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Beyond Individual Stress Reduction—The Mindful Students Program Benefits University Students and Their Environment

Elisabeth S. Blanke[1,2] · Susanne Krämer[2] · Laura S. Loy[3] · Christian Liebmann[2] · Steffen Nestler[4] ·
Ute Kunzmann[1]

Abstract

Objectives While mindfulness-based interventions (MBIs) for university students usually aim at individual stress prevention and reduction, they can also yield benefits in social and environmental domains that extend beyond the individual. We introduce an MBI, the Mindful Students Program (MSP), which aims to develop an ethical perspective of interdependence between the individual and their social and ecological environment. We hypothesized that the MSP fosters not only mindfulness and individual stress reduction but also, in the context of ethical considerations, promotes prosociality and pro-environmental behavior as primary outcomes.

Method The MSP was delivered to university students as an elective course within their curriculum. Across three semesters, university students ($n = 203$) were surveyed in a pre-post design in comparison to two control groups ($n = 302$); one consisting of participants waiting for an online mindfulness-based intervention and a passive control group consisting of participants without any specific interest in mindfulness. Acceptance and adverse effects were also monitored.

Results In comparison to the control groups, students receiving the MSP experienced decreases in stress, and increases in mindfulness and pro-environmental behavior. Their levels of prosocial behavior, which were already high at the beginning of the intervention, did not change. Students were highly satisfied with the MSP; adverse events related to meditation were comparatively rare and mostly mild.

Conclusions The MSP appears to be an effective and safe means of helping individuals to improve their well-being within the university context, while fostering pro-environmental action which may have ripple effects on society.

Preregistration A preregistration and supplementary material is stored on the OSF: https://osf.io/59gtc/.

Keywords Mindfulness-based intervention · Stress reduction · Prosociality · Pro-environmental behavior · University students · Adverse effects

The potential of mindfulness, when implemented in secular contexts, is becoming widely acknowledged in educational systems (Schonert-Reichl & Roeser, 2016). As Jon Kabat-Zinn once put it, "[i]t is only when the mind is open and receptive that learning and seeing and change can occur" (Kabat-Zinn, 2005, p. 31). Contemporary psychological definitions of mindfulness usually include at least two components of mindfulness: attention to and awareness of the present moment and an open, nonjudgmental, and accepting stance (Bishop et al., 2004). More comprehensive definitions make further fine-grained distinctions, for example, between awareness of inner processes (such as emotions) and outer phenomena (such as sounds; Bergomi et al., 2014).

Mindfulness-based interventions (MBIs) aim at cultivating a mindful state (e.g., Goldberg et al., 2022b). Upon recurrent experience, this state mindfulness manifests into trait mindfulness, a tendency to be mindful on many occasions in daily life (Kiken et al., 2015). Secular MBIs

✉ Elisabeth S. Blanke
elisabeth.blanke@uni-leipzig.de

1   Department of Lifespan Developmental Psychology,
    Wilhelm Wundt Institute for Psychology, Leipzig University,
    Leipzig, Germany

2   Present Address: Zentrum für Lehrer:innenbildung und
    Schulforschung, Leipzig University, Leipzig, Germany

3   Faculty of Psychology, RPTU University
    of Kaiserslautern-Landau, Kaiserslautern-Landau, Germany

4   Institute for Psychology, University of Münster, Münster,
    Germany

usually have specific target outcomes, mostly pertaining to stress reduction, as is the case for the Mindfulness-Based Stress Reduction program (MBSR; Kabat-Zinn, 2005), or the improvement of mental health more generally (Gu et al., 2015). In addition, MBIs are often tailored to specific contexts. Across 44 meta-analyses, different forms of MBIs have proven to be effective for a variety of populations (e.g., students or patients) with their given problems, indications, interventions, comparisons, and outcomes (Goldberg et al., 2022a, b).

While stress reduction and the improvement of mental health are very important outcomes, practitioners and researchers are increasingly interested in whether MBIs can also address concerns that are "bigger than oneself." This means enabling individuals "to compassionately reconnect [not only] to self, [but also to] others and the natural world" (Crane et al., 2023, p. 2). Through such reconnection, mindfulness may contribute to sustainable development (Ericson et al., 2014; Geiger et al., 2020; see also Bristow et al., 2022). Sustainable development aims to meet human needs without exceeding the Earth's resources (Kates et al., 2001) and "without compromising the ability of future generations to meet their own needs" (World Commission on Environment & Development, 1987, p. 24). To ultimately achieve this goal, it is essential to act within the boundaries of ethical considerations, ensuring that people and the planet are not further exploited (United Nations, 2015).

The ethical Buddhist foundations of MBIs suggest that mindfulness can be a source of sustainable development, as mindfulness practice is placed within the framework of ethical considerations about how to lead life, with ethics very broadly representing values of moral appropriateness of thoughts and actions (Grossman, 2015). Thereby, "actions and thoughts meant to cause harm are considered unwholesome, whereas conduct and mental activity meant to be benevolent or helpful are, on the other hand, considered wholesome" (Grossman, 2015, p. 18). Such a mindset involves a non-harming orientation towards life and an understanding of the interdependence of all beings, meaning that phenomena arise in conjunction with each other (e.g., Stanley, 2012).

In secular programs, however, an ethical stance may mainly be conveyed through the teacher's attitude, also referred to as the implicit curriculum, describing *how* an MBI is taught, as compared to the explicit curriculum, which refers to *what* is taught in an MBI (e.g., Crane et al., 2023). The removal of most explicit references to ethics from MBIs may have contributed to the dissemination of mindfulness and its application in various contexts (Riordan et al., 2022; for a critical discussion, see, e.g., Walsh, 2016). However, as Ericson et al. (2014) stated, "[i]f mindfulness is used [...] devoid of ecological and social awareness, it might not

contribute to the achievement of a more sustainable future" (p. 77).

Therefore, the effect of secular MBIs on ethical behaviors and, more broadly, on sustainable development, may depend on the type of MBIs applied. Two ethical behaviors that are regularly studied in relation to MBIs are prosocial and pro-environmental behaviors. Prosocial behaviors are "voluntary actions undertaken to benefit others, such as sharing, donating, caring, comforting, and helping" (Caprara et al., 2012, p. 1289), with prosociality defined as the tendency to often perform such prosocial behaviors (Caprara et al., 2012). Pro-environmental behavior is defined as a class of behaviors that protect or avoid harm to the environment (Kaiser & Wilson, 2004). While prosocial behavior may be strongly guided by a social-altruistic moral value orientation (Turaga et al., 2010), pro-environmental behavior can be conceived as a special type of prosocial behavior that benefits humanity by preserving its ecosystem (Klein et al., 2022). However, pro-environmental behavior may also be guided by a value orientation towards non-human species ("biospheric"; Turaga et al., 2010). We understand both types of behavior as related to the social and ecological aspects of sustainable development (with the third aspect relating to economic aspects; Purvis et al., 2019), which may be fostered by mindfulness practice (e.g., Jacob et al., 2009).

Practicing mindfulness may lead to more prosocial and pro-environmental behavior through various pathways which significantly overlap. Being more mindful may foster prosociality by increasing attention and interoceptive awareness, changing affect and emotion regulation, and by promoting a perception of the self as interdependent with others (Donald et al., 2019). Mindfulness thus may lead individuals to be more attentive to the needs of others, while being able to regulate their own affective distress when confronted with suffering. It may therefore have the effect of enabling practitioners to react more compassionately and act more prosocially towards fellow beings. While some researchers have proposed and provided empirical evidence suggesting that practicing mindfulness can also lead to attenuated prosociality (Schindler & Friese, 2022; Schindler et al., 2019), multiple meta-analyses suggest that in most cases mindfulness as a trait is related to higher prosociality, which can be further increased by MBIs (Berry et al., 2020; Donald et al., 2019; Luberto et al., 2018).

Caring for other people may also entail caring for an environment in which human and non-human beings can prosper; therefore, prosocial behavior has been proposed as a pathway linking mindfulness to pro-environmental behavior (e.g., Thiermann & Sheate, 2021). Other, potentially reinforcing pathways from mindfulness to pro-environmental behavior include an increased awareness for environmental issues, the disruption of routines, increased well-being, connectedness to nature, and a commitment to social values

(Geiger et al., 2019; Jansen et al., 2024; Thiermann & Sheate, 2021). Indeed, individuals practicing mindfulness meditation or other mind–body practices show more pro-environmental behavior than non-practitioners (e.g., Loy et al., 2022). Correlational evidence also suggests associations between state and trait mindfulness and pro-environmental behavior (for a review, see Geiger et al., 2019; see also Richter & Hunecke, 2022).

However, studies investigating the causal effect of MBIs on pro-environmental behavior have produced mixed results. In a study using a sustainability-adapted 8-week MBI, employees and university students, on average, did not change their sustainable food or clothing consumption behavior (Geiger et al., 2020; Stanszus et al., 2019). Furthermore, qualitative interviews with a subsample of participants showed that some even reported opposing tendencies, as they found it easier to justify unstainable choices for themselves (Frank et al., 2021). In contrast, when the same program was offered for students at school, there was a small effect on sustainable food consumption in these students (Böhme et al., 2018). In a study without a non-meditating control group, a 4-week online mindfulness meditation program led to increases in pro-environmental behavior in a pre-to-post comparison (Ray et al., 2021). Nevertheless, non-meditating control groups are important. For example, the effect of the 10-week EU Climate Leadership Program on pro-environmental behavior did not hold up when compared with its effect on a control group (Ramstetter et al., 2023), as there were slight increases in pro-environmental behavior in the control group as well as in the intervention group. Moreover, in a randomized controlled trial, Riordan et al. (2022) found an increase of pro-environmental behavior as compared to a passive control group, but only when considering both the effects of the MBSR training and the active control group together. Overall, these results imply that the effects of mindfulness training on pro-environmental behavior, if any, may be small. Studies to detect such effects thus need to have adequate statistical power, which has often not been the case. Moreover, interventions probably need to be of an appropriate length and intensity to elicit behavior change, and participants need to be informed about the focus of the MBI to ensure compliance (Geiger et al., 2020; Stanszus et al., 2019).

Whether or not MBIs lead to ethical behavior could also depend on the inclusion of ethics as part of an intervention's explicit curriculum. One ethics-based practice in many MBIs, including MBSR programs (e.g., Santorelli et al., 2017), is loving-kindness meditation, which focuses on fostering compassion towards the self and other people (Berry et al., 2020). However, in their meta-analysis, Berry et al. (2020) showed that MBIs without such ethics-based practices on average also lead to an increase in prosociality. In contrast, with regard to pro-environmental behavior,

Riordan et al. (2022) concluded that ethical considerations likely need to be an explicit part of an intervention's curriculum. They argue that, in secular MBIs, considerations of "interdependence of all beings as a primary motivation for cultivating healthier habits" may have gotten "lost in translation" (Riordan et al., 2022; p. 8).

Building on this research, the second author, Susanne Krämer, designed the "Mindful Students Program" (MSP) to foster compassionate reconnection to self, others, and the natural world, thereby promoting ethical behavior as the basis for sustainable development in young people. While most MBIs focus on either of these outcomes, the MSP aims at increasing mindfulness and well-being (in terms of stress reduction) for the self, prosocial behaviors for others, and pro-environmental behavior for the environment. These topics are featured both in the implicit and in the explicit curriculum. The MSP was originally developed for student teachers and teachers in schools (named Mindful Teachers Program (MTP)) and included reflections on mindfulness in school-related work contexts. Subsequently, the program was adapted to students of all subjects. As the adaptations are so similar in content, we consider them to be one intervention that we will henceforth refer to as the MSP.

The MSP features basic mindfulness practices as described in the MBSR curriculum (e.g., Santorelli et al., 2017), compassion and value-based practices from the Mindfulness-Based Compassionate Living (MBCL) program (Stocker et al., 2020), and practices aimed at increasing ethical behavior towards the environment (inspired, e.g., by Fritzsche et al., 2018; Macy & Brown, 2014). Some of the practices and adjustments made to the practices are described in Krämer (2019). As an overarching framework, the United Nations' Sustainable Development Goals (SDGs; United Nations, 2015) are introduced. In the program, students familiarize themselves with the idea that caring for the self (e.g., stress reduction), caring for others (e.g., prosociality), and caring for the environment (e.g., pro-environmental action) can be deduced from the SDGs and are part of the program curriculum. Mindful dialogues, as proposed by Kramer (2007), are part of almost all sessions in order to foster connection with other people. Whenever possible, mindfulness is practiced outdoors with the goal of fostering awareness of and connection with nature. In Table 1, an overview of the program and some of its central practices is given. The intervention manual is currently available in German but will be made accessible in English in the future. Overall, the topic of practicing mindfulness in daily life to care for the self, others, and the environment is interwoven in many practices. These practices do not necessarily have one target (e.g., either reducing stress or caring for the environment), but multiple, mutually reinforcing targets. Figure 1 illustrates this interconnectedness of the three core areas (self, other, environment) and possible outcomes.

Table 1 Overview of the Mindful Students Program (MSP)

Phase	#	Session Name	Goals	Examples of Content	Mindfulness Practice
Foundations of Mindfulness	1	**Introduction to mindfulness**	• Learning about mindfulness and sustainable development	• Learning about definitions and getting an overview of associations between mindfulness and sustainable development	• Breathing space (3–5 min)
	2	**Embodiment and emotion regulation systems**	• Leaning about and experiencing embodiment and emotion regulation systems	• Participants learn about embodiment and the emotion regulation systems. They discuss a possible disbalance between "soothing" and the "drive" and threat system (Gilbert, 2020)	• Body scan (20 min) • Mindful dialogue (MD) about the "drive system" ([reference blinded for review])
	3	**Perception**	• Practicing taking an attentive and nonjudgmental stance towards other people	• Participants sit in dyads and describe their perception of their interaction partner while separating perception from judgment and emotional response (Krämer, 2019)	• Sitting meditation, focus on breath and body (10 min) • MD about meditation practice
	4	**Stress**	• Reflecting on stress and burnout	• Participants reflect on stressors and stress reactions in their lives as well as coping mechanisms	• Mindful movement: Qi Gong or Yoga (15–20 min) • MD about own stressors and coping
	5	**Stress-intensifying/cognitive restructuring**	• Reflecting on and changing own stress-intensifying patterns of thought	• Participants playfully learn about the cognitive strategy of "catastrophizing" by telling a "black story" (a story that gets worse and worse) (Krämer, 2019)	• Sitting meditation, focus on breathing, body, and thoughts (20 min) • MD about changing habits
	6	**Regulating difficult emotions**	• Mindful emotion regulation	• Participants discuss the importance of the basic emotions (Krämer, 2019)	• Walking meditation (10 min) • Meditation on regulating difficult emotions (10 min) • MD about regulatory systems/basic tendencies
	7	**Strengthening helpful/positive emotions**	• Learning about self-compassion and embracing positive qualities	• Participants complete a mindful writing task by writing a compassionate letter to themselves (Krämer, 2019)	• (Self-)compassion meditation (15 min) • Mindful eating • MD: Reflecting on gratitude and happiness

Table 1 (continued)

Phase	#	Session Name	Goals	Examples of Content	Mindfulness Practice
Ethical orientation	8	**Inner parts/purpose**	• Learning about values and inner motivations	• Participants reflect on their own values (Stocker et al., 2020)	• Meditation: Nurturing positive experiences (10 min) • MD: What constitutes a successful life?
	9	**Interdependence**	• Learning about systemic thinking and interdependence	• Participants team up in groups and reflect on how to take mindful, compassionate action in daily life (Krämer, 2019)	• Meditation on interdependence (10 min) • MD on ecological footprint
Retreat	**Retreat**		• Fostering nature connectedness, global identity and challenging climate anxiety	• In a group exercise including mindful dialogue, participants confront their feelings towards climate change and reflect on their own actions (adapted from Macy & Brown, 2014)	• Various formal practices (outside if possible)
	10	**Living in a common world**	• Fostering hope and self-efficacy	• Participants view best-practice examples and discuss how to take action in daily life that is in accordance with their values	• Compassion meditation for all beings (10 min) • MD: Stories of hope/ecological handprint
Embodied Mindfulness/ Integration into Daily Life	11	**Being competent in relationships**	• Leaning about empathy and compassion	• Participants learn about ways to deal with difficult people (Krämer, 2019)	• Body scan with gratitude (15 min) • Meditation on forgiving (15 min)
	12	**Visions of social and working culture**	• Contemplating a mindful (work-ing) environment	• Participants reflect on how to be mindful in daily life and work	• Meditation: Open awareness (10 min) • MD or group writing exercise on social roles/working culture • Focus on informal practice
	13	**Final sessions**	• Empowerment	• Participants honor their mindfulness journey together by providing positive feedback to each other (Krämer, 2019)	• Meditations: Body scan, mindful movement, sitting meditation

MD mindful dialogue. Reflection and observation tasks are given as supplementary homework and documented in the learning diary

Fig. 1 Assumed mutually reinforcing outcomes of the Mindful Student Program (MSP). Note: In the MSP, mindfulness is understood as the basis for positive, mutually reinforcing outcomes pertaining to the three domains: self, other people, and the environment. Bold print indicates the primary outcomes which are the subject of this investigation (see preregistration)
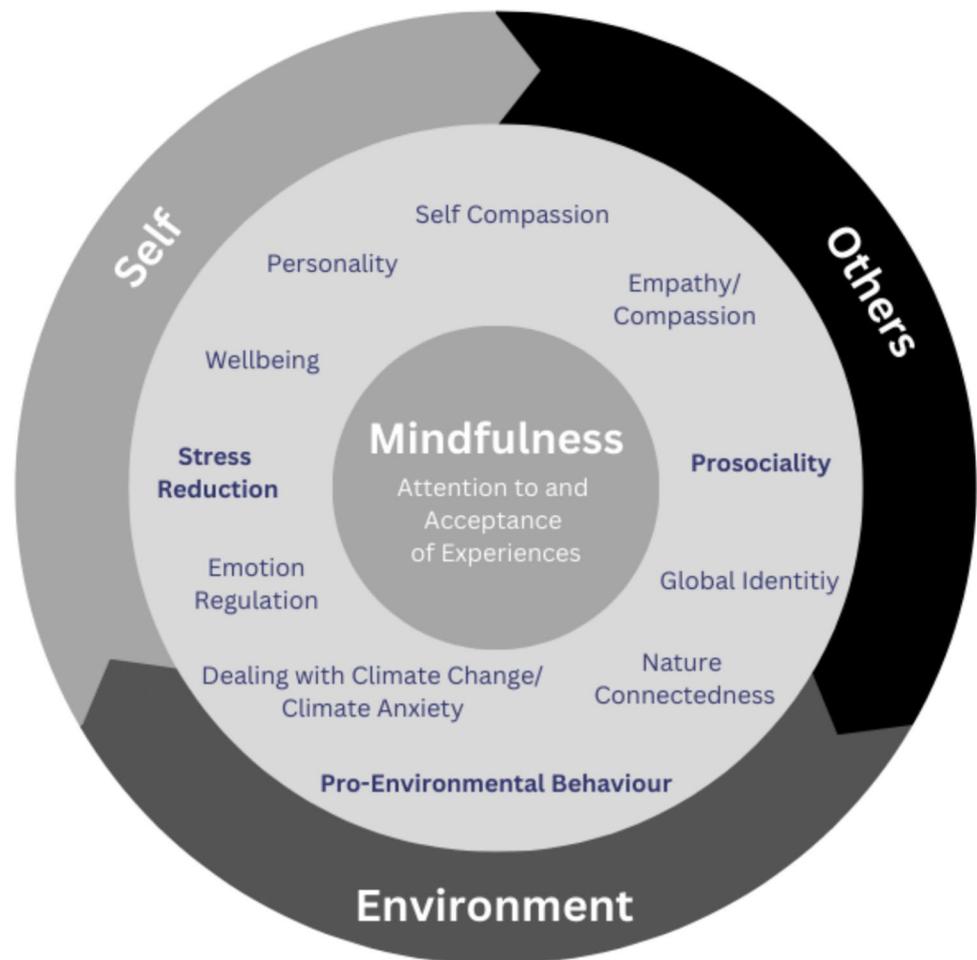
The program can be divided into three phases. In the first phase, mindfulness practices are introduced, accompanied by psychoeducation on topics such as stress and emotion regulation. The participants are encouraged to notice their own patterns of thoughts, feelings, and behaviors. Exercises designed to activate personal resources such as positive emotions, gratitude, and self-compassion are expected to further strengthen resilience.

In the second phase, building on these mindfulness-based skills, participants are invited to contemplate and challenge their own ethical values. They are prompted to question adopted narratives of lifestyles and to experiment with value-oriented, actionable behavior change. By combining practices like compassion meditation with a systemic view, participants are encouraged to experience their interdependence with other people and with nature. Rather than avoiding engagement with global crises and the associated emotions, such as climate anxiety (for an overview on climate emotions, see, e.g., Marczak et al., 2023), participants are encouraged to deal with the problems at hand and regulate their emotions using approaches learned in the first phase. Thereby, individuals are thought to eventually be able to align their actions with their values, potentially enhancing self-efficacy and hope for the future.

In the third phase, the integration of mindfulness-based practices into everyday life is prepared. Students reflect on how to embody mindfulness in daily life—as teachers in a classroom, as doctors in a hospital, or in other roles and contexts. In group discussions, they reflect on how to continue mindfulness-based practices, how to take responsibility for shaping their lives according to their values, and how to contribute to society.

Throughout the program, mindfulness thereby provides a basis for the promotion of other outcomes. To give an example, in Session 8 (Table 1), participants meditate on nourishing inner qualities, reflect on their values (see Stocker et al., 2020; p. 168), and then lead a mindful dialogue with a fellow student about what they feel constitutes a successful life. They are then informed about different ways in which psychologists and philosophers have thought about this question, again touching base with the core aspects of caring for the self, others, and the environment.

In the present study, we evaluated this novel mindfulness-based program, the MSP. We expected changes in the

intervention group at the end of the program (T2), which was the primary endpoint of the study, compared to two different control groups, in the following outcomes: (1) mindfulness, (2) stress reduction, (3) prosociality, and (4) pro-environmental behavior. These primary outcomes, the primary endpoint (T2), and the main analyses were pre-registered. As a secondary outcome, we evaluated acceptance of the program, and, as exploratory outcomes, other program characteristics: attendance, home practice, and adverse effects (see, e.g., Britton et al., 2021). Further pre-registered secondary outcomes (Fig. 1) and the results at a secondary endpoint (at the end of the semester) will be analyzed in additional papers.

Method

Participants and Procedure

The MSP was offered as an elective subject within the curriculum in the summer term (April-September) 2022 (Wave 1), the winter term (October–March) 2022/2023 (Wave 2), and in the summer term (April-September) 2023 (Wave 3). All surveys were generated using SoSci Survey (Leiner, 2024) and administered via www.soscisurvey.de. The study was approved by the ethics committee of Leipzig University, and the participants consented to take part. As reported in the pre-registration, based on the results of a power analysis with G*power (Erdfelder et al., 2009) and our resources, we aimed to assess $n = 300$ individuals at T1 in each group, with

an expected drop-out of around 20–30% at T2. However, we did not meet this goal. Figure 2 provides a flowchart of the students who took part in the study and the reasons for data exclusion. The preregistration and the supplementary materials are available via the OSF (https://osf.io/59gtc/).

Intervention Group: MSP

The MSP spans 13 sessions, each lasting 90 min, with one additional half-day retreat. Between sessions, home assignments include self-reflection, observation tasks, and short meditation practices (5–20 min, with audio files). The participants are encouraged to practice five times a week. To allow interpersonal practice between the sessions as part of the home assignments, participants pair up with a "buddy" in the program to practice mindful dialogs in dyads. The individual and interpersonal practice, reflection, and observation tasks are recorded by the participants in a learning diary, which encourages integration into daily life.

In Wave 1, we offered six courses for student teachers, who were the original target group of the program and the study. In Wave 2 and Wave 3, due to rising interest, we offered five courses for student teachers, two courses for students of all subjects, and one for medical students, as part of an elective preclinical course offering. Based on their interest, the students selected the MSP from a variety of courses offered on various topics. Depending on the classroom size, the course sizes ranged from 15 to 22 students. The courses were led by one of six teachers (including the first author, the second author, and the fourth author), all MBSR teachers
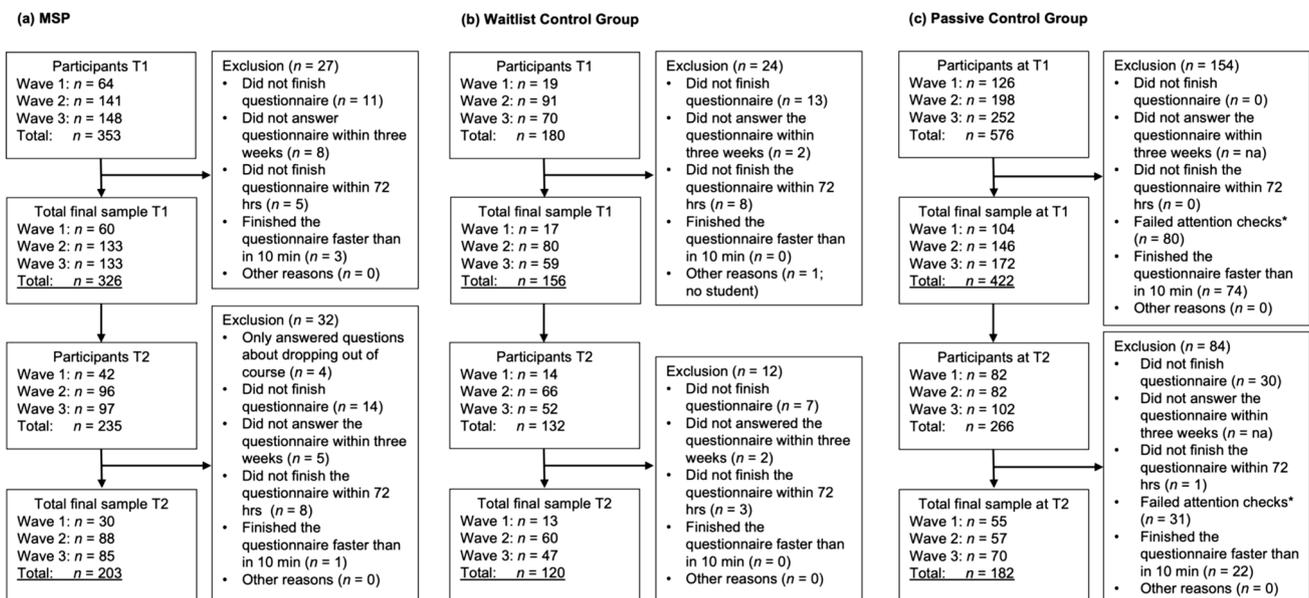

Fig. 2 Participant flow. Note: MSP, Mindful Students Program; na, not applicable (in the passive control group, the surveys were closed within three weeks). *Attention checks were only administered in the passive control group, starting at T2 of Wave 1

who had received additional MSP training. All trainers had previous expertise in teaching at universities; three of them were psychologists; two of them had clinical training. The students passed the course and received a credit for it if they handed in a learning diary detailing their participation and their understanding of the topic. Due to study regulations, the medical students were graded.

All students who signed up for the MSP were invited to take part in the study. Study participation was optional and not compensated. The MSP participants were also asked to nominate a person close to them to give observer ratings, which, however, are not part of this paper. Of the overall 361 students who were admitted to the MSP across the three waves, the majority of them ($n = 326$) registered for the study and started answering the questionnaire at T1 (Fig. 2). T1 was assessed during the first three weeks of the semester, as admissions close shortly before the start of the semester, and students still tend to change courses within this time frame. The assessment phase for T2 started directly after the last session. In Waves 2 and 3, we assessed the T2 questionnaire during the last session (absent students answered the questionnaire at home).

Waitlist Control Group

For the waitlist control group, we aimed to recruit students with a similar interest in mindfulness as in the MSP group. The students were offered to participate in an online MBI developed as a self-learning MSP for student teachers. They were recruited through various channels, including emails to different departments taking part in teacher training. Only participants who answered the surveys (parallel to the intervention group) before taking part in the online course were considered to be part of the waitlist control group (Fig. 2). Across the three waves, 54 additional students registered for the waitlist control group, but did not take part in T1; four provided wrong email-addresses; one disabled their address after receiving a study invitation. In Wave 1, due to organizational difficulties, the T1 assessment phase in both control groups was slightly later than in the intervention group (assessments were two and a half weeks later). The majority of the participants in the waitlist control group went to a university in the same federal state as the MSP group (72%).

Passive Control Group

To compare the intervention group and the waitlist group to individuals without any specific interest in mindfulness, a passive control group was recruited by the polling institute Bilendi GmbH from students who had signed up for their panels in Germany. In the first wave, we commissioned the institute to recruit student teachers; in the other waves, to match the intervention sample, we also commissioned them to recruit medical students and students of various disciplines. In contrast to the other groups, participants in this passive control group took part only in two assessments, parallel to T1 and T2. They received around one to three Euros for their participation in each survey (compensation depending on various parameters such as length of the survey). Because the intrinsic motivation to take part in the study was possibly lower in this group compared to in the two other groups, two attention checks were added to the surveys of this group (for all assessments starting T2 in Wave 1). The participants failing the attention check were excluded from the analyses. Those who had already taken part in both assessments in one of the waves were excluded from participating again in the following waves.

Data Exclusions, Drop-out, and Final Sample

Across all groups, the participants who did not complete the questionnaires were not invited back. We also excluded participants who answered the survey too fast (< 10 min), participants who answered the questionnaire later than 3 weeks after being invited, and participants who interrupted the process of answering the questionnaire for longer than 72 h. After these exclusions, the final sample who participated in T1 and T2 consisted of 203 participants in the MSP group, 120 participants in the waitlist control group, and 182 participants in the passive control group. The overall study drop-out and exclusion rates (in the case of the passive control group) were quite high, but the reasons for dropping out of the study remained largely unknown. The drop-out from T1 (after data exclusions) to T2 was 38% in the MSP, 23% in the waitlist, and 57% in the passive control group. In the intervention group, the drop-out from the study was not equivalent to drop-out from the MSP. While the exact number of students who finished the MSP is unknown (as attendance in all courses was not compulsory, except for medical students), 344 students passed the course as they handed in a portfolio, which can be seen as an approximation of participation.

We compared the study drop-outs to the completers, separately for all three groups, in terms of wave of participation, gender, age, number of semesters studied, study subject (only MSP and passive control group), prior meditation experience, and the four primary outcomes at T1 (see Methods). No statistically significant differences between drop-outs and completers emerged within the groups for any of the variables ($p > 0.05$), except for one difference in the MSP group, where fewer medical students dropped out of the study ($\chi_{(2)}^2 = 13.80, p = 0.01$). This could be due to study regulations being more strict for medical students than most other participants.

Table 2 Characteristics of the final sample ($n = 505$)

Characteristic		Group		
		MSP ($n = 203$)	Waitlist ($n = 120$)	Passive ($n = 182$)
Gender	Female	76%	88%	74%
	Male	22%	10%	25%
	Diverse	2%	2%	1%
Age (in years)		$M = 23.05$ $SD = 3.89$, Range: 18–52	$M = 24.63$, $SD = 5.17$, Range: 19–50	$M = 24.62$, $SD = 4.37$, Range: 18–47
Semesters studied		M = 6.17, SD = 3.24, Range: 1–20	M = 6.82, SD = 3.59, Range: 1–19	M = 6.49, SD = 4.19, Range: 1–25
Study subject	Teaching	60%	100%	55%
	Various disciplines	27%	0%	37%
	Medicine	13%	0%	8%
Meditation: Number of times practiced at T1	0	12%	10%	26%
	1–5	34%	31%	35%
	6–10	11%	16%	12%
	11–20	11%	18%	8%
	21–50	11%	10%	10%
	51–100	9%	5%	4%
	101–200	3%	6%	3%
	201–400	5%	3%	1%
	>400	4%	2%	1%

M mean, *SD* standard deviation. Deviations from 100% due to rounding

In Table 2, the characteristics of the final sample are reported. The groups differed with regard to gender ($\chi_{(4)}^2 = 10.98$, $p = 0.03$), with a higher percentage of females in the waitlist group than in the other groups. Kruskal–Wallis tests revealed a statistically significant difference in age ($\chi_{(2)}^2 = 21.72$, $p < 0.01$), but no differences in the number of study semesters emerged ($\chi_{(2)}^2 = 2.80$, $p = 0.25$). Post hoc tests showed that the intervention group was slightly younger than both control groups (MSP vs waitlist: $z = -2.92$; $p = 0.01$, $r = 0.16$; MSP vs passive: $z = -4.52$, $p < 0.01$, $r = 0.23$); however, the mean differences and effect sizes were rather small, and thus likely of little practical relevance. There was a small statistically significant difference between the MSP and the passive control group regarding study subject ($\chi_{(2)}^2 = 6.78$, $p = 0.03$, $V = 0.09$). As recruiting student teachers was more difficult for the passive control group, there were slightly fewer student teachers and more students of all subjects in the passive control group. With regard to meditation experience at the beginning of the intervention, there was a significant difference between groups ($\chi_{(2)}^2 = 23.39$, $p < 0.01$): The passive control group had less meditation experience than both the intervention group ($z = 4.34$; $p < 0.01$) and the waitlist control group ($z = -3.88$; $p < 0.01$). This was to be expected, given that both the intervention group and the waitlist control group had an interest in mindfulness. In essence, the overall differences were either to be expected or small.

Measures

Primary Outcomes

Descriptive information for the primary outcomes is depicted in Table 3; zero-order correlations are reported in Table 4. All items are reported in the online supplementary materials (Table S1). The distribution of the primary outcomes is shown in Fig. 3.

Trait Mindfulness Trait mindfulness was assessed with the 24-item short form of the Comprehensive Inventory of Mindfulness Experiences (CHIME; Bergomi et al., 2014; short form: Cladder-Micus et al., 2019). We analyzed the composite score (overall mean) across eight dimensions. The response scale of each item ranged from 1 (*almost never*) to 6 (*almost always*) and referred to the last 2 weeks.

Perceived Stress Perceived stress was assessed with the German version of the Perceived Stress Scale (Cohen et al., 1983; German version: Klein et al., 2016), which includes 10 items. We analyzed the composite score (overall mean). The response scale of each item ranged from 1 (*never*) to 5 (*very often*) and pertained to experiences in the last 4 weeks.

Table 3 Means and standard deviations for the primary outcomes ($n=505$)

			T1			T2		
Variable	Scale range	Group	M	SD	α	M	SD	α
(1) Mindfulness	1–6	MSP	3.67	0.54	0.83	4.05	0.52	0.86
		Waitlist	3.66	0.56		3.68	0.59	
		Passive	3.74	0.53		3.76	0.53	
(2) Perceived Stress	1–5	MSP	2.97	0.67	0.87	2.81	0.65	0.88
		Waitlist	3.06	0.74		3.14	0.70	
		Passive	3.16	0.71		3.10	0.71	
(3) Prosociality	1–5	MSP	3.83	0.49	0.88	3.89	0.48	0.88
		Waitlist	3.75	0.54		3.78	0.48	
		Passive	3.64	0.67		3.62	0.66	
(4) Pro-environmental behavior	Rasch scores $(-\infty, +\infty)$	MSP	0.09	1.04	-	0.29	0.95	-
		Waitlist	−0.19	1.03		−0.23	1.14	
		Passive	−0.48	1.03		−0.56	1.08	

MSP Mindful Student Program. Sample sizes were as follows: MSP $n=203$, Waitlist $n=120$, Passive $n=182$

Table 4 Zero-order correlations of primary outcomes ($n=505$)

	Variable	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Mindfulness T1	0.65*	−0.56*	−0.43*	0.15*	0.13*	0.10*	0.10*
(2)	Mindfulness T2		−0.43*	−0.62*	0.22*	0.28*	0.16*	0.22*
(3)	Perceived Stress T1			0.51*	0.01	−0.04	0.03	−0.05
(4)	Perceived Stress T2				<0.01	−0.05	−0.07	−0.10*
	Prosociality T1					0.73*	0.32*	0.27*
(6)	Prosociality T2						0.31*	0.28*
(7)	Pro-environmental Behavior T1							0.84*
(8)	Pro-environmental Behavior T2							-

*Statistically significant at $\alpha=0.05$

Prosociality Prosociality was assessed with the Prosocialness Scale for Adults (Caprara et al., 2005; German version: Fassbender & Luhmann, 2021), which comprises 16 items. We analyzed the composite score (overall mean) across four dimensions: helping, caring, sharing, and empathy. The response scale of each item ranged from 1 ([almost] never) to 5 ([almost] always) and pertained to participants' average behavior.

Pro-environmental Behavior Pro-environmental behavior was assessed with 32 items regarding mobility, consumption and resource use, energy use, and social behaviors. The items were based on the General Ecological Behavior Scale (GEB; Kaiser & Wilson, 2004), the Environmental Action Scale (Alisat & Riemer, 2015), and items from Geiger et al. (2020). Similar to other publications (e.g., Loy & Reese, 2019), we selected items and also added self-developed items that seemed appropriate for our specific setting. We discussed the item selection with students, with the aim of including behaviors that can be adopted in their daily lives (such as going to demonstrations versus buying solar panels

for a house), that can occur frequently in their daily lives (such as using a bike versus taking a plane), and that may be achievable within one semester (such as eating less meat versus buying more ecological furniture). The participants rated how often they engaged in these behaviors in the last four weeks on a scale from 1 (*never*) to 5 (*very often*). Two items had a dichotomous response scale (yes/no; e.g., *I use green electricity*). The participants also had the opportunity to answer *does not apply*. Following Kaiser and Wilson (2004), we dichotomized protective behaviors as 0 (*never*, *seldom*, once in a while) and 1 (*often*, *very often*) as well as harmful behaviors as 0 (*once in a while*, *often*, *very often*) and 1 (*never*, *seldom*). A 1-dimensional Rasch analysis of all items across all measurement points ($n=1010$) revealed a satisfactory person separation reliability of $R_p=0.80$. The item mean square infit values were below the recommended threshold of 1.20 for samples between 500 and 1000 (Bond & Fox, 2007), except for one item which had a value of 1.22. However, as this value was close to 1.20, we retained the item, since it covered an important topic (energy consumption). The proportion of individuals with person t infit values

(a) Mindfulness

(b) Perceived Stress

c) Prosociality

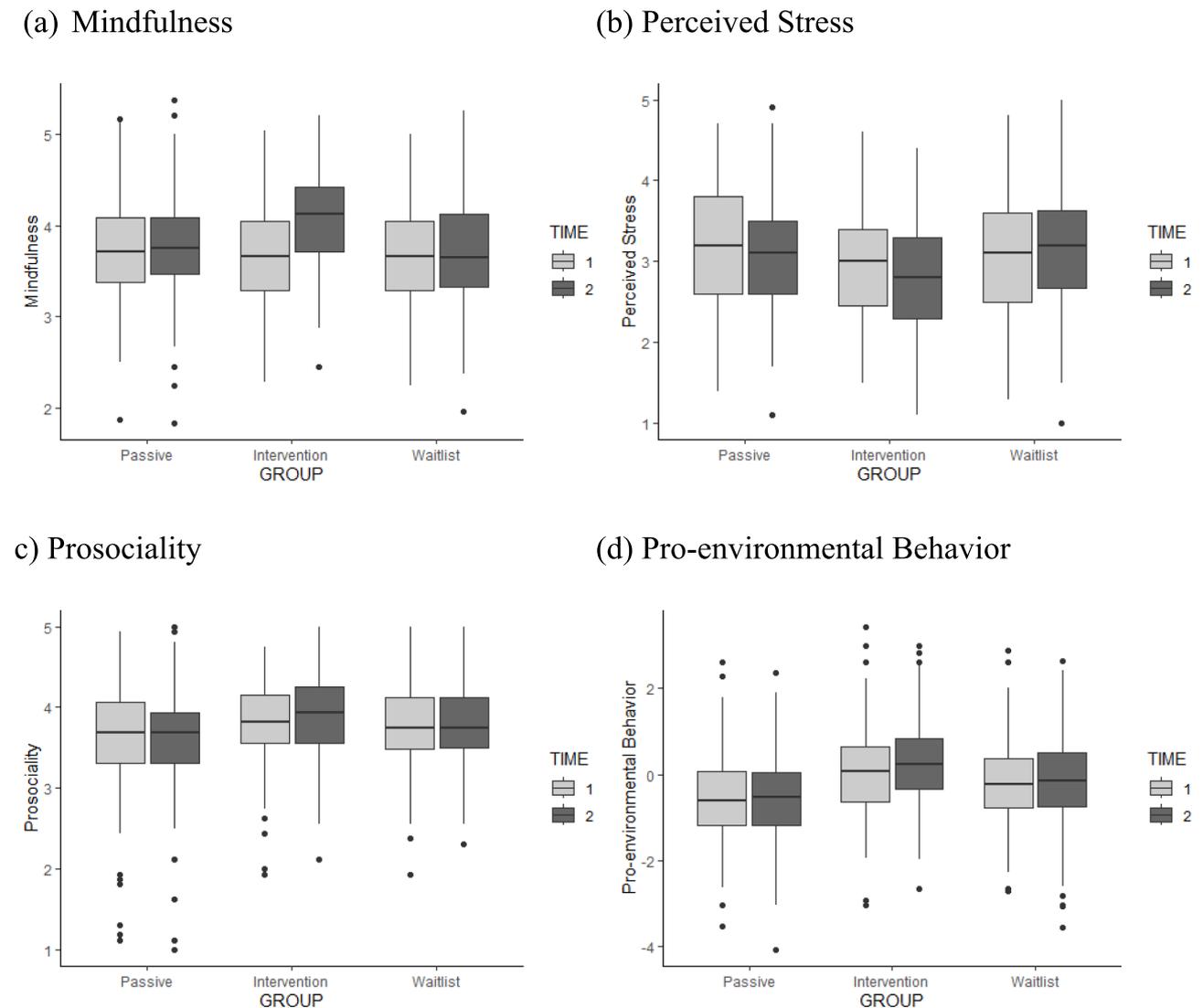## (d) Pro-environmental Behavior

Fig. 3 Illustration of distribution of primary outcomes at T1 and T2. **a** Mindfulness, **b** perceived stress, **c** prosociality, **d** pro-environmental behavior. Note: Box plots illustrate the distribution of the main outcome data at T1 and T2 (first to third quartile, with the line indicating the median). Single data points illustrate extreme data points. We identified outliers as extreme data points outside a 2.5 interquartile range

below 1.96 was 4.5% and thus under the recommended threshold of 5% (Bond & Fox, 2007).

Secondary and Explorative Outcomes: Program Characteristics in the MSP Group

Attendance Attendance was retrospectively assessed at T2. The participants indicated which sessions of the program they attended *(yes/ no).*

Home Practice The participants indicated how often they meditated throughout the program, with the following response options: 1 (*Not at all*), 2 (*1–5 times*), 3 (*5–10 times*), 4 (*10–15 times—around 1 per week*), 5 (*15–20 times*), 6 (*20–30 times—around 2 per week*), 7 (*30–40 times—around 3 per week*), 8 (*40–50 times—around 4 per week*), 9 (*50–60 times—around 5 per week*), 10 (*more than 60 times*).

Acceptance Seven questions ($\alpha = 0.87$) referring to overall satisfaction with the program (Table 5) were answered with a scale ranging from 1 (*does not apply at all*) to 7 (*applies very well*). We expected participants to be satisfied with the program (higher average ratings than 4). We also asked a number of other exploratory questions pertaining to satisfaction with the teachers, the group, and the buddy system. We

Table 5 Acceptance of the program (*n* = 203)

	M	*SD*
I was satisfied with the seminar	6.12	0.93
It was worthwhile for me to attend the seminar	6.16	1.07
The seminar matched the description	6.24	0.91
The seminar was well-structured	6.32	0.79
Because of the seminar, I would like to continue engaging with the topic of mindfulness in the future	5.92	1.10
I would like to continue the exercises from the seminar	5.36	1.34
I would recommend the seminar to others	6.33	1.01
Overall score	6.06	0.78

Scale ranging from 1 to 7 with higher values indicating greater acceptance

report the questions and answers to these questions in the online supplementary materials (Table S2).

Adverse effects In accordance with recommendations (e.g., Van Dam et al., 2018), we asked the participants at T2 whether they had experienced any particularly unpleasant experiences that they attributed to the meditation practice (*yes/no*). If they had, they were asked to describe the experience (optional) and rate their experience on a scale with the following response options: 1 (*mild effects without consequences*), 2 (*moderate effects and stressful*), 3 (*severe effects that required countermeasures*), 4 (*very severe effect with permanent consequences*), or 5 (*extremely serious effects that were life-threatening or required hospitalization*). The scale was inspired by Lindahl et al. (2017).

Data Analyses

The analysis scripts for the main analyses as well as the supplementary tables are available in the online supplementary materials. As pre-registered, we compared the means of the four primary outcomes at T1 to detect potential differences before the intervention between (1) the three waves, (2) the student populations (student teachers, medical students, and students of all subjects), and (3) the overall MSP group and the control groups. Following our pre-registered analysis plan, we used longitudinal multilevel models with full maximum likelihood estimation. Specifically, we estimated a multilevel model with random intercepts for the participants, with two dummy-coded variables for group membership (reference category = passive control group), a time variable (0 = pre-intervention and 1 = post-intervention), and the interaction of the variables. The advantage of the multilevel model approach in contrast to a standard ANOVA (with group membership as a between-subjects factor and time as a within-subjects factor) is that it allows for missing data (i.e., there is no case-wise exclusion of participants); hence, all of

the available data can be included in the analyses. Furthermore, *F*-tests for group, time point, and for the group × time point interaction can be computed. These *F*-tests equal the respective *F*-tests in a standard within-subject ANOVA, where we would only consider cases without missing data (e.g., Liu et al., 2012). We estimated all multilevel models in R using the lme4 package (Bates et al., 2015). The significance tests were based on the Satterthwaite degrees of freedom approximation which is implemented in the lmerTest package (Kuznetsova et al., 2015).

To compare the means of two groups at the second time point, we had originally planned to use an ANCOVA approach. However, during the data analyses, it turned out that this was not necessary since the differences in potential covariates were small. Therefore, we do not report the results of this approach. We compared the means at T2 using Tukey tests when the interaction term in the model reached significance (as preregistered).

Results

Primary Outcomes

Preliminary Analyses

As pre-registered, we compared the means of the primary outcomes at T1 for the different waves and student populations. First, we found no differences between the three waves in perceived stress, prosociality, and pro-environmental behavior at T1 (all $p > 0.05$). Trait mindfulness differed between the waves ($F[2, 502] = 3.04$, $p < 0.05$). The scores were higher in Wave 1 ($M = 3.79$, $SD = 0.55$) than in Wave 3 ($M = 3.63$, $SD = 0.56$; mean difference = 0.16, $SE = 0.07$, $p = 0.04$). In the main analyses, we therefore report results regarding mindfulness for all waves together as well as separately for Wave 1 versus the other waves.

Second, we found no statistically significant differences between the student populations (student teachers, medical students, and students of all subjects) in mindfulness, perceived stress, and pro-environmental behavior at T1 (all $p > 0.05$). Prosociality differed between student populations ($F[2, 502] = 4.16$, $p = 0.02$); the scores were lower for students from all subjects ($M = 3.62$, $SD = 0.62$) than for student teachers ($M = 3.77$, $SD = 0.55$; mean difference = 0.15, $SE = 0.06$, $p = 0.04$) or medical students ($M = 3.87$, $SD = 0.57$; mean difference = 0.25, $SE = 0.10$, $p = 0.04$). After exclusion of three individuals with extremely low prosociality scores (lower than 2.5 interquartile range), the Tukey tests did not reveal significant differences between the groups anymore. In the main analyses, we report results regarding prosociality (a) for all participants and populations, (b) without the three outliers, and (c) separately

for the students from all subjects versus the other student populations.

We then also tested for pre-existing differences at T1 between the MSP group and the control groups. We found differences between the MSP and control groups in perceived stress ($F[2, 502] = 3.45$, $p = 0.03$), pro-environmental behavior ($F[2, 502] = 14.53$, $p < 0.01$), and prosociality ($F[2, 292.93] = 3.54$, $p = 0.03$; Welch test due to unequal variances, $p = 0.01$), but not mindfulness ($F[2, 502] = 1.15$, $p = 0.32$). Perceived stress was lower in the MSP group ($M = 2.97$, $SD = 0.67$) than in the passive control group ($M = 3.16$, $SD = 0.71$; mean difference = 0.19, $SE = 0.07$, $p = 0.02$), but not than in the waitlist control group ($M = 3.06$, $SD = 0.74$). Pro-environmental behavior was higher in the MSP group ($M = 0.09$, $SD = 1.04$) than in the passive control group ($M = -0.48$, $SD = 1.03$; mean difference = 0.57, $SE = 0.11$, $p < 0.01$), but not compared to the waitlist control group ($M = -0.19$, $SD = 1.03$; mean difference = 0.28, $SE = 0.12$, $p > 0.05$). Pro-environmental behavior was also higher in the waitlist group than in the passive control group (mean difference = 0.29, $SE = 0.12$, $p < 0.05$). For prosociality, we used the robust Games-Howell test for post hoc comparisons. Prosociality was higher in the MSP group ($M = 3.83$, $SD = 0.49$) than in the passive control group ($M = 3.64$, $SD = 0.67$; mean difference = 0.20, $SE = 0.06$, $p < 0.01$), but not than in the waitlist control group ($M = 3.75$, $SD = 0.54$). After exclusion of the three outliers, the variances in prosociality were equal between the groups, but the pattern of results otherwise remained the same.

Main Analyses

The results of the multilevel analyses are reported in Table 6.

Trait Mindfulness The multilevel analysis of the combined data across all participants and waves revealed a significant main effect of time, no main effect of group, and, most importantly, a significant group × time interaction. Tukey tests confirmed a large significant increase in mindfulness from T1 to T2 in the MSP group, $t(502) = -12.91$, $p < 0.01$,

$d = 1.15$, but revealed no changes in the waitlist group, $t(502) = -0.69$, $p = 0.49$, or the passive control group, $t(502) = -0.73$, $p = 0.46$. The results did not change when Wave 1 was analyzed separately.

Perceived Stress For perceived stress, we found no significant main effect of time, but a main effect of group, and, most importantly, a significant group × time interaction. Tukey tests confirmed a small significant decrease in stress from T1 to T2 in the MSP group, $t(502) = 3.18$, $p < 0.01$, $d = 0.28$, but revealed no changes in the waitlist group, $t(502) = -1.38$, $p = 0.17$, or the passive control group, $t(502) = 1.13$, $p = 0.26$.

Prosociality We found no significant main effect of time, but a main effect of group. No significant group × time interaction emerged. Thus, none of the groups changed from T1 to T2 regarding prosociality. The MSP group scored higher than the passive control group across both measurement occasions (intercept passive control group—3.64, $SE = 0.04$, $p < 0.01$; fixed effect estimate intervention group = 0.20, $SE = 0.06$, $p < 0.01$; see also Table 3). Exclusion of the three outliers in prosociality ($n = 502$) or sole consideration of the student teachers and medical students ($n = 383$) did not change the statistical significance or the pattern of results. Sole consideration of the students of all subjects ($n = 122$) did not reveal any main effects and interaction effect (with no comparison to waitlist, which consisted only of student teachers).

Pro-environmental Behavior We found no significant main effect of time, but a main effect of group, and, most importantly, a significant group × time interaction. Tukey tests confirmed a statistically significant increase with a small to medium effect size in pro-environmental behavior from T1 to T2 in the MSP group, $t(502) = -4.79$, $p < 0.01$, $d = 0.43$, but revealed no changes in the waitlist group, $t(502) = 0.69$, $p = 0.49$, or the passive control group, $t(502), = 1.74$, $p = 0.08$.

Table 6 Results of the multilevel models

Outcomes	Trait mindfulness		Perceived stress		Prosociality		Pro-environmental behavior	
Effect	F (df)	p	F (df)	p	F (df)	p	F (df)	p
Time	$F(1, 502) = 55.81$	$<0.01*$	$F(1, 502) = 1.75$	0.19	$F(1, 502) = 2.05$	0.15	$F(1, 502) = 1.10$	0.29
Group	$F(2, 679.01) = 1.16$	0.32	$F(2, 803.47) = 3.54$	$0.03*$	$F(2, 658.69) = 5.99$	$<0.01*$	$F(2, 591.24) = 14.36$	$<0.01*$
Group × time	$F(2, 502) = 43.68$	$<0.01*^a$	$F(2, 502) = 4.61$	$0.01*^a$	$F(2, 502) = 1.58$	0.21^b	$F(2, 502) = 11.87$	$<0.01*^a$

*Statistically significant at α = 0.05

[a]Tukey Test: statistically significant change in the expected direction over time in the MSP group, but no significant change over time in the waitlist and passive control groups

[b]No significant change in any of the groups

Secondary and Explorative Outcomes: Program Characteristics in the MSP Group

Attendance

On average, the students reported participation in 10.32 of the 13 classes (range 5–13; $SD = 1.82$), and 84% of the sample were present at the half-day retreat.

Home Practice

The median and the mode of reported practice were both *20–30 times—around 2 per week*. This option was pursued by 26% of the sample. Less frequent practice was applied by 41% of the sample, more frequent practice by 33%, respectively. That is, as a central tendency, participants practiced less than they were encouraged to (five times a week).

Acceptance

As can be seen in Table 5, acceptance was very high for all questions asked, with the average across all items well above the midpoint of the scale ($M = 6.06$, $SD = 0.78$; range 3.71 to 7.00). Overall, only 2% of the participants had an average satisfaction score of 4 or slightly lower, whereas the majority (62%) had an average score of 6 or higher.

Adverse Effect

Adverse effects were reported by 23 participants (11% of the sample). Of these 23 participants, nine reported *mild effects without consequences* (1), eleven reported *moderate effects* (2), and three reported *severe effects that required countermeasures* (3). Options 4 (*very severe effects*) and 5 (*extreme effects*) were not reported. In the open answering format, students described negative events such as stress induced by not being able to meditate, experiencing back pain and, foremost, experiencing negative thoughts or feelings during meditation that potentially lingered on. We explored whether participants who experienced adverse effects rated the seminar as less satisfactory than participants who did not, but this was not the case, $t(38.86) = 1.39$, $p = 0.17$. Even the three students who reported severe effects had high overall satisfaction scores ($M = 6.29$, $SD = 0.25$).

Discussion

In the present study, we evaluated a novel MBI for university students, the Mindful Students Program (MSP), which was integrated into the students' curriculum as an elective course offering. The program was well attended and accepted by the participants. Adverse effects occasionally occurred, but did not curb students' enthusiasm for the program. The MSP aimed at increasing individuals' care for themselves, others, and the environment. In line with our predictions, we found that students' stress level decreased, while their mindfulness and pro-environmental behavior increased. Unexpectedly, prosociality did not change, but it was already comparably high in the intervention group at the beginning.

To our knowledge, our study is among the first that show that it is possible to conduct an MBI in a university setting for students as part of their curriculum in an engaging and safe manner which can have both individual benefits as well as benefits for the environment (for similar approaches, see, e.g., Frank & Stanszus, 2019; for an overview see Frank et al., 2019). Despite being offered at universities, MBIs for students are often not part of the curriculum but rather additional classes (for an exception, see also, e.g., the Munich Model; de Bruin, 2021). Participation in an additional class may constitute a barrier for students who already report high stress levels. Training mindfulness may be a quality in itself that enables learning, rather than a mere add-on (Kabat-Zinn, 2005). We therefore think it is a strength of this study that it investigated a program embedded in a curriculum. However, we also believe that practicing mindfulness should remain optional, as previous research indicates that mandatory MBIs can lead to disengagement and worsening health conditions, as shown in pupils in the MYRIAD trial (e.g., Montero-Marin et al., 2022).

In our study, the participants were engaged in the program which we consider to have been delivered in a safe manner. Students attended the sessions frequently, although for most students (except for the medical students) attendance was not required, showing their overall engagement with the program. Adverse effects were reported by 11% of participants, most of which were mild in nature. This rate seems low compared to other recent studies. For example, in a study with adults suffering from affective disturbances, 37–58% of the sample (depending on the assessment instrument) reported adverse events during an 8-week MBI (Britton et al., 2021). In a study on meditators in the US ($n = 434$; Goldberg et al., 2022a), 32% of the sample reported adverse effects. Even for participants with very little meditation experience (0–10 h), this percentage was higher (20%) than in our study. Similarly to the study of Goldberg et al., (2022a), the participants who reported adverse events in our study were as satisfied with the program as the other participants. Nevertheless, it is possible that participants who did not like the program or who had more severe adverse effects dropped out of the study. We were not able to monitor the drop-outs closely, which would certainly be desirable for future research. It is also noteworthy that we focused on a specific class of adverse events (i.e., unpleasant experiences). As we only considered changes in outcomes at the mean level, it is also likely that some participants did not profit from the MBI or

even changed in the opposite direction (e.g., showed less pro-environmental behavior; see Frank et al., 2021).

In our pre-registration, we specified four primary outcomes: trait mindfulness, stress, prosocial behavior, and pro-environmental behavior. Because mindfulness is supposed to be the central component of MBIs (Goldberg et al., 2022b), and enhancing trait mindfulness is one of the main assumed mechanisms by which MBIs help achieve other outcomes, such as stress reduction and well-being (Gu et al., 2015), an increase in self-reported trait mindfulness after an MBI can also be seen as a "manipulation check." Although self-report measures of mindfulness have been criticized due to problems with construct validity (e.g., Van Dam et al., 2018), mindfulness, as an intraindividual capacity, may be accessible to individuals themselves. Moreover, the measure we used was specifically designed to overcome limitations of prior instruments, for example, by enhancing comprehensibility for non-meditators (Bergomi et al., 2014). In our study, the increase in self-reported mindfulness was quite large as compared to in other programs for students (Dawson et al., 2020). Potentially, the length of the program (12 weeks), which was longer than other MBIs for students (Dawson et al., 2020; Halladay et al., 2019), enabled the students to devote more time to developing a mindful stance. While mindfulness may be enhanced through practice, our students reported less frequent meditation practice at home than was recommended. Some of them also seemed to be stressed by this recommendation, as evident in their open answers regarding adverse events. However, in addition to attending the program, students also engaged in a number of other homework tasks, such as short informal exercises or reflections, but engagement in these tasks was not surveyed in the study. It is therefore possible that, despite lower levels of formal practice, students engaged in mindfulness in their daily lives, thereby fostering their overall levels of mindfulness.

Comparable to established programs, the MSP reduced stress in the participants. The effect size was small, as is common in MBIs for students (Halladay et al., 2019). Notably, students who signed up for the MSP were already less stressed before the program than students in the passive control group. This may seem unusual, given that people who sign up for MBIs often do so to improve their well-being. We can only speculate that students who signed up for the program were already aware of the importance of dealing with stressors in everyday life in adaptive ways and were thus seeking to add mindfulness to their already existent toolbox. In contrast, highly stressed students may also feel that they do not have time to attend a class that is not directly related to their studies.

In contrast to most other MBIs for students, the MSP addresses issues "bigger than self" by aiming to foster the experience of interdependence with others and nature. While previous research on mindfulness and pro-environmental

behavior has mostly been correlational, and evidence for the effects of MBIs on pro-environmental behavior is mixed (e.g., Geiger et al., 2019, 2020), we found an increase in self-reported pro-environmental behavior in the MSP group after the program. Interestingly, the MSP group already displayed the highest level of pro-environmental behavior of all groups before the intervention, but their pro-environmental behavior still increased throughout the program. We think that this finding is especially important given that we did not capture attitudes, which may change more easily, but specific behaviors. While our measure of pro-environmental behavior included various items with varying impacts on climate change, we believe in the potential of ripple effects of mindfulness for society (Engert et al., 2023). For example, changes in consumption of animal products, changes in transportation, or changes in how participants engage in public climate action may have effects on participants' social interactions, potentially shifting social norms over time.

There may be several reasons as to why the MSP had an effect on pro-environmental behavior. In contrast to most other programs for students, the MSP fosters the interconnection between humans and between humans and nature, encourages students to deal with emotions regarding climate change, such as climate anxiety, and provides them with several strategies for setting their ideas into action. One exciting avenue for future research is to examine which of these mechanisms are the most important for behavior change. We believe that MBIs need to evoke explicit reflection about own ethical values with regard to nature conservation to achieve pro-environmental behavior change. However, since the MSP comprises various meditation techniques, reflexive exercises, and perspectives, we aim to obtain a better understanding of the mechanisms underlying the effects of the MSP on pro-environmental behavior in future analyses (Loy et al., in preparation). Furthermore, it would be interesting to uncover the effects of the MSP by comparing it to a program without ethical components.

In contrast to findings reported in meta-analyses (Berry et al., 2020; Donald et al., 2019; Luberto et al., 2018), our MBI did not lead to increases in prosocial behavior. Several factors might have played a role in this result. First, the MSP group was already the group with the highest prosociality scores at T1, significantly higher than the passive control group. Thus, we speculate that increases might have been difficult to achieve. Potentially, increases in prosociality were not even desirable in the eyes of the students, as many of them were studying helping professions (e.g., student teachers, medical students) which already involve devoting much time and effort to other people. Especially in helping professions, burnout related to empathic distress is considered a threat to well-being (Singer & Klimecki, 2014). This is why MSP focuses on developing compassion towards both the self and others, including self-care

which does not lead to fatigue. Therefore, our measure of prosociality, which covered a wide range of helping, sharing, caring, and empathy, may not have been an adequate outcome (including items such as *I intensely feel what others feel*). We speculate that it was important to improve our sample's self-compassion first, which can then be an emotional resource needed to provide care for others without burning out (Neff, 2023). Nevertheless, we also did not see a decrease in prosocial behavior, which is sometimes also theorized to result from mindfulness practice (Schindler & Friese, 2022). In future projects, we aim to explore whether the MSP has effects on self-compassion and on outcomes related to interpersonal competence, such as interpersonal mindfulness (Pratscher et al., 2022).

Limitations and Future Research

Despite the many strengths of our study, several limitations need mentioning. First, due to its embeddedness into everyday life, this was a quantitative, quasi-experimental study with a selected sample without randomization. While randomization is one of the most important tools for intervention research to minimize selection bias and establish causality, this was neither possible nor—in our view—desirable, as the MSP was part of the elective course offering at a university. Therefore, only interested students took part, which may have led to an overestimation of acceptance and effectiveness. Moreover, self-selection into the program might have strengthened students' pre-existing assumptions about themselves and the world (i.e., mental models), instead of raising their meta-awareness of such thought processes (for a discussion, see Frank et al., 2021). To investigate this possibility, a mixed-method approach, including qualitative interviews, could be applied. This would be particularly interesting as questioning the self-image is part of the curriculum. Furthermore, qualitative methods may be best suited to gain an understanding as to why participants engaged in pro-environmental behaviors. While it is possible that they were motivated by moral concerns for other beings, presenting oneself as a responsible person can also be an egoistic motivation (for a discussion, see Turaga et al., 2010). Additionally, we did not implement an active control group, which would have required embedding additional courses into the curriculum. In future research, randomization of the groups and comparisons to active control groups is desirable.

Second, as we aimed to be transparent, students and trainers alike knew about the focus of the program and the underlying hypotheses. This is especially relevant as our primary outcomes were trait self-reports, which are susceptible to biases, such as expectation effects and impression management. Therefore, we believe that our effects need to be replicated using other approaches, such as observational, laboratory, or psychophysiological paradigms (e.g., Voss

et al., 2020). In future projects, we will further analyze our data regarding secondary or exploratory outcomes, such as observer reports by friends of our participants (e.g., Loy et al., in preparation). In addition, we also acknowledge that outcomes like prosocial and pro-environmental behaviors are by far more complex than the quantitative indicators that we assessed. Thus, it may be relevant to further critically dissect some of the measures that we used, including our consolidation of various behaviors under the term "pro-environmental behavior" (for a discussion, see Lange, 2024). In a similar vein, the use of the term sustainable development per se may be discussed (see, e.g., Purvis et al., 2019). Furthermore, to gain an in-depth understanding of how participants conceptualized changes in their behavior towards other people and the environment, which may relate to the idea of fostering sustainable development, qualitative interviews could be used in future research.

Third, although we recruited a relatively large sample and two control groups, we were not able to survey as many participants as we expected, partly because of high data exclusion and drop-out rates. While there were almost no differences between drop-outs and completers in the primary outcomes at T1 across the intervention group and the control groups, the high drop-out rate is still problematic. Because the reasons for drop-out are largely unknown, it is possible that particularly students who were less satisfied with the program dropped out, which would further reinforce the notion of self-selection. Notably, the dropout rates may have had different reasons among the groups. Furthermore, these rates also differed in size; they were lower in the waitlist control group than in the passive control group. In the waitlist group, fewer participants were recruited than aimed for, as we were not able to disseminate the information about the study as expected. Overall, the power to detect effects was reduced by our smaller sample size, and our results pertain to a selective group of participants. Furthermore, similar to previous research (e.g., Dawson et al., 2020), the sample was not very diverse in terms of the location of participants or gender.

Fourth, the focus of the present study was to evaluate the effects of the program as a whole with regard to pre-specified outcomes. While there are many ways of fostering the outcomes we considered, we think that the MSP may provide students with skills that help them navigate their studies and their daily lives by connecting with the present moment in a nonjudgmental and compassionate way while supporting ethical behavior. However, we do not yet know the mechanisms underlying the changes in these outcomes. We consider it likely that the changes in stress and pro-environmental behavior were related to the concept of mindfulness (i.e., the practice and understanding of mindfulness as well as changes in trait mindfulness), but other components of the program, such as unspecific factors (e.g., effects of

the group, Canby et al., 2021) or other specific factors (e.g., reflections that may not necessitate a concept of mindfulness), might also be effective. While we are currently analyzing our existing data to better understand relations between changes in various, also secondary outcomes, our study was not designed to disentangle the effects of different components or exercises of the program, but to evaluate the effects of the program as a whole. To obtain a better understanding of the effects, active components of the program could be removed (dismantling studies), or adherence of instructors to these components could be tested (Goldberg, 2022). Another interesting avenue for future research could involve monitoring how changes in outcomes in daily life unfold over time after implementing certain intervention components, using intensive longitudinal approaches (for an application of a daily diary design, see, e.g., Richter & Hunecke, 2022). Lastly, similar to many studies evaluating MBIs, our primary endpoint was the end of the intervention. However, to acquire a better understanding of whether the main effects remain robust over time, we will analyze the data of the secondary endpoint (at the end of the semester; Blanke et al., in preparation).

To conclude, the results suggest that the MSP reduced stress and, at the same time, increased mindfulness and pro-environmental behavior. These results are promising, but future research of the current intervention format is needed to explore a variety of exciting questions. These range from substantive aspects, such as the specific mechanisms that might underlie the effects, to method-related issues, such as selectivity effects. While we strive to further scrutinize these findings in the future, our study contributes to research suggesting that MBIs can lead to "bigger than self" outcomes. Explicating ethical perspectives might expand mindfulness training curricula beyond focusing on the self to include the environment. This may be an important step towards increasing the effects of MBIs not only for individuals but for society as a whole.

Declarations

Ethical Approval The present study was approved by the ethics committee of Leipzig University and was therefore performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Informed Consent All participants gave their written informed consent prior to their inclusion in the study. Details that might disclose the identity of the subjects under study are omitted.

Conflict of Interest Susanne Krämer developed the Mindful Students Program.

Use of Artificial Intelligence (AI) ChatGPT was used to adjust individual phrases in English. Otherwise, no AI was used.

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