



# How does mindfulness relate to proenvironmental behavior? The mediating influence of cognitive reappraisal and climate change awareness

Vanessa Apaolaza<sup>a,\*</sup>, Mario R. Paredes<sup>b</sup>, Patrick Hartmann<sup>a</sup>, Jose M. Barrutia<sup>a</sup>, Carmen Echebarria<sup>a</sup>

<sup>a</sup> Faculty of Economics and Business Administration, University of the Basque Country UPV/EHU, Avda. Lehendakari Aguirre, 83, 48015, Bilbao, Spain

<sup>b</sup> School of Management and Business, Universidad del Rosario, Calle 200 Autopista Norte y Carrera 7, Bogotá, Colombia

## ARTICLE INFO

Handling Editor: Dr Sandra Caeiro

### Keywords:

Mindfulness  
Cognitive reappraisal  
Climate change  
Nature connectedness  
Proenvironmental behavior

## ABSTRACT

Mindfulness has recently been identified as an antecedent of proenvironmental behavior. This study aims to consolidate and expand recent research findings by suggesting that mindfulness is associated with proenvironmental behavior through cognitive reappraisal and climate change awareness. Our findings showed that mindfulness correlated with proenvironmental behavior through both cognitive reappraisal and climate change awareness. Moreover, nature connectedness was found to negatively moderate this relationship: for individuals with greater levels of nature connectedness, the influence of mindfulness on proenvironmental behavior was diminished. Theoretical and practical implications of our findings are discussed.

## 1. Introduction

Climate change, ocean pollution, and loss of biodiversity are among the most relevant issues that affect the sustainability of our society (Geiger et al., 2020; Wang et al., 2019). The current high levels of resource consumption are unsustainable (Ericson et al., 2014; Oskamp, 2000). Also, the average global surface temperature has been increasing, which scientific evidence suggests is predominantly caused by human activities (National Research Council, 2020). Understanding human actions and practices to mitigate this kind of behavior has become an urgent need (Mayer et al., 2009).

Recent research has proposed a relationship between proenvironmental behavior and mindfulness. Mindfulness has been defined as enhanced attention to a present (moment-by-moment) experience without judgment (Kabat-Zinn, 1990; Linehan, 1993). It can be understood as a mental state (*state mindfulness*) or as a psychological trait (*dispositional* or *trait mindfulness*). Following previous research on the mindfulness paradigm (Baer et al., 2006; Garland et al., 2009, 2011; Panno et al., 2018), this study understands mindfulness as a trait, which is the disposition to attend to the present moment. Trait mindfulness varies among individuals and research suggests that meditation practices can increase an individual's mindfulness level (Davidson and Kaszniak, 2015; Kiken et al., 2015).

Mindfulness has been shown to relate to environmentally friendly behaviors regarding transportation, diet, waste reduction, and energy use, among other factors (see Amel et al., 2009; Barbaro and Pickett, 2016; Brown and Kasser, 2005; Ericson et al., 2014). Despite the growing interest in mindfulness and sustainability, researchers agree that the study of mindfulness and engagement in environmentally friendly behavior still requires further exploration (Amel et al., 2009; Geiger et al., 2020; Wamsler and Brink, 2018), since only a few studies have examined the underlying mechanism by which mindfulness relates to proenvironmental behavior (e.g., Koger, 2015; Wamsler, 2018; Wamsler et al., 2018). Specifically, in the recent literature there has been a call for more research on the relationship between mindfulness, climate change awareness (Wamsler, 2018; Wamsler et al., 2018; Wang et al., 2019) and proenvironmental behavior (Hornsey et al., 2016; Wamsler and Brink, 2018).

Based on the mindfulness paradigm (Baer et al., 2006; Garland et al., 2009, 2011), cognitive reappraisal (Gross, 1998, 2015), and connectedness to nature (Restall and Conrad, 2015; Schultz et al., 2004), this study develops a conceptual framework to explore the influence of mindfulness on environmentally friendly behavior and the mediating roles of cognitive reappraisal and climate change awareness, as well as the moderation effect of nature connectedness on these relationships. Cognitive reappraisal is a psychological mechanism that allows

\* Corresponding author. Faculty of Economics and Business Administration, University of the Basque Country UPV/EHU, Bilbao, Spain.

E-mail addresses: [vanessa.apaolaza@ehu.eus](mailto:vanessa.apaolaza@ehu.eus) (V. Apaolaza), [mario.paredes@urosario.edu.co](mailto:mario.paredes@urosario.edu.co) (M.R. Paredes), [patrick.hartmann@ehu.eus](mailto:patrick.hartmann@ehu.eus) (P. Hartmann), [josemaria.barrutia@ehu.eus](mailto:josemaria.barrutia@ehu.eus) (J.M. Barrutia), [carmen.etxebarria@ehu.eus](mailto:carmen.etxebarria@ehu.eus) (C. Echebarria).

<https://doi.org/10.1016/j.jclepro.2022.131914>

Received 10 June 2020; Received in revised form 26 March 2022; Accepted 21 April 2022

Available online 25 April 2022

0959-6526/© 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

individuals to change or reframe their thoughts and feelings about the emotional impact of a situation (Gross, 1998). Our research expands recent research of Panno et al. (2015, 2018) who found an effect of cognitive reappraisal on climate change beliefs, which, in turn, fosters environmentally responsible behavior.

The remainder of this article is structured as follows: We review the literature to derive hypotheses and propose a conceptual model. Subsequently, we present the methodology, followed by the results, discussions, and implications. Finally, limitations and suggestions for future research, as well as conclusions are presented.

## 2. Theoretical background

### 2.1. The relationship of mindfulness and proenvironmental behavior

Recent empirical research has suggested a positive link between mindfulness and proenvironmental behavior (see Barbaro and Pickett, 2016; Brown and Kasser, 2005; Panno et al., 2015, 2018). Individuals with greater levels of dispositional mindfulness become more aware of their consumption habits and the environmental impact of their behavior (Brown and Ryan, 2003; Rosenberg, 2004). Mindfulness is related to lower materialism, and the reduction of consumption—mechanisms that are associated with proenvironmental behavior (Brown and Kasser, 2005; Brown and Ryan, 2003; Ericson et al., 2014).

In a recent literature review on mindfulness and sustainable consumption behavior, Fischer et al. (2017) stated that mindfulness enhances awareness, which makes individuals more conscious of their behavior; therefore, enabling them to change some unconscious consumption routines by “switching off the automatic pilot” (Grossman et al., 2004). Mindful consumers will be more aware of their decisions and actions, rather than making routine consumption habits (Bahl et al., 2016). The enhancement of non-material values (Ericson et al., 2014), and the activation of intrinsic values (Brown and Kasser, 2005) as a consequence of mindfulness, are related to people’s engagement in environmentally responsible behavior. Brown and Kasser (2005) found a direct connection between dispositional mindfulness and ecologically responsible behavior. Klug and Niemand (2021) offered evidence of a positive relationship between mindfulness and precycling (a lifestyle for waste prevention before purchasing). Amel et al. (2009) showed that mindfulness relates to sustainable habits in consumers because attentional awareness makes people more conscious of their actions and prompts them to self-reflect on their consumption. Panno et al. (2018) found a relationship between dispositional mindfulness and proenvironmental behavior, mediated by social dominance orientation (i.e., preferences for group-based hierarchies). Mindfulness has been furthermore shown to relate to proenvironmental behavior through its effect on individual health behavior, such as improved nutrition and increased exercise (Geiger et al., 2018). Using an experimental sustainability-adapted mindfulness-based intervention, Geiger et al. (2020) found that mindfulness affected material values and well-being, which in turn are related to proenvironmental consumer behavior. Barbaro and Pickett (2016) found a relationship between mindfulness and proenvironmental behavior mediated by nature connectedness. Barber and Deale (2014), who also found a relationship between mindfulness and sustainable behavior showed that this effect was the result of mindful individuals being more concerned for others, society, and the environment. Thus, in line with the aforementioned literature, we expect that higher levels of mindfulness relate to a higher likelihood of environmentally friendly behavior:

**Hypothesis 1.** Mindfulness has a significant positive relationship with proenvironmental behavior.

### 2.2. The effect of mindfulness on proenvironmental behavior via climate change awareness

Although climate change awareness, that is, the degree to which people are aware that climate change is a reality, has become an important topic in the literature (Jerneck et al., 2011), there has been yet little research about its relationship with mindfulness (Koger, 2015; Wamsler et al., 2018; Wamsler and Brinker, 2018). There has been some evidence that mindfulness increases awareness of climate change (Wang et al., 2019). Mindfulness has also been shown to have a positive correlation with a proactive response to an adaptation to climate change (O’Brien and Hochachka, 2011; Wamsler and Brink, 2018; Wamsler et al., 2018). In particular, as Wang et al. (2021) found, for people with high levels of mindfulness, higher levels of climate change risk perception are positively linked to stronger climate change beliefs, environmental efficacy, and negatively to climate change inaction. Similarly, Panno et al. (2018) found that mindful individuals are more aware of climate change because they have an increased awareness of their environment, and are therefore also more likely to engage in proenvironmental behavior. Mindfulness therefore likely will increase climate change awareness, which in turn positively influences proenvironmental behavior.

**Hypothesis 2.** Mindfulness is positively related to proenvironmental behavior via climate change awareness.

### 2.3. The effect of mindfulness on proenvironmental behavior via cognitive reappraisal and climate change awareness

Emotion regulation strategies can affect how individuals experience and express emotions (Gross, 1998). Cognitive reappraisal refers to an emotion regulation mechanism in which the meaning of a situation is reinterpreted to affect emotional responses (Gross, 2015). Cognitive appraisal theory has initially been developed to describe the emotional coping process in stressful situations (Lazarus, 1966, 1991). Cognitive reappraisal seeks to increase the level of positive emotions or decrease negative ones by individuals taking conscious control of their cognitive thoughts and the effect of those thoughts on emotions. Individuals take awareness of their situation and actively aim to promote a more positive appraisal of this situation through strengthening positive thoughts (Gross, 1998).

A line of research has revealed a positive relationship between the capacity for cognitive reappraisal and mindfulness (Garland, 2007; Garland et al., 2009, 2011). The underlying argument is that mindfulness enhances awareness and promotes the ability to differentiate thoughts and emotions. To engage in cognitive reappraisal, individuals have to be conscious of their behavior by identifying their thoughts and emotions – a more evident characteristic in those who report higher trait mindfulness (Amel et al., 2009; Brown and Kasser, 2005; Brown and Ryan, 2003). Mindfulness, therefore, provides greater cognitive flexibility and the ability to disengage from negative emotions, enhancing individuals’ capacity to reinterpret the initial stimulus (Troy et al., 2013). Cognitive reappraisal, in turn, has been shown to relate to awareness of climate change and proenvironmental behavior. Indeed, the relationship between cognitive reappraisal and climate change is mediated by awareness of climate change (Panno et al., 2015). As Panno et al. (2015) argue, cognitive reappraisal can help to deal with emotions evoked by awareness of climate change. Cognitive reappraisal may be used to frame emotional responses to climate change as information motivating the avoidance of behavior that contributes to climate change. The inability to process these emotions may motivate more climate-harmful behavior. Therefore, individuals who are more likely to reappraise may be more aware of the signs of climate change such as changes in temperature and weather tendencies, and react with adapting their behavior toward more environmentally friendly alternatives. Since mindfulness may trigger cognitive reappraisal, mindfulness will

likely relate to proenvironmental behavior through cognitive reappraisal which, in turn, will relate to a higher awareness of climate change-related events, motivating individuals to adapt their impact on the climate.

**Hypothesis 3.** Mindfulness has an indirect relationship with proenvironmental behavior sequentially mediated by cognitive reappraisal and climate change awareness.

#### 2.4. The effect of connectedness to nature on climate change awareness

Connectedness to nature refers to the extent an individual feels part of the natural world (Mayer and Frantz, 2004); it is related to people's understanding of and relationship with the natural environment (Restall and Conrad, 2015). Individuals with higher exposure to and positive experiences with nature derive positive physical and emotional benefits resulting in their overall well-being (Mayer et al., 2009). When individuals are connected to nature, they also care more for the environment (Perkins, 2010).

Several researchers have explored the positive effects of connectedness with nature on subjective well-being (Frantz and Mayer, 2009; Howell et al., 2011), recovery from stress (Hartig et al., 2003), improved mood (Nisbet et al., 2019), and eco-friendly behavior (Liu et al., 2019; Nisbet et al., 2009). According to Wang et al. (2019), the relationship between nature connectedness and climate change awareness, however, has not been addressed so far. Several studies indicate a relationship between connectedness to nature and environmental concern, as people view damaging the environment as effectively harming themselves (Barbaro and Pickett, 2016; Mayer and Frantz, 2004; Schultz et al., 2004). In a recent meta-analysis, Whitburn et al. (2020) identified a direct and significant association between higher nature connectedness and environmentally friendly behavior. Specifically, people highly connected to nature will be more concerned regarding climate change (Hornsey et al., 2016; Wang et al., 2019).

**Hypothesis 4.** Nature connectedness is positively related to climate change awareness.

#### 2.5. The moderating effect of connectedness to nature

Research suggests that mindfulness relates to the awareness of nature experiences, and individuals' nature connectedness (Howell et al., 2011; Nisbet et al., 2019). Both mindfulness and nature connectedness are associated with concern for climate change (Hornsey et al., 2016; Mayer et al., 2009; Wang et al., 2019). Also, both mindfulness and nature connectedness have a positive relationship with climate change awareness (Wang et al., 2019) and environmentally friendly behavior (Amel et al., 2009; Nisbet et al., 2009).

Nature connectedness has also been found to moderate the relationship of mindfulness with other behavioral variables such as emotional well-being (Martin et al., 2020) and sustainable consumption behavior (Dong et al., 2020). Based on that, our study proposes that different degrees of nature connectedness may have a moderating effect on the relationship of mindfulness with environmentally friendly behavior (through climate change awareness and cognitive reappraisal). Specifically, because highly nature connected individuals already have a higher climate change awareness (Howell et al., 2011; Liu et al., 2019; Wang et al., 2019) and are more prone to environmentally friendly behavior (Dong et al., 2020; Krettenauer et al., 2019; Otto and Pensini, 2017; Wang et al., 2019), nature connectedness will have a negative moderating effect on the relationship between mindfulness and these variables. That is, in individuals with greater levels of nature connectedness, we do not expect mindfulness to strengthen the relationship between climate change awareness and proenvironmental behavior because they already have higher levels in these variables. Thus, consumers with average to high nature connectedness (in contrast to those with lower levels) will be less susceptible to the relationship of

mindfulness with proenvironmental intentions—mediated sequentially by cognitive reappraisal and climate change awareness.

**Hypothesis 5.** The relationship of mindfulness with proenvironmental intentions mediated sequentially by cognitive reappraisal and climate change awareness is negatively moderated by nature connectedness.

Fig. 1 depicts the conceptual model of hypothesized relationships.

### 3. Method

#### 3.1. Participants and procedure

The proposed model was tested with a convenience sample of 245 volunteer undergraduate economics and business students of a large public university in Spain (51.8% female; 17–56 years;  $M = 19.69$ ;  $SD = 4.16$ ). Participants were approached on the campus grounds by the interviewers and invited to participate voluntarily in the survey. They did not receive any financial compensation. The interviewees provided informed permission to complete an anonymous self-administered questionnaire on mindfulness, sustainability, and climate change awareness. The anonymity of the participant's responses was guaranteed. The completion of the survey took approximately 15 min.

#### 3.2. Variables measurement

To assess *mindfulness*, we used eleven items from Garland et al. (2011), including the following four components of the Five Facet Mindfulness Questionnaire (Baer et al., 2006): “observing and attending to experience”, “describing and discriminating emotional experiences”, “acting with awareness”, and “non-judging of experience”. The items were evaluated on 7-point Likert scales, ranging from 1 (strongly disagree) to 7 (strongly agree).

To assess *cognitive reappraisal*, we used six items of the emotional regulation scale (Balzarotti et al., 2010). Participants evaluated the extent to which they agreed with self-descriptive assertions reflecting cognitive reappraisal. Each item was measured on a 7-point Likert-type scale ranging from 1 (strongly disagree) and 7 (strongly agree).

For the assessment of *climate change awareness*, we employed six items from Heath and Gifford (2006). Participants assessed the degree to which they agreed with these assertions on a 5-point Likert-type scale, with the responses anchored at 1 (strongly disagree) and 5 (strongly agree).

*Proenvironmental behavior* was assessed with seven items of the Student Environmental Behavior Scale (Markowitz et al., 2012), which employs a self-report measure evaluating ecologically responsible behavior that individuals adopt to decrease their ecological footprint, and the additional item “I usually prefer to eat vegetables than meat” (Panno et al., 2015). Items were rated on 5-point Likert-type scales with 1 = never, 2 = rarely, 3 = sometimes, 4 = often, and 5 = always.

The last section of the questionnaire addressed participants' connection with nature. Based on Mayer and Frantz's (2004) scale, *nature connectedness* was measured with seven items on 5-point Likert-type scales, with the responses anchored at 1 (strongly disagree) and 5 (strongly agree). Each item reflected feelings and thoughts about one's connection to nature, for example, “I often feel a sense of oneness with the natural world around me.” All measurement items and their properties are displayed in Table 1. Cronbach's alpha confirmed the reliability of all scales.

### 4. Results

Variable correlations are shown in Table 2. The correlations between all studied variables were significant ( $p < .01$ ) and large ( $> .50$ ; Cohen, 1988). Proenvironmental behavior had a positive correlation with mindfulness ( $r = 0.67$ ). Likewise, results revealed a positive correlation of mindfulness and cognitive reappraisal ( $r = 0.63$ ), and of cognitive

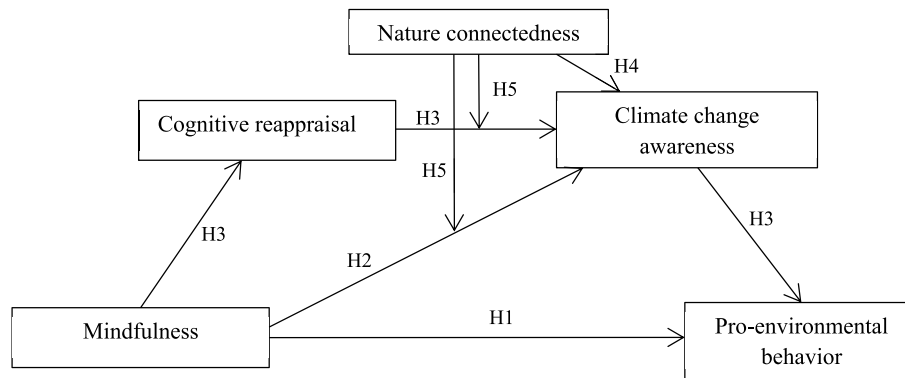


Fig. 1. Conceptual model.

reappraisal and climate change awareness ( $r = 0.54$ ). In turn, climate change awareness correlated positively with proenvironmental behavior ( $r = 0.71$ ). Finally, as expected, we found a significant correlation between nature connectedness and climate change awareness ( $r = 0.54$ ) as well as nature connectedness and proenvironmental behavior ( $r = 0.62$ ).

The relationships between mindfulness, cognitive reappraisal, climate change awareness, and proenvironmental intentions, was assessed with the SPSS macro PROCESS 3.5 (Hayes, 2013). A mediation analysis was conducted to assess the relationship of dispositional mindfulness with proenvironmental behavior and the indirect relationship between these constructs via cognitive reappraisal and climate change awareness. First, as projected, trait mindfulness was positively and significantly related to proenvironmental behavior when cognitive reappraisal and climate change awareness were not included as mediators ( $b = .44$ ,  $SE = 0.03$ ,  $t = 13.98$ ,  $p < .001$ ), providing support for Hypothesis 1.

Similarly, consistent with the theoretical framework proposed in Hypothesis 2, we confirmed an indirect influence of mindfulness on proenvironmental behavior, mediated by climate change awareness ( $b = 0.13$ ,  $SE = 0.03$ , 95% Bootstrap CI [.08, .18]). As proposed in Hypothesis 3, multiple mediation analysis showed that mindfulness had an indirect effect on proenvironmental behavior, mediated sequentially by cognitive reappraisal and climate change awareness ( $b = 0.05$ ,  $SE = 0.02$ , 95% Bootstrap CI [.02, .08]). Table 3 indicates the indirect effects with their corresponding bootstrap confidence intervals.

As shown in Table 3, cognitive reappraisal and climate change awareness are both significant mediators even if they do not account for the complete relationship between dispositional mindfulness and proenvironmental behavior. Thus, the direct effect of mindfulness on proenvironmental behavior when cognitive reappraisal and climate change awareness are considered as mediators continues to be significant ( $b = .22$ ,  $SE = 0.04$ ,  $t = 5.97$ ,  $p < .001$ ). Furthermore, as predicted, nature connectedness was significantly and positively associated with climate change awareness ( $b = 1.37$ ,  $SE = 0.16$ ,  $t = 8.48$ ,  $p < .001$ ), providing support for Hypothesis 4.

Subsequently, we assessed whether the indirect effects of mindfulness on proenvironmental behavior through climate change awareness, as well as through cognitive reappraisal and climate change awareness, were moderated by the level of nature connectedness, as proposed in Hypothesis 5, respectively. Moderated regression analysis confirmed a significant negative moderation by nature connectedness of the effects of mindfulness ( $b = -0.13$ ,  $SE = 0.06$ ,  $t = -2.06$ ,  $p = .03$ ) and cognitive reappraisal ( $b = -0.11$ ,  $SE = 0.05$ ,  $t = -1.95$ ,  $p = .05$ ) on climate change awareness. The results, therefore, confirmed the proposed moderation effects.

The moderation of the indirect effect of mindfulness on proenvironmental behavior through cognitive reappraisal and climate change awareness, as well as the effect at different values of the moderator nature connectedness is depicted in Table 4.

The results confirmed that the mediated influence of mindfulness on proenvironmental intention through climate change awareness is moderated negatively by the nature connectedness variable. Therefore, consumers high on nature connectedness are less sensitive to the influence of mindfulness on environmentally friendly behavior mediated by positive climate change awareness. Similarly, the results also confirmed that the sequentially mediated influence via cognitive reappraisal and climate change awareness is moderated negatively by the nature connectedness variable. Therefore, consumers with average and high nature connectedness, in contrast with those with lower levels, are less susceptible to the effects of mindfulness on proenvironmental behavior mediated sequentially by cognitive reappraisal and climate change awareness. As expected, for consumers with higher levels of nature connectedness, the effect of trait mindfulness over the level of climate change awareness and proenvironmental behavior is not as strong as for those individuals with lower levels, since the former already experience higher levels of climate change awareness, as shown by the confirmation of Hypothesis 4.

## 5. Discussion and theoretical contribution

Recent literature calls for the identification of the underlying mechanisms of the effect of mindfulness on environmental concern. This study supports extant research on the positive relationship between mindfulness and proenvironmental behavior. Findings furthermore provide a process explanation for this effect by supporting a relationship between individuals' level of dispositional mindfulness and cognitive reappraisal that is, the capacity to reframe their initial thoughts and beliefs. In turn, individuals with higher levels of cognitive reappraisal were more aware of climate change. Cognitive reappraisal can help to deal with emotions evoked by awareness of climate change because it may lead to reframing emotional responses to climate change as information motivating the avoidance of climate harmful behavior (Panno et al., 2015).

Further findings of this study provide empirical support of the scarcely explored relationship of nature connectedness and climate change awareness. In line with the extant literature (Hornsey et al., 2016; Wang et al., 2019; Whitburn et al., 2020), our findings confirm that a higher degree of nature connectedness is associated with stronger climate concerns and a higher sensitivity to the hazards of climate change. The moderating effect of nature connectedness on the relationship between mindfulness, climate change awareness, and environmentally friendly behavior has not been studied previously. Therefore, a novel contribution of this study is to shed light on the effects of nature connectedness in these relationships. The proposed negative moderating effect of nature connectedness on the indirect relationship of mindfulness and environmentally friendly behavior through cognitive reappraisal and climate change was confirmed. This finding implies that mindfulness does not relate to climate change awareness and

**Table 1**  
Variables and measurement items.

	Mean	SD	$\alpha$
<b>Mindfulness</b>	<b>4.39</b>	<b>1.74</b>	<b>.85</b>
It's easy for me to keep track of my thoughts and feelings.			
I'm good at finding words to describe my feelings.			
When I have a sensation in my body, it's hard for me to describe it because I can't find the right words. ( <i>reverse coded</i> )			
I find it difficult to stay focused on what's happening in the present. ( <i>reverse coded</i> )			
It seems I am "running on automatic" without much awareness of what I'm doing. ( <i>reverse coded</i> )			
I notice how my emotions express themselves through my body.			
I pay attention to whether my muscles are tense or relaxed.			
I pay attention to sensations, such as the wind in my hair or the sun on my face.			
I find myself doing things without paying attention. ( <i>reverse coded</i> )			
I believe some of my thoughts are abnormal or bad and I shouldn't think that way. ( <i>reverse coded</i> )			
I think some of my emotions are bad or inappropriate and I shouldn't feel them. ( <i>reverse coded</i> )			
<b>Cognitive reappraisal</b>	<b>4.47</b>	<b>1.79</b>	<b>.90</b>
When I want to feel more positive emotions (such as joy or amusement), I change what I'm thinking about.			
When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.			
When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.			
When I want to feel more positive emotions, I change the way I'm thinking about the situation.			
I control my emotions by changing the way I think about the situation I'm in.			
When I want to feel less negative emotion, I change the way I'm thinking about the situation.			
<b>Climate change perception</b>	<b>4.21</b>	<b>1.12</b>	<b>.93</b>
I am quite sure that global warming is occurring now.			
It seems to me that weather patterns have changed compared to when I was a child.			
I have already noticed some signs of global warming.			
It seems to me that the temperature is warmer now than in years before.			
It seems to me that snowpacks are melting earlier than in years before due to warmer temperatures.			
Personally, I am worried about global warming (climate change).			
<b>Pro-environmental behavior</b>	<b>3.53</b>	<b>1.16</b>	<b>.78</b>
Recycle paper, plastic, and metal.			
Use recycled paper.			
Use reusable shopping bags.			
Leave the lights on when you leave a room. ( <i>reverse coded</i> )			
Throw recyclables (e.g., plastic bottles) in the trash can. ( <i>reverse coded</i> )			
Print documents single-sided. ( <i>reverse coded</i> )			
Avoid using public transportation. ( <i>reverse coded</i> )			
I usually prefer to eat vegetables to meat.			
<b>Nature connectedness</b>	<b>3.48</b>	<b>1.01</b>	<b>.89</b>
I often feel a sense of oneness with the natural world around me.			
I often feel part of the web of life.			
As a tree can be part of a forest, I feel embedded within the broader natural world.			
I often feel a kinship with animals and plants.			
I think of the natural world as a community to which I belong.			
My personal welfare is independent of the welfare of the natural world. ( <i>reverse coded</i> )			
I often feel disconnected from nature. ( <i>reverse coded</i> )			

**Table 2**  
Variable correlations.

	MF	CR	CCP	PB	NC
Mindfulness (MF)					
Cognitive reappraisal (CR)	.63***				
Climate change perception (CCP)	.60***	.54***			
Pro-environmental behavior (PB)	.67***	.54***	.71***		
Nature connectedness (NC)	.57***	.51***	.54***	.62***	

\*\*\*p < .01.

**Table 3**  
Indirect effects of mindfulness on pro-environmental behavior via cognitive reappraisal and climate change perception.

DV	Mediator	B (indirect)	Boot SE	Boot LLCI	Boot ULCI
PB	Climate change perception	.13	.03	.08	.18
PB	CR → Climate change perception	.05	.02	.02	.08

Notes: Bootstrap confidence intervals: 95% bias corrected; 10,000 bootstrap samples; DV = Dependent variable, PB = Pro-environmental behavior, CR = Cognitive reappraisal.

**Table 4**  
Indirect effects at different values of the nature connectedness moderator.

Mediator	Values Moderator	Indirect effects (conditional)	Boot SE	Boot LLCI	Boot ULCI
CR	2.70 (-1SD)	.08	.02	.05	.12
	3.48 (M)	.04	.01	.01	.06
	4.26 (+1SD)	-.01	.01	-.03	.01
CC	2.70 (-1SD)	.33	.07	.19	.46
	3.48 (M)	.23	.05	.12	.33
	4.26 (+1SD)	.13	.07	-.01	.27

Note. NC: Nature connectedness, CR: cognitive reappraisal, CC: climate change perception, values of moderators: mean (M) and mean plus/minus one SD (-1SD/+1SD), bias corrected 95% bootstrap confidence intervals, 10,000 bootstrap samples.

proenvironmental behavior as much for people with higher levels of nature connectedness, since they already rate high on environmental attitudes.

## 6. Practical implications

Our findings have important implications for the promotion of sustainable, climate-friendly behaviors by governments and policymakers. Encouraging mindfulness practice society-wide could enhance climate change awareness and foster proenvironmental behavior. Schools and educational institutions should create programs to teach mindfulness and encourage environmental learning. Mindful training programs for students and teachers alike could have benefits in terms of tendencies to climate-friendly behaviors, apart from generally developing social and sustainability competencies (Bakosh et al., 2016; Gold et al., 2010; Hensley, 2020).

Since our research showed that the relationship between mindfulness and proenvironmental behavior was stronger for individuals who were less connected to nature, this is the segment of individuals for whom mindfulness education is most urgent. Our findings support the suggestion of Bask et al. (2020) and Howell (2021), that education for sustainability may positively influence individuals' environmental values and attitudes. To foster proenvironmental behavior, sustainability education should also focus on mindfulness.

Our findings furthermore provide additional insights for the development of effective information campaigns aimed at increasing climate change awareness. Such campaigns should trigger cognitive reappraisal

about climate change, for instance, by prompting recipients to evaluate their emotional responses to extreme weather and climate events.

Finally, since nature connectedness relates to climate change awareness, nature exposure programs could be helpful to stimulate proenvironmental behavior, especially since people in developed countries spend most of their time indoors (MacKerron and Mourato, 2013) and children's outdoor activities have significantly decreased (Clements, 2004). Educational programs promoting outdoor nature experiences would be beneficial from early life stages on and specifically for children since nature connectedness may also improve their behavioral regulation strategies (Frantz and Mayer, 2009; Taylor et al., 2002) and, in turn, climate change awareness and proenvironmental behavior.

## 7. Limitations and future research

This study has several limitations. We employed self-reported measurements to explore trait mindfulness based on the five facets mindfulness questionnaire (Baer et al., 2006). Further studies should consider alternative measurements of mindfulness such as the sustainability-adaptive mindfulness-based intervention (Geiger et al., 2020) or mindful climate action (MCA) training (Grabow et al., 2018). Since self-reported behavior may contain recall errors, subsequent studies should complement this methodology with the measurement of the variables in a controlled laboratory setting.

The cross-sectional character of the study does not allow to establish causality and directionality of effects. To overcome these limitations, future research should use experimental approaches such as the guided mindfulness intervention (Nisbet et al., 2019) and longitudinal studies, for instance, based on the longitudinal assessments of mindfulness practices (Fischer et al., 2017). The sample size ( $N = 245$ ) is sufficient to estimate coefficients with appropriate power, but, because it is nevertheless limited, particularly concerning the external validity of results, future research should employ larger and, instead of university students, more diverse samples. The studied relationships should furthermore be addressed in other groups, such as children, since, for instance, little research has been conducted on the effects of nature connectedness on children's behavior (Bakir-Demir et al., 2019).

## 8. Conclusions

Responding to the call for research explaining the recently revealed relationship between mindfulness and proenvironmental behavior, this research proposes and tests a conceptual model providing a process explanation for the mindfulness-proenvironmental link based on the sequential mediating influences of cognitive reappraisal and climate change concern and the negative moderating effect of nature connectedness. Our findings provide new insight into these processes by confirming the association between mindfulness and proenvironmental behavior and the mediating influence of cognitive reappraisal, and climate change awareness. The study furthermore confirmed that this process was attenuated for individuals rating high on nature connectedness. Thus, a significant contribution of our study to the literature is to show that particularly for those individuals who experience a lower connection with nature, mindfulness could be a significant factor enhancing proenvironmental behavior through stimulating cognitive reappraisal and, in turn, personal awareness of changes in temperature and weather patterns.

## CRedit authorship contribution statement

**Vanessa Apaolaza:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing – original draft. **Mario R. Paredes:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Patrick Hartmann:** Conceptualization, Data curation, Formal analysis, Funding acquisition,

Investigation, Methodology, Resources, Software, Validation, Visualization, Supervision, Writing – review & editing. **Jose M. Barrutia:** Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Software, Writing – review & editing. **Carmen Echebarria:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

This work was supported by the Spanish Government and European Regional Development Fund [grant numbers ECO 2016-76348-R, AEI/FEDER, UE], the Basque Government [grant numbers GIC 15/128; IT-952-16] and FESIDE Foundation.

## References

- Amel, E.L., Manning, C.M., Scott, B.A., 2009. Mindfulness and sustainable behavior: pondering attention and awareness as means for increasing green behavior. *Ecopsychology* 1, 14–25. <https://doi.org/10.1089/eco.2008.0005>.
- Baer, R.A., Smith, G.T., Hopkins, J., Krietemeyer, J., Toney, L., 2006. Using self-report assessment methods to explore facets of mindfulness. *Assessment* 13, 27–45. <https://doi.org/10.1177/1073191105283504>.
- Bahl, S., Milne, G.R., Ross, S.M., Mick, D.G., Grier, S.A., Chugani, S.K., Chan, S., Gould, S.J., Cho, Y.-N., Dorsey, J.D., Schindler, R.M., Murdock, M.R., Boesen-Mariani, S., 2016. Mindfulness: its transformative potential for consumer, societal, and environmental well-being. *J. Publ. Pol. Market.* 35, 1–13. <https://doi.org/10.1509/jppm.15.139>.
- Bakir-Demir, T., Berument, S.K., Sahin-Acar, B., 2019. The relationship between greenery and self-regulation of children: the mediation role of nature connectedness. *J. Environ. Psychol.* 65, 101327. <https://doi.org/10.1016/j.jenvp.2019.101327>.
- Bakosh, L.S., Snow, R.M., Tobias, J.M., Houlihan, J.L., Barbosa-Leiker, C., 2016. Maximizing mindful learning: mindful awareness intervention improves elementary school students' quarterly grades. *Mindfulness* 7, 59–67. <https://doi.org/10.1007/s12671-015-0387-6>.
- Balzarotti, S., John, O.P., Gross, J.J., 2010. An Italian adaptation of the emotion regulation questionnaire. *Eur. J. Psychol. Assess.* 26, 61–67. <https://doi.org/10.1027/1015-5759/a000009>.
- Barbaro, N., Pickett, S.M., 2016. Mindfully green: examining the effect of connectedness to nature on the relationship between mindfulness and engagement in pro-environmental behavior. *Pers. Individ. Differ.* 93, 137–142. <https://doi.org/10.1016/j.paid.2015.05.026>.
- Barber, N.A., Deale, C., 2014. Tapping mindfulness to shape hotel guests' sustainable behavior. *Cornell Hosp. Q.* 55, 100–114. <https://doi.org/10.1177/1938965513496315>.
- Bask, A., Halme, M., Kallio, M., Kuula, M., 2020. Business students' value priorities and attitudes towards sustainable development. *J. Clean. Prod.* 264, 121711. <https://doi.org/10.1016/j.jclepro.2020.121711>.
- Brown, K.W., Kasser, T., 2005. Are psychological and ecological well-being compatible? The role of values, mindfulness, and lifestyle. *Soc. Indic. Res.* 74, 349–368. <https://doi.org/10.1007/s11205-004-8207-8>.
- Brown, K.W., Ryan, R.M., 2003. The benefits of being present: mindfulness and its role in psychological well-being. *J. Pers. Soc. Psychol.* 84, 822–848. <https://psycnet.apa.org/doi/10.1037/0022-3514.84.4.822>.
- Clements, R., 2004. An investigation of the status of outdoor play. *Contemp. Issues Early Child.* 5, 68–80. <https://doi.org/10.2304/ciec.2004.5.1.10>.
- Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences*, second ed. Lawrence Erlbaum Associates, Publishers, Hillsdale, NJ.
- Davidson, R.J., Kaszniak, A.W., 2015. Conceptual and methodological issues in research on mindfulness and meditation. *Am. Psychol.* 70 (1), 581–592. <https://doi.org/10.1037/a0039512>.
- Dong, X., Liu, S., Li, H., Yang, Z., Liang, S., Deng, N., 2020. Love of nature as a mediator between connectedness to nature and sustainable consumption behavior. *J. Clean. Prod.* 242, 118451. <https://doi.org/10.1016/j.jclepro.2019.118451>.
- Ericson, T., Kjønstad, B.G., Barstad, A., 2014. Mindfulness and sustainability. *Ecol. Econ.* 104, 73–79. <https://doi.org/10.1016/j.ecolecon.2014.04.007>.
- Fischer, D., Stanzus, L., Geiger, S., Grossman, P., Schrader, U., 2017. Mindfulness and sustainable consumption: a systematic literature review of research approaches and findings. *J. Clean. Prod.* 162, 544–558. <https://doi.org/10.1016/j.jclepro.2017.06.007>.
- Frantz, C.M., Mayer, F.S., 2009. The emergency of climate change: why are we failing to take action? *Anal. Soc. Issues Public Policy* 9, 205–222. <https://doi.org/10.1111/j.1530-2415.2009.01180.x>.

- Garland, E.L., 2007. The meaning of mindfulness: a second-order cybernetics of stress, metacognition and coping. *Compl. Health Pract. Rev.* 12, 15–30. <https://doi.org/10.1177/1533210107301740>.
- Garland, E.L., Gaylord, S., Park, J., 2009. The role of mindfulness in positive reappraisal. *Explore* 5 (1), 37–44. <https://doi.org/10.1016/j.explore.2008.10.001>.
- Garland, E.L., Gaylord, S.A., Fredrickson, B.L., 2011. Positive reappraisal mediates the stress-reductive effects of mindfulness: an upward spiral process. *Mindfulness* 2, 59–67. <https://doi.org/10.1007/s12671-011-0043-8>.
- Geiger, S.M., Fischer, D., Schrader, U., Grossman, P., 2020. Meditating for the planet: effects of a mindfulness-based intervention on sustainable consumption behaviors. *Environ. Behav.* 52, 1012–1042. <https://doi.org/10.1177/0013916519880897>.
- Geiger, S.M., Otto, S., Schrader, U., 2018. Mindfully green and healthy: an indirect path from mindfulness to ecological behavior. *Front. Psychol.* 8, 1–11. <https://doi.org/10.3389/fpsyg.2017.02306>.
- Gold, E., Smith, A., Hopper, I., Herne, D., Tansey, G., Hulland, C., 2010. Mindfulness-based stress reduction (MBSR) for primary school teachers. *J. Child Fam. Stud.* 19, 184–189. <https://doi.org/10.1007/s10826-009-9344-0>.
- Grabow, M., Bryan, T., Checovich, M.M., Converse, A.K., Middlecamp, C., Mooney, M., Torres, E.R., Younkin, S.G., Barrett, B., 2018. Mindfulness and climate change action: a feasibility study. *Sustainability* 10, 1–24. <https://doi.org/10.3390/su10051508>.
- Gross, J.J., 1998. The emerging field of emotion regulation: an integrative review. *Rev. Gen. Psychol.* 2, 271–299. <https://doi.org/10.1037/1089-2680.2.3.271>.
- Gross, J.J., 2015. Emotion regulation: current status and future prospects. *Psychol. Inq.* 26, 1–26. <https://doi.org/10.1080/1047840X.2014.940781>.
- Grossman, P., Niemann, L., Schmidt, S., Walach, H., 2004. Mindfulness-based stress reduction and health benefits: a meta-analysis. *J. Psychosom. Res.* 57, 35–43. [https://doi.org/10.1016/S0022-3999\(03\)00573-7](https://doi.org/10.1016/S0022-3999(03)00573-7).
- Hartig, T., Evans, G.W., Jamner, L.D., Davis, D.S., Gärling, T., 2003. Tracking restoration in natural and urban field settings. *J. Environ. Psychol.* 23, 109–123. [https://doi.org/10.1016/S0272-4944\(02\)00109-3](https://doi.org/10.1016/S0272-4944(02)00109-3).
- Hayes, A.F., 2013. *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*. The Guilford Press, London and New York, NY.
- Heath, Y., Gifford, R., 2006. Free-market ideology and environmental degradation: the case of belief in global climate change. *Environ. Behav.* 38, 48–71. <https://doi.org/10.1177/0013916505277998>.
- Hensley, N., 2020. Educating for sustainable development: cultivating creativity through mindfulness. *J. Clean. Prod.* 243, 118542.
- Hornsey, M.J., Harris, E.A., Bain, P.G., Fielding, K.S., 2016. Meta-analyses of the determinants and outcomes of belief in climate change. *Nat. Clim. Change* 6, 622–626. <https://doi.org/10.1038/nclimate2943>.
- Howell, A.J., Dopko, R.L., Passmore, H.A., Buro, K., 2011. Nature connectedness: associations with well-being and mindfulness. *Pers. Individ. Differ.* 51, 166–171. <https://doi.org/10.1016/j.paid.2011.03.037>.
- Howell, R.A., 2021. Engaging students in education for sustainable development: the benefits of active learning, reflective practices and flipped classroom pedagogies. *J. Clean. Prod.* 325, 129318. <https://royalsocietypublishing.org/journal/rsos/10.1098/rsos.210109>.
- Jerneck, A., Olsson, L., Ness, B., Anderberg, S., Baier, M., Clark, E., Hickler, T., Hornborg, A., Kronsell, A., Lövbrand, E., Persson, J., 2011. Structuring sustainability science. *Sustain. Sci.* 6 (1), 69–82. <https://doi.org/10.1007/s11625-010-0117-x>.
- Kabat-Zinn, J., 1990. *Full Catastrophe Living: Using the Wisdom of the Body and the Mind to Face Stress, Pain and Illness*. Bantam Books, New York.
- Kiken, L.G., Garland, E.L., Bluth, K., Palsson, O.S., Gaylord, S.A., 2015. From a state to a trait: trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Pers. Individ. Differ.* 81, 41–46. <https://doi.org/10.1016/j.paid.2014.12.044>.
- Klug, K., Niemand, T., 2021. The lifestyle of sustainability: testing a behavioral measure of precycling. *J. Clean. Prod.* 297, 126699.
- Koger, S.M., 2015. A burgeoning ecopsychological recovery movement. *Ecopsychology* 7, 245–250. <https://doi.org/10.1089/eco.2015.0021>.
- Krettenauer, T., Wang, W., Jia, F., Yao, Y., 2019. Connectedness with nature and the decline of pro-environmental behavior in adolescence: a comparison of Canada and China. *J. Environ. Psychol.* 71, 101348. <https://doi.org/10.1016/j.jenvp.2019.101348>.
- Lazarus, R.S., 1966. *Psychological Stress and the Coping Process*. McGraw-Hill, New York, NY.
- Lazarus, R.S., 1991. *Emotion and Adaptation*. Oxford University Press, New York, NY.
- Linehan, M., 1993. *Skills Training Manual for Treating Borderline Personality Disorder*. Guilford Press, New York, NY.
- Liu, T., Geng, L., Ye, L., Zhou, K., 2019. Mother Nature” enhances connectedness to nature and pro-environmental behavior. *J. Environ. Psychol.* 61, 37–45. <https://doi.org/10.1016/j.jenvp.2018.12.003>.
- MacKerron, G., Mourato, S., 2013. Happiness is greater in natural environments. *Global Environ. Change* 23 (5), 992–1000. <https://doi.org/10.1016/j.gloenvcha.2013.03.010>.
- Markowitz, E.M., Goldberg, L.R., Ashton, M.C., Lee, K., 2012. Profiling the “pro-environmental individual”: a personality perspective. *J. Pers.* 80 (1), 81–111. <https://doi.org/10.1111/j.1467-6494.2011.00721.x>.
- Martin, L., White, M.P., Hunt, A., Richardson, M., Pahl, S., Burt, J., 2020. Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. *J. Environ. Psychol.* 68, 101389. <https://doi.org/10.1016/j.jenvp.2020.101389>.
- Mayer, F.S., Frantz, C.M., 2004. The connectedness to nature scale: a measure of individuals’ feeling in community with nature. *J. Environ. Psychol.* 24, 503–515. <https://doi.org/10.1016/j.jenvp.2004.10.001>.
- Mayer, F.S., Frantz, C.M., Bruehlman-Senecal, E., Dolliver, K., 2009. Why is nature beneficial? The role of connectedness to nature. *Environ. Behav.* 41 (5), 607–643. <https://doi.org/10.1177/0013916508319745>.
- National Research Council, 2020. *Climate Change, Evidence & Causes*.
- Nisbet, E.K., Zelenski, J.M., Grandpierre, Z., 2019. Mindfulness in nature enhances connectedness and mood. *Ecopsychology* 11, 81–91. <https://doi.org/10.1089/eco.2018.0061>.
- Nisbet, E.K., Zelenski, J.M., Murphy, S.A., 2009. The nature relatedness scale: linking with nature to environmental concern and behavior. *Environ. Behav.* 27, 1–26. <https://doi.org/10.1177/0013916508318748>.
- O’Brien, K., Hochachka, G., 2011. *Integral adaptation to climate change*. *J. Integral Theory Pract.* 5, 89–102.
- Oskamp, S., 2000. A sustainable future for humanity? How can psychology help? *Am. Psychol.* 55, 496–508.
- Otto, S., Pensini, P., 2017. Nature-based environmental education of children: environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global Environ. Change* 47, 88–94. <https://doi.org/10.1016/j.gloenvcha.2017.09.009>.
- Panno, A., Carrus, G., Maricchiolo, F., Mannetti, L., 2015. Cognitive reappraisal and pro-environmental behavior: the role of global climate change perception. *Eur. J. Soc. Psychol.* 45, 858–867. <https://doi.org/10.1002/ejsp.2162>.
- Panno, A., Giacomantonio, M., Carrus, G., Maricchiolo, F., Pirchio, S., Mannetti, L., 2018. Mindfulness, pro-environmental behavior, and belief in climate change: the mediating role of social dominance. *Environ. Behav.* 50, 864–888. <https://doi.org/10.1177/0013916517718887>.
- Perkins, H.E., 2010. Measuring love and care for nature. *J. Environ. Psychol.* 30 (4), 455–463. <https://doi.org/10.1016/j.jenvp.2010.05.004>.
- Restall, B., Conrad, E., 2015. A literature review of connectedness to nature and its potential for environmental management. *J. Environ. Manag.* 159, 264–278. <https://doi.org/10.1016/j.jenvman.2015.05.022>.
- Rosenberg, E.L., 2004. Mindfulness and consumerism. In: Kasser, T., Kanner, A.D. (Eds.), *Psychology and Consumer Culture: the Struggle for a Good Life in a Materialistic World*. American Psychological Association, Washington, DC, pp. 107–125.
- Schultz, P.W., Shriver, C., Tabanico, J.J., Khazian, A.M., 2004. Implicit connections with nature. *J. Environ. Psychol.* 24, 31–42. [https://doi.org/10.1016/S0272-4944\(03\)00022-7](https://doi.org/10.1016/S0272-4944(03)00022-7).
- Taylor, A.F., Kuo, F.E., Sullivan, W.C., 2002. Views of nature and self-discipline: evidence from inner city children. *J. Environ. Psychol.* 22, 49–63. <https://doi.org/10.1006/jenvp.2001.0241>.
- Troy, A.S., Shallcross, A.J., Davis, T.S., Mauss, I.B., 2013. History of mindfulness-based cognitive therapy is associated with increased cognitive reappraisal ability. *Mindfulness* 4, 213–222. <https://doi.org/10.1007/s12671-012-0114-5>.
- Wamsler, C., 2018. Mind the gap: the role of mindfulness in adapting to increasing risk and climate change. *Sustain. Sci.* 13, 1121–1135. <https://doi.org/10.1007/s11625-017-0524-3>.
- Wamsler, C., Brink, E., 2018. Mindsets for sustainability: exploring the link between mindfulness and sustainable climate adaptation. *Ecol. Econ.* 151, 55–61. <https://doi.org/10.1016/j.ecolecon.2018.04.029>.
- Wamsler, C., Brossmann, J., Hendersson, H., Kristjansdottir, R., McDonald, C., Scarampi, P., 2018. Mindfulness in sustainability science, practice, and teaching. *Sustain. Sci.* 13, 143–162. <https://doi.org/10.1007/s11625-017-0428-2>.
- Wang, C., Geng, L., Rodriguez-Casallas, J.D., 2021. How and when higher climate change risk perception promotes less climate change inaction. *J. Clean. Prod.* 321, 128952.
- Wang, J., Geng, L., Schultz, P.W., Zhou, K., 2019. Mindfulness increases the belief in climate change: the mediating role of connectedness with nature. *Environ. Behav.* 51, 3–23. <https://doi.org/10.1177/0013916517738036>.
- Whitburn, J., Linklater, W., Abrahamse, W., 2020. Meta-analysis of human connection to nature and proenvironmental behavior. *Conserv. Biol.* 34, 180–193. <https://doi.org/10.1111/cobi.13381>.