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ORIGINAL PAPER

Does Mindfulness Mediate the Relationship Between Emotion Regulation and Pro-Environmental Behaviors Differently Based on Gender?

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Abstract

Objectives This study aimed to explore possible gender differences in the relationship between emotion dysregulation, mindfulness, and pro-environmental behaviors. Specifically, it aimed to investigate whether mindfulness mediated the association between emotion dysregulation and pro-environmental behaviors, and if there were any gender differences in this relationship.

Method A sample of 1,406 employees (56.3% males, average age = 44.85) participated in the study. Participants completed the Pro-Environmental Behaviors Scale (PEBS), Difficulties in Emotion Regulation Scale- Short Form (DERS-SF), and Five Facet Mindfulness Questionnaire (FFMQ) to assess pro-environmental behaviors, emotion regulation, and mindfulness, respectively. Data were analyzed using ANOVA, Pearson's correlation analysis, and mediation analysis.

Results Women exhibited higher scores on the PEBS total scale ($p < 0.001$; $\eta^2 = 0.02$), higher scores on the Observe and Describe FFMQ subscales ($p < 0.001$; $\eta^2 = 0.01$), and lower scores on the Non-react FFMQ subscale ($p < 0.001$; $\eta^2 = 0.01$), compared to men. No gender differences were found on the DERS-SF total scale ($p > 0.05$; $\eta^2 = 0.00$). Higher levels of emotion dysregulation were associated with lower pro-environmental behaviors ($r = -0.12$; $p < 0.05$). Mindfulness mediated the relationship between emotion dysregulation and pro-environmental behaviors, specifically through the ability to observe one's own emotions and external stimuli. Gender differences were found based on the Non-react facet of mindfulness, which is negatively associated with pro-environmental behaviors in men ($\beta = -0.08$; $p < 0.05$) and positively associated with them in women ($\beta = 0.09$; $p < 0.05$).

Conclusions The findings suggest that emotion dysregulation and mindfulness are associated with pro-environmental behaviors. The ability to observe one's own emotions and external stimuli plays a significant role in promoting sustainable behaviors, while the ability to perceive one's own emotions without feeling overwhelmed or compelled to react to them has different associations with pro-environmental behaviors in men and women. These results provide insights for the development of interventions targeting emotion regulation and mindfulness to encourage pro-environmental behaviors, specifically based on gender.

Preregistration This study is not preregistered.

Keywords Emotion regulation · Mindfulness · Pro-environmental behaviors · Serial mediation model · Gender

Numerous studies have pointed out that in order to halt and prevent the effects of climate change, it is necessary for individuals to actively modify many of their daily behaviors, such as energy use, transportation, diet, and purchases (Dietz et al., 2009; Gifford, 2011). Consequently, several studies have focused on interventions that can encourage pro-environmental behaviors (Grilli & Curtis, 2021; Steg & Vlek, 2009), which are defined as "behaviors that consciously seek to minimize the negative impact of one's actions on the natural and built world (e.g., minimize resource and energy consumption, use of non-toxic substances, reduce waste production)" (Kollmuss & Agyeman, 2002, p. 240).

Recently, Thiermann and Sheate (2020a) highlighted the need to implement intervention programs that take into account cognitive and emotional aspects in relation to self,

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others, and nature, rather than just normative aspects, in order to promote the emergence and maintenance of pro-environmental behaviors. Indeed, emotions can drive people to act sustainably and care for the environment, and emotional variables can interact in multidimensional ways to determine people's behavior (Li et al., 2019). Research has highlighted the relevance of emotional reactions to climate change for sustainable behavior and its modification (Bradley et al., 2020; Davidson & Kecinski, 2022), and some studies have found that certain emotional variables are key factors in influencing pro-environmental behaviors (Brosch & Steg, 2021; Carmi et al., 2015; Li et al., 2019). It is important to consider that, although numerous studies have highlighted how there are gender differences in emotional factors (Bianchin & Angrilli, 2012; Rochat, 2023), there are no studies that have investigated whether the association of emotional factors on pro-environmental behaviors could be different based on gender.

While many studies have focused on variables such as empathy (Berenguer, 2007; Ienna et al., 2022), empathy with nature (Wang et al., 2023), compassion (Ramstetter et al., 2023; Zelenski & Desrochers, 2021), and gratitude (Sun et al., 2023; Tam, 2022), recently, a growing body of research suggests that not only perceived emotions but especially the ability to regulate one's own emotions can be associated with pro-environmental behaviors (Li et al., 2022; Panno et al., 2015; Panno et al., 2020).

One factor that could explain the relationship between emotion regulation and pro-environmental behaviors is mindfulness. Numerous studies have shown a close relationship between emotion regulation and mindfulness (Lyvers et al., 2014; Roemer et al., 2015). For example, several studies have found that mindfulness-based training allows for an improvement in the ability to regulate one's own emotions (Farb et al., 2014; Wimmer et al., 2019). The Western psychological concept of decentering, which involves viewing one's thoughts and emotions with detached awareness, parallels the Buddhist practice of mindfulness and the understanding of no-self, or anatta, emphasizing the impermanent and non-self nature of mental phenomena.

The emotion regulation and mindfulness constructs should be considered together when thinking about interventions to promote pro-environmental behaviors. Effective emotion regulation skills could enable people to approach emotions such as concern for the environment and the climate crisis, and greater awareness of their emotions could lead them to act more in tune with them. Indeed, a wide range of studies have demonstrated that mindfulness can improve pro-environmental behavior in various ways (Thiermann & Sheate, 2020b).

The regulation of emotions has been defined as the processes by which individuals influence the emotions they experience when they experience them, and how they experience and express these emotions (Rottenberg & Gross, 2003). Gratz and Roemer (2004) considered the necessary components for successful emotion regulation: awareness and acceptance of one's emotions, the ability to change emotions according to one's goals, and the ability to control behavior in the presence of negative emotions. The absence of one of these capacities is termed emotion dysregulation (Gratz & Roemer, 2004).

The concept of emotion regulation, and especially emotion dysregulation, has been extensively studied in the field of clinical psychology, showing associations with various psychopathological manifestations such as eating disorders (Ballarotto et al., 2017; Rania et al., 2021), schizophrenia (Liu et al., 2020), personality disorders (Chapman, 2019; Ponzoni et al., 2021), psychopathy (Garofalo et al., 2021), and aggression (Garofalo et al., 2018; Velotti et al., 2019). McRae et al. (2008) have indicated that there were gender differences in how one regulates one's emotions. Through an fMRI study, they have shown that compared to women; men showed smaller increases in prefrontal regions associated with cognitive reappraisal, greater decreases in the amygdala, which is associated with emotional responding, and less engagement of ventral striatal regions, which are associated with reward processing. However, other studies found higher dysregulation in women (Brindle et al., 2019; Velotti et al., 2016), while other studies have not highlighted gender differences in emotion dysregulation (Ballarotto et al., 2024; Gross & John, 2003).

Recently, some studies have shown that the enhanced ability to regulate one's emotions is also associated with environmentally supportive behaviors (Li et al., 2022). Specifically, recent studies have underlined that individual differences in the way of regulating one's emotions can foster the perception of climate change and, in turn, be related to pro-environmental behaviors (Li et al., 2022; Panno et al., 2015; Panno et al., 2020). Panno et al. (2015) were interested in understanding if and how individual variations in emotion regulation can influence the perception of climate change and, consequently, be associated with pro-environmental behaviors. Thanks to Gross and John (2003), we know that individuals can use strategies to regulate their own emotions. One of these strategies is cognitive reappraisal, which offers benefits in multiple areas, from work performance to decision-making (Finkel et al., 2013; Gross, 2011; Leroy et al., 2012; Panno et al., 2013). Cognitive reappraisal is the ability to re-evaluate a situation by modifying its emotional response, affecting the way people see their physical environment and the goals they pursue (Panno et al., 2015). Thanks to this strategy, individuals can better protect the natural environment around them as they understand more deeply the emotions provided by it. Panno et al. (2020) have shown that those who routinely use cognitive reappraisal to regulate their emotions have increased sensitivity to the

climate emergency, and this awareness could encourage more sustainable behaviors. The authors consider the more accurate perception of climate change as a central factor in the relationship between the habitual use of cognitive reappraisal and sustainable behavior. They have also discovered that pro-environment actions increase because, with cognitive reappraisal, individuals rediscover the awareness of the benefits of nature and reinterpret the immersion with it as a positive experience and something to safeguard as much as possible. This happens thanks to an individual's perception of the self that escapes from routine reality and takes refuge in the natural environment, which is felt as a restorative experience.

However, cognitive reappraisal is only one strategy of emotion regulation and does not represent the complete functioning of an individual's emotion regulation. Furthermore, there are no studies investigating the role of emotion dysregulation in acting pro-environmental behaviors. Indeed, emotion dysregulation is associated with maladaptive relational functioning and fewer prosocial behaviors (Casini et al., 2022; Garofalo et al., 2017; Malkoç et al., 2019). Given that pro-environmental behaviors are a specific form of prosocial behavior (Nolan & Schultz, 2014), further studies should investigate how emotion dysregulation might be negatively associated with pro-environmental behaviors, exploring the factors that can promote environmentally supportive actions. One construct that could help enhance understanding of this relationship is mindfulness.

Being mindful means being aware and paying attention to both our internal experiences and the external world without avoiding thoughts or feelings that we may dislike or wish were not true (Baer et al., 2006). Mindfulness can be defined as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994, p. 4) or as "receptive attention to and awareness of present events and experience" (Brown et al., 2007, p. 212). The Buddhist concept of no-self asserts that there is no unchanging, permanent self or soul within beings, challenging the notion of a fixed identity. This doctrine encourages the understanding that what we consider "self" is merely a collection of transient mental and physical processes. In contrast, the Buddhist framework also differentiates between the conventional truth, which acknowledges the everyday perception of a self for practical purposes, and the ultimate truth, which recognizes the absence of an inherent, independent self. This dual perspective aids in the deeper realization of the impermanent nature of existence.

Studies that have investigated gender differences in mindfulness skills have found conflicting results: while Alispahic and Hasanbegovic-Anic (2017) found a greater tendency in women than men to attend to internal and external stimuli, along with related cognitions and emotions, Fuentes et al. (2022) did not find this difference. However, they did find a higher ability in men than in women to perceive their own emotions and thoughts without feeling overwhelmed or compelled to react to them. On the other hand, Tasneem and Panwar (2019) found no gender difference.

A specific mindfulness characteristic, the Western conceptualization of decentering, involves the ability to observe one's thoughts and emotions with a detached awareness, recognizing them as transient mental events rather than intrinsic aspects of the self (Hayes-Skelton & Graham, 2013). This perspective emphasizes an objective, non-reactive stance towards one's internal experiences, allowing individuals to respond to situations more adaptively rather than being driven by automatic, habitual reactions. Decentering helps in reducing cognitive fusion, where thoughts are perceived as accurate reflections of reality, thus fostering greater emotion regulation and psychological flexibility (Hayes-Skelton & Graham, 2013).

Mindfulness has been associated with pro-environmental behaviors (Panno et al., 2018) and a general connectedness to nature (Van Gordon et al., 2018). High levels of mindfulness as a trait have been linked to a tendency to consume more sustainably (Dhandra, 2019; Fischer et al., 2017; Park & Dhandra, 2017), eat less meat (Hunecke & Richter, 2019; Werner et al., 2020), and participate more frequently in environmental activism initiatives (Wamsler & Brink, 2018). Some researchers have also found that individuals who engage in active mindfulness practices, such as meditation or other mind-body exercises, are more likely to adopt pro-environmental behaviors (Jacob et al., 2009; Loy et al., 2022; Loy & Reese, 2019; Panno et al., 2018). Indeed, mindfulness can improve pro-environmental behavior in various ways. For example, Barbaro and Pickett (2016) argued that mindfulness enhances interactions with the natural surroundings, potentially nurturing a deeper bond with the environment. Furthermore, mindfulness is correlated with higher levels of subjective general well-being and health-related conditions, which, in turn, influence how we perceive environmental problems and approach them. Dealing with anxiety, depression, stress, or physical pain can make it harder to focus on climate change because when basic needs are not fulfilled, people become more focused on personal concerns (Ericson et al., 2014). Additionally, increased awareness can reduce emotional and cognitive habits, thus promoting a more flexible, non-automatic, and objectively informed way of being (Ericson et al., 2014). Long-term changes in environmental behaviors can be significantly hindered by habitual behaviors, especially if unsustainable behaviors are driven by unaware emotional impulses (Klöckner & Verplanken, 2018). Therefore, several studies have found that mindfulness can improve sustainable behaviors by reducing automatic and impulsive behaviors, helping individuals observe their internal and external experiences and act with greater awareness. For example, an interesting study (Armstrong, 2012)

found that mindfulness learning leads to reported changes in areas related to affect regulation and the sense of self experiences in compulsive buyers, such that there is a decrease in emphasis on consumer goods sought for their emotional or symbolic properties. Furthermore, Amel et al. (2009) found a significant positive correlation between the mindfulness facet "acting with awareness" and scores on a green behavior scale in a small sample of 100 visitors to a sustainability expo. Moreover, in two recent studies (Hunecke & Richter, 2019; Richter & Hunecke, 2020), the mindfulness facet "observe" was identified as the strongest predictor of sustainable and organic food consumption. A weak positive correlation was also found between "acting with awareness" and sustainable food consumption (Hunecke & Richter, 2019). This aspect of mindfulness, its effect on reducing automatic and impulsive behaviors, helps us understand the close interconnection between mindfulness and emotion regulation.

While research has demonstrated the clinical efficacy of mindfulness-based interventions in a wide range of psychological conditions (Goldberg et al., 2018; Klainin-Yobas et al., 2012; Shapero et al., 2018), interventions based on increasing awareness to promote pro-environmental behaviors have yielded disappointing results (Böhme et al., 2018; Geiger, Fischer, et al., 2019; Stanszus et al., 2019). Further studies are needed to understand the mechanisms that may promote greater pro-environmental behaviors and a better understanding of any gender differences. Indeed, while some studies have demonstrated various gender-based strategies for regulating emotions (McRae et al., 2008) and attending to internal and external stimuli (Alispahic & Hasanbegovic-Anic, 2017), there are none that have investigated how distinct emotional factors based on gender might yield divergent outcomes in terms of sustainability behaviors. Although an association has been found between emotion regulation skills and pro-environmental behaviors, as well as between mindfulness and pro-environmental behaviors, we aimed to further explore the relationship between these two constructs in order to understand the complex dynamics that can lead to the implementation of greater pro-environmental behaviors.

Based on the current state of research, the aim of our study was to explore the complex interplay between emotion regulation, mindfulness, and pro-environmental behaviors, as well as to investigate potential gender differences in this relationship. Specifically, we wanted to verify the following hypotheses.

Building on previous studies (Zelezny et al., 2000), we hypothesized (1) that women would exhibit higher levels of pro-environmental behaviors compared to men. Additionally, based on the existing literature (Catak, 2012; Gross & John, 2003), we did not expect to find gender differences in levels of mindfulness and emotion dysregulation.

Drawing on previous theoretical premises, we wanted to investigate (2) whether the association between lower levels of emotion dysregulation (indicating adaptive emotion regulation abilities) and greater pro-environmental behaviors could be explained by mindfulness, separately for men and women. We hypothesized that the ability to regulate one's emotions would foster self-awareness and an awareness of the surrounding world, ultimately leading to pro-environmental action (Fig. 1).

Method

Participants

Thanks to the collaboration with several firms operating in the country, a sampling of employees aged 18 years and older was recruited. The companies that were asked to participate in our study were national and multinational companies, which represented different sectors, including energy, technology, and finance. The sample consisted of $n = 1406$ employees (56.30% males; average age = 44.85; $SD = 10.10$). An a priori power analysis was conducted using the G*Power 3.1.9.6 software, in order to determine the sample size necessary to test our hypotheses. In H1 we wanted to verify a difference between the means based on gender ($k = 2$). The n was therefore calculated based on ANOVA analyzes conducted. The number of groups considered was two (males and females). The degree of freedom in the numerator was 1. The chosen critical alpha value was 0.05, while the 1-beta value was 0.95, and the effect size f was 0.15. Based on this, a required sample size of 580 subjects was determined. Therefore, the sample we collected satisfies the size necessary to test the hypotheses formulated. By observing the demographic characteristics of the sample, we see

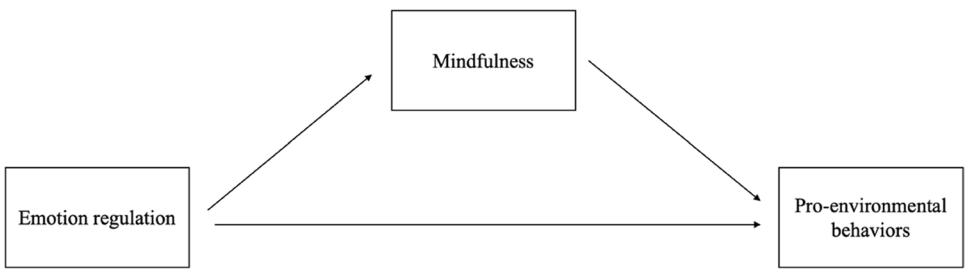


Fig. 1 Hypothesized model

that 48.90% of the sample lived in cities (with more than 100,000 inhabitants), 56.20% had a master's degree or post-graduate qualification, and 52.80% earned between 36000 and 70000 euros per year. Furthermore, 50% of the sample was married, and 15% was cohabitant. 55.80% had at least one child.

Procedure

After researchers explained the study objectives, all participants filled out an informed consent in which the purposes of the study were explained in detail. The participants completed an online survey containing the questionnaires described below.

Measures

Pro-environmental behaviors. Participants completed the Pro-Environmental Behaviors Scale (PEBS; Markle, 2013; Italian adaptation - Menardo et al., 2020), a self-report questionnaire designed to assess individuals' pro-environmental behaviors across four dimensions: conservation, environmental citizenship, food, and transportation. The Italian adaptation of the scale includes 15 items. For the purposes of this study, the total score was utilized, which demonstrates satisfactory internal consistency (McDonald's omega = 0.66; Cronbach's alpha = 0.65).

Emotion regulation. In order to assess emotion regulation, the Difficulties in Emotion Regulation Scale – Short Form (DERS-SF; Victor & Klonsky, 2016; Italian validation – Rossi et al., 2023) was administered. The DERS-SF is a shortened version of the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). Participants filled out 18 items rated on a 5-point Likert scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The scale measures levels of emotion dysregulation, providing a total score and scores for six dimensions: Non-Acceptance, Awareness, Clarity, Strategies, Goals, and Impulse. For this study, the DERS Total score (ranging from 18 to 90) was considered. The McDonald's omega for the DERS-18 Total Score in this study was 0.88, and the Cronbach's alpha was 0.90, indicating high internal consistency.

Mindfulness. Participants completed the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006 - Italian translation - Giovannini et al., 2014) to assess dispositional mindfulness. The FFMQ is a self-report questionnaire consisting of 39 items, rated on a 5-point Likert scale (ranging from 1 = *never true* to 5 = *always true*). The FFMQ measures an individual's tendency to be mindful in daily life across five distinct domains. The "Observe" subscale assesses the tendency to attend to internal and external stimuli, as well as related cognitions and emotions. The "Describe" subscale measures the ability to articulate one's own emotional experience. The "Act with Awareness" subscale evaluates the tendency to pay ongoing attention to present activities while being aware of personal motives. The "Non-Judge" subscale assesses the tendency to adopt a non-evaluative stance toward one's own thoughts and feelings. Finally, the "Non-React" subscale measures the ability to perceive one's own emotions and thoughts without feeling overwhelmed or compelled to react to them. Higher scores on each subscale indicate higher levels of dispositional mindfulness. The internal consistency coefficients for the individual subscales of the FFMQ in the current sample indicated adequate reliability (McDonald's omega ranged from 0.75 to 0.91; Cronbach's alpha ranged from 0.71 to 0.90).

Data Analyses

Descriptive analyses, including frequencies, means, and standard deviations, were conducted, and the normality of the variables was assessed. The reliability of the instruments used was also examined.

To investigate potential differences between women and men on the measured variables, a one-way ANOVA was performed. The dependent variables included the PEBS Total Score, the DERS-SF Total Score, and the scores on the FFMQ domains, while the independent variable was gender. A one-way ANOVA was used instead of a t-test because the sample size and the normality of the distribution of the variables allowed for its use (for further details, see Thompson, 2006).

In order to test the hypothesized model, a mediation analysis was conducted. First, Pearson's correlation analyses were performed to examine significant correlations between the measured variables. Subsequently, a mediation analysis was conducted to investigate whether mindfulness mediated the relationship between emotion dysregulation and pro-environmental behaviors. The indirect effect was assessed using bias-corrected 95% confidence intervals (CIs) based on 10,000 bootstrap samples. All statistical analyses were carried out using IBM SPSS software, version 27.0. Serial mediation analysis was conducted using Hayes's PROCESS macro (Model 6, the model used to analyze serial mediations) (Hayes, 2017).

Results

Assessing gender differences

To examine potential differences between women and men in levels of pro-environmental behaviors, emotion dysregulation, and mindfulness, an ANOVA was conducted. The independent variable was gender, while the dependent variables were the PEBS Total Score, the DERS-SF Total Score,

and the scores on FFMQ domains. As shown in Table 1, the results revealed that women exhibited greater pro-environmental behaviors and higher levels of the Observe and Describe FFMQ domains compared to men. However, no significant gender differences were found in terms of emotion dysregulation, Actaware, and Non-judge FFMQ domains ($p > 0.05$), while men scored higher on the Non-react FFMQ domain (Table 2).

The mediator role of mindfulness in the relationship between emotion regulation and pro-environmental behaviors

Pearson's correlation analyses were conducted to examine the significant correlations among the measured variables, gender, and age. Consistent with the ANOVA findings, the correlation analyses revealed significant associations between gender and the PEBS Total Score, as well as the Observe, Describe, and Non-react FFMQ domains. Females demonstrated greater pro-environmental behaviors, and a higher ability to observe and describe their own emotional experiences. However, males showed a lower tendency to feel overwhelmed or compelled to react to their emotions and thoughts compared to females. Additionally, higher age was correlated with lower levels of emotion dysregulation and higher scores on all FFMQ domains. Moreover, significant correlations emerged among the investigated constructs. Specifically, higher levels of pro-environmental behaviors were associated with lower levels of emotion dysregulation and higher scores on the Observe, Describe, and Non-react domains. Furthermore, emotion dysregulation exhibited negative correlations with all FFMQ domains.

Based on the significant correlations, mediation analyses were conducted to examine whether mindfulness mediated the relationship between emotion dysregulation and pro-environmental behaviors. Additionally, based on the significant correlations observed with the gender variable and in order to verify potential gender differences, two separate models were constructed for men and women. As depicted in Fig. 2, the results of the mediation analyses demonstrated significant direct and total negative effects of emotion dysregulation on pro-environmental behaviors for men.

Regarding indirect effects in the path concerning men, Table 3 indicates that the total indirect effect was not statistically significant. Specifically, the indirect path through the Non-React domain was found to be statistically significant. However, the mediations through the Describe and Observe domains were not significant.

Table 2 Pearson's correlation coefficient between measured variables

	1	2	3	4	5	6	7	8	9
1. Gender	—								
2. Age	0.13**	—							
3. PEBS Total Score	-0.14**	0.04	—						
4. DERS-SF Total Score	0.02	-0.12**	-0.10*	—					
5. FFMQ Observe	-0.12**	0.09*	0.31**	-0.11**	—				
6. FFMQ Describe	-0.12**	0.05*	0.13**	-0.47**	0.36**	—			
7. FFMQ Actaware	0.03	0.06*	0.03	-0.62**	0.02	0.33**	—		
8. FFMQ Non-Judge	0.07*	0.08*	0.04	-0.55**	-0.12**	0.25**	0.50**	—	
9. FFMQ Non-React	0.09**	0.10**	0.09**	-0.27**	0.31**	0.22**	0.09**	0.11**	—

Gender: 0 = females and 1 = males; PEBS = Pro-environment Behavior Scale; DERS-SF Total Score = Difficulties in Emotion Regulation Scale – Short Form Total Score; FFMQ = Five Facet Mindfulness Questionnaire. * $p < 0.05$; ** $p < 0.001$

Table 1 Means, standard deviations, *F, p,* and η^2 of women and men on measured variables

	Women	Men	$F(1,1404)$	p	η^2
PEBS Total Score	45.93 (8.49)	43.48 (8.96)	27.05**	< 0.001	0.02
DERS-SF Total Score	34.44 (10.30)	34.77 (9.52)	0.40	0.526	0.00
FFMQ Observe	27.02 (5.66)	25.65 (5.40)	21.17**	< 0.001	0.01
FFMQ Describe	28.63 (6.32)	27.18 (5.88)	19.47**	< 0.001	0.01
FFMQ Actaware	30.21 (5.74)	30.51 (5.66)	0.92	0.338	0.00
FFMQ Non judge	27.64 (5.95)	28.42 (5.65)	6.30*	0.012	0.00
FFMQ Non react	20.46 (4.03)	21.20 (3.73)	12.75**	< 0.001	0.01

PEBS = Pro-environment Behavior Scale; DERS-SF Total Score = Difficulties in Emotion Regulation Scale – Short Form Total Score; FFMQ = Five Facet Mindfulness Questionnaire. * $p < 0.05$; ** $p < 0.001$

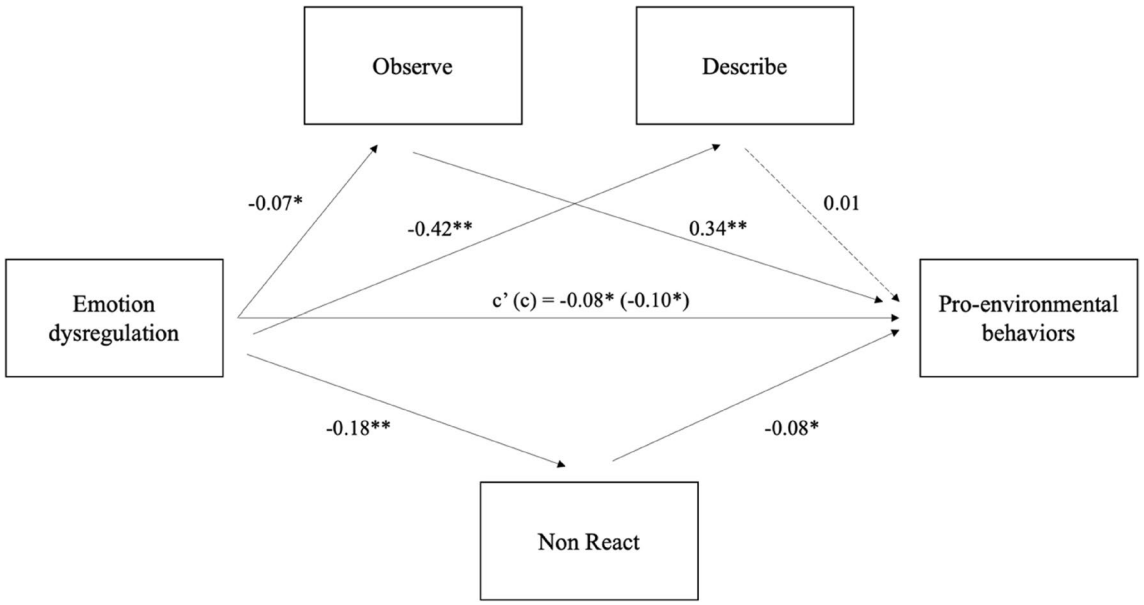


Fig. 2 Mediation of mindfulness on the relationship between emotion dysregulation and pro-environmental behaviors in men. Coefficients shown are standardized path coefficients. c' = direct effect; c = total effect. * $p < 0.05$; ** $p < 0.001$

Table 3 Indirect effect of emotion dysregulation on pro-environmental behaviors via mindfulness domains

Indirect Effect	Effect (BootSE)	LLCI	ULCI
Total	-0.01 (0.02)	-0.05	0.03
DERS-SF → FFMQ Observe → PEBS	-0.02 (0.01)	-0.05	0.00
DERS-SF- → FFMQ Describe → PEBS	-0.001 (0.02)	-0.04	0.03
DERS-SF → FFMQ Non-React → PEBS	**0.01 (0.01)**	**0.00**	**0.03**

BootSE = Boot-strapped standard error; LLCI = Lower level confidence interval; ULCI = Upper level confidence level confidence interval. DERS-SF = Difficulties in Emotion Regulation Scale – Short Form; FFMQ = Five Facet Mindfulness Questionnaire

All bold values are statistically significant (CI did not contain zero

As regards women, as depicted in Fig. 3, the results of the mediation analyses demonstrated significant direct and total negative effects of emotion dysregulation on pro-environmental behaviors.

Regarding indirect effects in the path concerning women, Table 4 indicates that the total indirect effect was not statistically significant. Specifically, the indirect path through the Observe and Non-React domains was found to be statistically significant. However, the mediations through the Describe domain were not significant.

Observing the two models (Figs. 2 and 3), it is interesting to note a significant difference between men and women. While high levels on the Non-React subscale were positively associated with greater pro-environmental behaviors in women, this association was negative in men.

Discussion

Recent studies have shown that adaptive emotion regulation is associated with high levels of pro-environmental behaviors (Li et al., 2022; Panno et al., 2015; Panno et al., 2020). However, the underlying mechanism of this relationship remains unclear, and mindfulness is considered a potential factor that could partially explain it. Thus, the present study aimed to investigate the mediating role of mindfulness in the relationship between emotion regulation and pro-environmental behaviors.

The first hypothesis of the study proposed that women would exhibit greater pro-environmental behaviors than men. The findings confirmed this hypothesis, as women reported higher levels of pro-environmental behaviors compared to men. This result aligns with existing literature indicating that women are more likely to engage in sustainable consumption behaviors (Zelezny et al., 2000). Women's higher participation in sustainable consumption can be attributed, in part, to their involvement in activities related to daily living, such as water and energy conservation at home and material reuse, which contribute to greater sustainability (Bulut et al., 2017; Hunter et al., 2004). Although women tend to purchase more food, clothing, and household items, men's overall consumption is less sustainable when considering factors such as women's purchases for themselves and

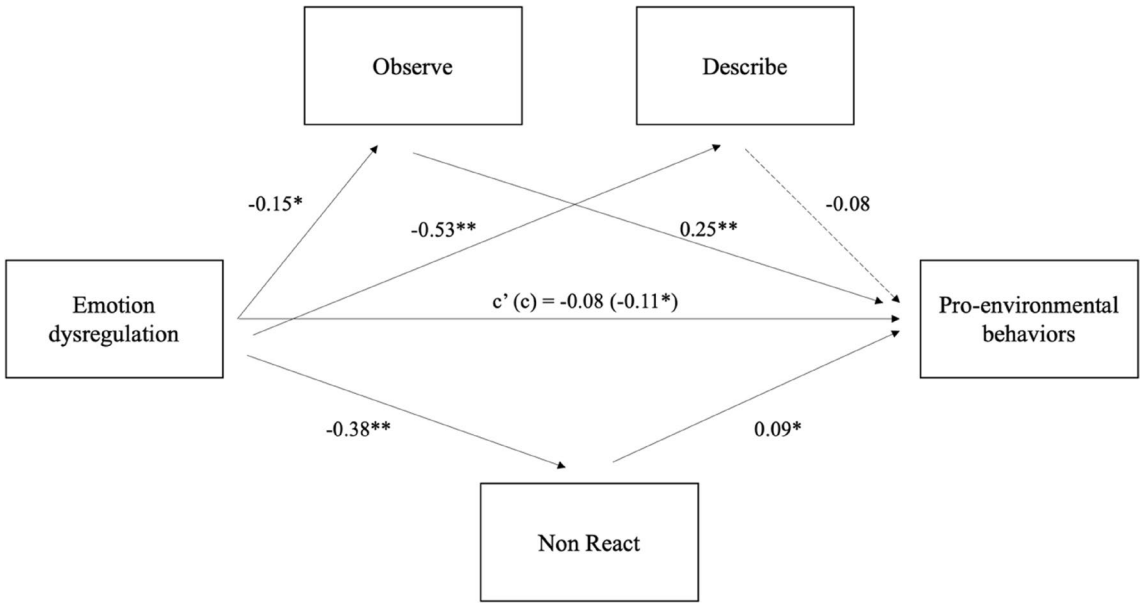


Fig. 3 Mediation of mindfulness on the relationship between emotion dysregulation and pro-environmental behaviors in women. Coefficients shown are standardized path coefficients. c' = direct effect; c = total effect. * $p < 0.05$; ** $p < 0.001$

Table 4 Indirect effect of emotion dysregulation on pro-environmental behaviors via mindfulness domains.

Indirect Effect	Effect (BootSE)	LLCI	ULCI
Total	-0.03 (0.03)	-0.09	0.03
DERS-SF → FFMQ Observe → PEBS	**-0.04 (0.01)**	**-0.06**	**-0.01**
DERS-SF- → FFMQ Describe → PEBS	0.04 (0.03)	-0.01	0.09
DERS-SF → FFMQ Non-React → PEBS	**-0.03 (0.02)**	**-0.07**	**-0.003**

BootSE = Boot-strapped standard error; LLCI = Lower level confidence interval; ULCI = Upper level confidence level confidence interval. DERS-SF = Difficulties in Emotion Regulation Scale – Short Form; FFMQ = Five Facet Mindfulness Questionnaire

All bold values are statistically significant (CI did not contain zero)

family members or transportation choices (e.g., cars, motorcycles) (Johnsson-Latham, 2007; Xiao & Hong, 2010).

Furthermore, the findings revealed that women demonstrated a higher tendency to attend to internal and external stimuli, as well as related cognitions and emotions, and had a greater ability to articulate their emotional experiences compared to men. Conversely, men reported a higher ability to experience emotions without reactive defense mechanisms compared to women. These results differed from our initial expectations. Most studies indicate that there are no gender differences in mindfulness (Catak, 2012; De Petrillo et al., 2009). However, it is possible that gender differences may be present in specific facets of mindfulness. Studies utilizing the FFMQ tool have reported similar results. For instance, Fuentes et al. (2022) found that men had a higher ability to experience emotions without reactive defense mechanisms, while Alispahic and Hasanbegovic-Anic (2017) and Giovannini et al. (2014) found that women demonstrated a higher tendency to attend to cognitions and emotions. These subtle yet noteworthy differences may be attributed to gender differences in emotional-behavioral and cognitive functioning between males and females. Females generally exhibit higher levels of self-regulation (Downing et al., 2008) and perform better on verbal tests than males (Weiss et al., 2003), while men tend to display less emotional responsiveness compared to women (LaFrance & Banaji, 1992), although results in this area are mixed (Labott et al., 1991). These gender differences could have a different effect on the different pro-environmental behaviors that men and women implement. Moreover, in line with our hypothesis and existing literature (Gross & John, 2003), no gender differences were found in levels of emotion dysregulation.

Based on the gender differences highlighted, we wanted to verify whether the different facets of mindfulness could mediate differently the relationship between emotion dysregulation and pro-environmental behaviors in men and women. Specifically, the second hypothesis of the study proposed that mindfulness would mediate the relationship between emotion dysregulation and pro-environmental behaviors. The correlations among the variables were examined, and the results were consistent with previous research linking emotion regulation (Panno et al., 2015; Panno et al., 2020) and mindfulness (Thiermann & Sheate, 2020a) to

pro-environmental behaviors. These findings suggest that the ability to regulate emotions and greater conscious awareness, facilitated by mindfulness, contribute to engaging in pro-environmental actions (Fig. 1).

Two serial mediation analysis models were tested, for men and women separately. The findings revealed a direct and total effect of emotion dysregulation on pro-environmental behaviors, in both models. However, in both models tested, the mediation analysis showed that the relationship between emotion dysregulation and pro-environmental behaviors was only partially mediated by mindfulness facets. Specifically, for men, the results showed that lower levels of emotion dysregulation were associated with a greater ability to perceive one's own emotions and thoughts without feeling overwhelmed or compelled to react to them. This ability not to react to them, however, was negatively associated with pro-environmental behaviors in men. As regards women, however, a different model was highlighted. Women with lower levels of emotion dysregulation demonstrated a greater ability to attend to internal and external stimuli, cognitions, and emotions and a greater ability to perceive their own emotions and thoughts without feeling overwhelmed or forced to react to them, which, in turn, facilitated pro-environmental actions. This finding is consistent with studies that identified the mindfulness facet of "Observe" as the strongest predictor of sustainable and organic food consumption (Hunecke & Richter, 2019; Richter & Hunecke, 2020). The relationship between the "Observe" facet of mindfulness and pro-environmental behaviors has also been observed in other studies (Barbaro & Pickett, 2016; Geiger, Grossman, & Schrader, 2019; Ray et al., 2021). Notably, some studies have suggested that the association between the "Observe" facet of mindfulness and pro-environmental behaviors is mediated by connectedness to nature (Barbaro & Pickett, 2016; Ray et al., 2021). In line with these findings, we propose that the "Observe" facet, which focuses on external stimuli in addition to internal cognitions and emotions (Baer et al., 2006), allows individuals to establish a stronger connection with the surrounding environment. Numerous studies have shown that such a connection is strongly associated with pro-environmental behaviors (Barbaro & Pickett, 2016; Liu et al., 2019; Mackay & Schmitt, 2019; Martin et al., 2020; Whitburn et al., 2020) and may influence behavior by highlighting sustainable choices as more salient and significant, while also increasing belief in climate change (Wang et al., 2019). Notably, this indirect mediating effect of the "Observe" facet was significant only for women. A very interesting observation is the difference highlighted in the indirect effect of the "Non-React" facet of mindfulness. In fact, while in women, a greater tendency not to feel overwhelmed by emotions and not react to them was associated with greater pro-environmental behavior, in men, this association was negative. Neupane (2020) found associations between these facets of dispositional mindfulness (Observe and Non-react) and recurring household energy behaviors, but it is the first time that different paths have been analyzed based on gender. These gender differences may be linked to the distinct emotional characteristics previously highlighted in men and women. However, they also offer intriguing perspectives for interventions aimed at fostering gender-specific pro-environmental behaviors. Our findings suggest that women, by paying greater attention to their emotions and thoughts, tend to align their actions more closely with environmental considerations, likely due to fostering a deeper emotional connection with the natural world. Conversely, men might benefit from leveraging their emotions more outwardly to actively protect the natural environment. Further studies should delve into these variations to craft more targeted and efficient interventions tailored to each gender.

Additionally, it is noteworthy that in both models, the relationship between emotion dysregulation and pro-environmental behaviors was not entirely mediated by the facets of mindfulness and self-observation ability. There was also a direct relationship, suggesting that regulating one's emotions, particularly by accepting and experiencing concern for the climate crisis (reflected by lower emotion dysregulation scores), was associated with pro-environmental behaviors. By regulating negative emotions, individuals exhibit greater acceptance of their emotions and the ability to transform them into active behaviors that contribute to the environment.

The present study has several notable strengths. Firstly, the sample comprised a large number of working adults, which enhances the generalizability of our findings to the broader population of employed individuals. This diverse sample provides a robust basis for examining the relationships between emotion regulation, mindfulness, and pro-environmental behaviors across different demographic groups. Secondly, the sample was geographically and socially stratified, ensuring that participants were drawn from various regions and social backgrounds. This stratification adds to the representativeness of the sample and allows for a more comprehensive analysis of how geographic and social factors might influence the studied variables.

Furthermore, this study is pioneering in its approach, as it is the first to investigate the complex relationship between emotion regulation and pro-environmental behaviors while examining various facets of mindfulness. By dissecting mindfulness into its specific components, we were able to provide a more detailed understanding of which aspects of mindfulness are most influential in promoting pro-environmental behaviors. This nuanced analysis offers valuable insights that can inform the development of targeted interventions. Importantly, our study also considered gender differences by examining these relationships separately for men

and women. This gender-specific analysis is crucial, as it highlights how men and women might differ in their emotion regulation strategies and mindfulness practices, as well as how these differences impact their pro-environmental behaviors. Understanding these gender differences can help tailor interventions to be more effective for each group, thereby enhancing the overall impact of such programs.

In summary, the strengths of this study lie in its large and diverse sample, its pioneering approach to investigating the intricate relationships between emotion regulation, mindfulness, and pro-environmental behaviors, and its consideration of gender-specific differences. These strengths collectively contribute to the robustness and applicability of our findings, offering valuable directions for future research and intervention development.

Limitations and Future Directions

Despite its strength, this study has certain limitations. First, self-report instruments were used to measure emotion regulation, mindfulness, and pro-environmental behaviors. Although these instruments are widely validated and have demonstrated reliability within our sample, the potential for social desirability bias in reporting pro-environmental behaviors (Lange & Dewitte, 2019) should be acknowledged. Participants may have overreported their environmentally friendly behaviors to align with perceived social norms.

Second, the study employed a cross-sectional design, which limits the ability to establish causal relationships among the variables. Cross-sectional data provide a snapshot at a single point in time, thus making it difficult to infer the directionality of the observed relationships. Future research should employ longitudinal designs to explore the causal dynamics between emotion regulation, mindfulness, and pro-environmental behaviors over time. Longitudinal studies would help in understanding how changes in emotion regulation and mindfulness can predict subsequent changes in pro-environmental behaviors.

Despite these limitations, our findings have important implications for both research and practice. While interventions based on mindfulness programs aimed at promoting pro-environmental behaviors have shown disappointing short-term results (Böhme et al., 2018; Geiger, Fischer, et al., 2019; Stanszus et al., 2019), our findings provide insights into the specific facets of mindfulness that are most strongly associated with pro-environmental behaviors. This nuanced understanding can inform the design of more targeted mindfulness interventions.

Additionally, no specific interventions to date have considered individuals' emotion regulation in relation to sustainable behaviors. The results of this study suggest that interventions focusing on emotion regulation, particularly the capacity for self-observation, may lead to sustained behavioral changes in favor of environmental sustainability. Emotion regulation skills can help individuals manage their responses to environmental issues more effectively, potentially leading to more consistent pro-environmental actions.

Further research, including longitudinal studies, should validate and expand upon these findings. Future studies should aim to develop and test specific evidence-based interventions that incorporate both mindfulness and emotion regulation strategies, while also considering the peculiarities of gender. By doing so, we can better understand how to foster long-term pro-environmental behaviors across diverse populations.

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Use of Artificial Intelligence AI was not used.

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Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethic Approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of the Department of Dynamic and Clinical Psychology, and Health Studies, University of Rome "La Sapienza" (Prot. no. 0000595, 11/04/2022).

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors report there are no competing interests to declare.

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