre-intervention Psychological Well-Being score and experimental condition, and separately regressed the post-intervention Emotion Balance score onto the pre-intervention Emotion Balance score and experimental condition. The hypothesis was not supported. Results showed that, when controlling for relevant pre-intervention scores, there were no statistically significant differences between the *Nature Spiritual* condition and the *Nature Instrumental* conditions on either Psychological Well-Being (β = 0.02 [-0.06, 0.09], $p = 0.648$) or Emotion Balance (β = 0.03 [-0.11, 0.17], $p = 0.692$); nor were there statistically significant differences between the *Nature Spiritual* condition and the *Architecture Spiritual* condition on either Psychological Well-Being (β = -0.00 [-0.08, 0.07] $p = .938$) or Emotion Balance (β = 0.05 [-0.09, 0.19], $p = 0.501$).

Exploratory Analyses

Did changes in Ecospirituality predict changes in the outcome variables?

We preregistered an exploratory hypothesis predicting that, across conditions, increases in self-reported Ecospirituality would predict increases in the four outcome variables. This hypothesis was supported, as indicated by bivariate correlations between pre-intervention/post-intervention change scores (Table 2). Pre/post changes in Ecospirituality were positively

correlated with pre/post changes in Rejection of Trade-offs ($r = 0.11$, $p < 0.001$), Moral Obligation to Nature ($r = 0.18$, $p < 0.001$), Psychological Well-Being ($r = 0.19$, $p < 0.001$), and Emotion Balance ($r = 0.12$, $p < 0.001$).

Although these results are consistent with the possibility that pre/post increases in ecospirituality led to increases in the outcome variables, these results are strictly correlational and cannot rule out other causal explanations (e.g., reverse causality, confounding by third variables, demand artifacts associated with the experimental procedures). We conducted an additional analysis to address one third-variable explanation: The possibility that a pre/post increase in mood (which might plausibly result simply from going for a short walk outdoors) caused both an increase in self-reported Ecospirituality and an increase in concern for nature. To address this specific alternative explanation, we included the Emotion Balance change score as a covariate when predicting pre/post changes in Rejection of Trade-offs, Moral Obligation to Nature, and Psychological Well-Being from pre/post changes in Ecospirituality. The previously-described effects—changes in Ecospirituality predicted changes in outcome measures—remained statistically significant. (These results, as well as the results of additional models with an additional covariates, are reported in the supplemental material.)

Table 2

Correlations between pre-intervention/post-intervention change scores

Change Scores	1.	2.	3.	4.
1. Ecospirituality				
2. Rejection of Trade-Offs	0.11^{**}			
3. Moral Obligation to Nature	0.18^{***}	0.16^{***}		
4. Psychological Well-Being	0.19^{***}	0.07	0.18^{***}	
5. Emotion Balance	0.12^{***}	0.04	0.08^{*}	0.17^{***}

*p<0.05, **p<0.01, ***p<0.001

Did Ecospirituality predict environmental concern and well-being prior to the experimental manipulation?

We also examined pre-intervention correlations between self-reported Ecospirituality and the measures of environmental concern and well-being. As shown in Table 3, Ecospirituality correlated positively with Rejection of Trade-Offs and with Moral Obligation to Nature (*r*'s = 0.14 and 0.33, respectively) and also correlated positively with Psychological Well-Being and Emotion Balance (*r*'s = 0.32 and 0.11, respectively).

Several other measured variables (i.e., gender, socioeconomic status, conservatism, and religiosity) were found to correlate with measures of Ecospirituality, environmental concern and well-being, raising the possibility that the correlations reported above might be spurious. To address this possibility, additional regression analyses including these individual difference variables as additional predictor variables. Results showed that, even when controlling for these additional variables, self-reported Ecospirituality remained a statistically significant predictor of measures assessing environment concern and well-being. (Results are presented in the supplemental material.)

We conducted additional regression analyses in which, in addition to Ecospirituality, we included either Rejection of Trade-Offs or Moral Obligation to Nature as additional predictors of measures assessing well-being. Results showed that, even when controlling for these measures of environmental concern, Ecospirituality remained a statistically significant predictor of both Psychological Well-Being and Emotion Balance. Additionally, neither Rejection of Trade-Offs nor Moral Obligation to Nature were statistically significant predictors of the well-being measures. (Results are presented in the supplemental material.)

Table 3

Correlations between pre-intervention scores for five key variables.

Pre-Intervention Scores	1.	2.	3.	4.
1. Ecospirituality				
2. Rejection of Trade-Offs	0.14***			
3. Moral Obligation to Nature	0.33***	0.18***		
4. Psychological Well-Being	0.32***	0.06	0.10*	
5. Emotion Balance	0.11***	0.02	0.02	0.60***

*p<0.05, **p<0.01, ***p<0.001

Did pre-intervention measures moderate any effects of the photo-taking task?

An additional set of exploratory regression analyses examined the possibility that pre/post differences in environmental concern and well-being might be affected by baseline (i.e., pre-intervention) scores on those variables, or by baseline levels of self-reported Ecospirituality. Therefore, we examined interactions between baseline levels of these variables and experimental condition.

Results showed that higher levels of baseline Ecospirituality predicted greater increases in all four outcome measures: Rejection of Trade-Offs (β = 0.11 [0.04, 0.18], p = 0.002), Moral Obligation to Nature (β = 0.08 [0.01, 0.15], p = 0.024), Psychological Well-Being (β = 0.09 [0.02, 0.16], p = 0.010), and Emotion Balance (β = 0.10 [0.03, 0.17], p = 0.005). No interactions between baseline Ecospirituality and experimental condition were observed. These results suggest that people predisposed to ecospirituality were more responsive to the photo-taking manipulation, regardless of experimental condition.

Additionally, higher baseline scores on the Rejection of Trade-offs measure predicted greater pre/post increases in Rejection of Trade-offs (β = 0.11 [0.04, 0.18], p = 0.002). In contrast, higher baseline Moral Obligation to Nature predicted smaller increases in Moral Obligation to Nature (β = -0.22 [-0.29, -0.15], p < 0.001), higher baseline Psychological Well-

Being predicted smaller increases in Psychological Well-Being (β = -0.19 [-0.26, -0.12], p < 0.001), and higher baseline Emotion Balance predicted smaller increases in Emotion Balance (β = -0.33 [-0.44, -0.26], p < 0.001).

The negative relation between baseline Psychological Well-Being and pre/post change in Psychological Well-Being was moderated by experimental condition. The negative relation was strongest in the *Nature Spiritual* condition (b = -0.15) and weakest in the *Nature Instrumental* condition (b = -0.02), a difference that was statistically significant (β = -0.29 [-0.46, -0.12], p = 0.001). Closer examination of these data revealed that this effect was attributable primarily to results among the subsample of participants who reported exceptionally low baseline well-being (n = 144 participants below -1 SD on the pre-intervention measure of Psychological Well-Being); among the remaining participants, the size of the negative relation between baseline scores and change scores was similar across conditions.

General Discussion

Does increased ecospirituality lead to increased concern for the preservation of the natural environment? Might it also lead to increased subjective well-being? To address these questions, we created a novel photo-taking intervention intended to temporarily increase a person's ecospiritual connection to nature, and tested the effects of this intervention against the effects of two control photo-taking procedures (one that was intended to highlight the instrumental [rather than spiritual] value of nature, and one that was intended to highlight the spiritual value of a human-built [rather than natural] entity). Results were suggestive, but inconclusive. In all three experimental conditions there was evidence of increased concern for the environment and increased well-being, but there were no between-condition differences in the magnitudes of those increases. Additional results showed increases in self-reported

ecospirituality in each of the three conditions (compared to a baseline measure of ecospirituality). Across conditions, participants who exhibited a greater increase in ecospirituality also exhibited greater increases in measures of environmental concern and measures of well-being.

The non-effects of the experimental manipulation are discussed below, but first a few words about the correlational results: These correlational results replicate and extend previous research documenting correlations between self-reported ecospirituality and measures assessing care and concern for the natural environment (Billet et al., 2023). Additionally, the results linking self-reported ecospirituality to well-being extend previous research on nature and well-being (e.g., Anderson et al., 2018; Folk & Dunn, 2023). These correlations do not allow confident inferences about causality, however, and some additional limitations must be noted as well. The participant sample consisted of students at a university in the Pacific Northwest region of North America—a region in which spiritual reverence for the surrounding natural beauty is pervasive (Shibley, 2004). While correlations between ecospirituality and environmental concern have been observed in samples obtained from other populations in other countries (Billet et al., 2023), the generalizability of correlations between ecospirituality and well-being remains unknown. Also, while the repeated-measures design employed in this study offered inferential benefits beyond previous correlational studies on ecospirituality (e.g., allowing us, for example, to test whether *changes* in ecospirituality predicted *changes* in the key outcome variables), additional inferential benefits can accrue from methods—such as experience sampling (Scollon et al., 2003)—that allow these variables to be measured more often and over a greater period of time. Experience-sampling studies, for example, have shown that exposure to nature predicts happiness (MacKerron & Mourato, 2013; Stieger et al., 2022). Future research might profitably

employ experience-sampling methods to test whether spiritual experiences in nature (compared to non-spiritual experiences in nature) predict even greater increases in happiness, well-being, and concern for the well-being of the natural environment.

Perhaps even more inferentially useful will be additional research that employs experimental methods to test hypotheses about the causal influence of ecospirituality on these outcome variables. To the best of our knowledge, the experiment reported here is the first attempt to do so, but the results pose an inferential challenge: How to interpret results showing equivalent increases in the key outcome measures across all three experimental conditions?

One possibility is that the intervention employed in the *Nature Spiritual* condition had the intended psychological effect—a temporary increase in participants' ecospiritual connection to nature—but that this effect on ecospirituality was no greater than occurred incidentally in the two control conditions. The photo-taking instructions differed in specific ways across the three conditions—encouraging participants to attend to different things and to do so with different goals in mind—but participants' actual experiences in the three conditions overlapped in many other ways. They all spent time outdoors, for instance, and in two of the three conditions they spent that time in the same forest. Even participants in the *Architecture Spiritual* condition spent time in an area with visible trees and other sights, sounds, and scents of the natural environment. Perhaps the procedures in all three conditions (and not just the *Nature Spiritual* condition) promoted a spiritual connect to nature and did so to a similar degree. Results on the manipulation check—which showed equivalent pre/post changes in self-reported ecospirituality across all three experimental conditions—are consistent with this interpretation. If so, and if ecospirituality does have the hypothesized causal influence on environmental concern and well-being, it follows that there would also be equivalent increases on those outcome variables.

But that is just one possible interpretation. Another interpretation is that the apparent increases in ecospirituality are not meaningful, and neither are the apparent increases in measures of environmental concern and well-being. They might all simply be the result of demand artifacts. Experimenters were unavoidably aware of participants' experimental condition. Participants completed the same self-report measures before and after engaging in a creative and effortful task amongst their peers. Hypothesis guessing, the desire to be a "good participant," and social pressure to respond in specific ways to these procedures could have motivated participants to report changes on self-report measures even if they did not actually experience those changes. We attempted to quell this motivation by including the following statement in the instructions that preceded the post-intervention survey: "Some items will be familiar, but try to respond to them with respect to how you felt while taking the photos. There is no right way to answer these items—we don't care if your answers are consistent and we don't care if they change. Just report what you feel." Nevertheless, this interpretation of the results cannot be ruled out.

These are different interpretations of the results, but they have at least one thing in common: According to both interpretations, the experimental manipulation failed. As Aronson et al. (1998, p. 177) observed, "An experiment cannot test a hypothesis unless the independent variable manipulates what it is supposed to manipulate." It is entirely possible that the novel ecospirituality intervention employed here (the photo-taking task in the *Nature Spiritual* condition) failed to promote the psychological experience of ecospirituality to a greater degree than the procedures employed in the other two experimental conditions. If so, then the experimental procedures provided an inadequate test of the hypotheses.

It is perhaps no coincidence that prior research on ecospirituality has employed correlational rather than experimental methods. Designing a valid and reliable measure of

ecospirituality (Billet et al., 2023) is not without its challenges; but it is an entirely different kind of challenge to design an experimental intervention that temporarily creates the specific set of cognitions and emotions that define the psychological construct of ecospirituality, and does so consistently across a diverse sample of research participants. (For an extended discussion of this kind of methodological challenge in different context, see Hofer et al., 2024.) We had hoped that the procedures used in this experiment might meet this challenge. We now hope that, by describing these methods and their results here, we might inspire other researchers to design additional methods that might more convincingly create the psychological experience that defines ecospirituality. Only by doing so can one rigorously test whether ecospirituality does, or does not, exert a unique causal influence on environmental concern and well-being.

If there is a simple conclusion to draw from these results, it is perhaps this: Correlational evidence suggests that viewing nature through a spiritual lens might be good for the natural environment and also good for one's own subjective well-being; but convincing experimental evidence of the hypothesized causal relationship remains elusive.

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