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► **To cite this version:**

Mareike Kaemmerer, Anne Congard, Sarah Le Vigouroux, Bruno Dauvier, Eva Andreotti, et al.. Do Mindfulness-Based Interventions Have Effects Only on Negative Aspects of Psychological Functioning? A Randomized Controlled Trial. *Mindfulness*, 2022, 10.1007/s12671-022-01849-z . hal-03628043

**HAL Id: hal-03628043**

**<https://hal.science/hal-03628043>**

Submitted on 17 Oct 2023

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Kaemmerer, M., Congard, A., Le Vigouroux, P., Dauvier, B., Andreotti, E., & Antoine, P. (2022). Do Mindfulness-Based Interventions Have Effects Only on Negative Aspects of Psychological Functioning? A Randomized Controlled Trial. *Mindfulness*. DOI: 10.1007/s12671-022-01849-z.

## Do Mindfulness-Based Interventions Have Effects Only on Negative Aspects of Psychological Functioning? A Randomized Controlled Trial

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**Abstract Objectives** The benefits of mindfulness-based interventions (MBIs) for stress, depression, and anxiety have been shown in various studies. However, only a few studies have investigated the effects of MBI on positive psychological functioning, and even fewer studies have simultaneously studied positively and negatively valenced variables. Nevertheless, the evaluation of both seems indispensable for understanding mindfulness and its effects on psychological health. Therefore, this randomized controlled trial compared the effects of a home-based, 6-week MBI on positive and negative aspects of three psychological variables.

**Methods** Eighty-seven participants were randomly assigned to an MBI group ( $n = 40$ ) or a wait-list control group ( $n = 47$ ). All participants were evaluated in terms of their positive/negative automatic thoughts, self-compassion levels, and use of cognitive emotion regulation strategies before and after the 6-week period. General linear models were used to compare outcomes on positive and negative scales through likelihood ratio tests. **Results** The MBI group benefited significantly from the intervention. Larger effects of the MBI on positive automatic thoughts ( $\chi^2(1) = 9.75, p = .001$ ), positive self-compassion ( $\chi^2(1) = 5.63, p = .02$ ), and “more adaptive” cognitive emotion regulation strategies ( $\chi^2(1) = 8.99, p = .003$ ) than on their negative counterparts were observed. The effects were moderated by participants’ initial scores for these variables.

**Conclusions** The evaluation of MBI outcomes should consistently include positive and negative aspects of psychological health. In addition, the benefits of MBIs depend on participants’ initial scores for the evaluated variables. Therefore, individual differences before the intervention must be considered in evaluations.

**Keyword** Mindfulness-based interventions · Positive and negative variables · Psychological health · Individual differences

Improvements in people's psychological health and well being can be achieved through interventions targeting aspects of maladaptive psychological functioning. In this respect, mindfulness-based interventions (MBIs) have been found to be effective (Khoury et al., 2015; Spijkerman et al., 2016). Research on MBIs often focuses on negative variables of psychological functioning, such as stress, depression, or anxiety symptoms (Parsons et al., 2017). However, the evaluation of positive variables is as important as the study of negative variables. Indeed, psychological health is not equivalent to the absence of psychopathological symptoms or negative emotions but to a healthy balance of both negative and positive affects and other variables such as automatic thoughts or life satisfaction (Diener et al., 2009; Lindsay et al., 2018). In this context, it seems important to investigate whether MBIs have a beneficial influence only on negative aspects of psychological functioning or if they are equally able to improve positive aspects. MBIs aim to help individuals find ways to develop awareness or consciousness to experience what is present in each moment of their lives (Kabat-Zinn, 1996). They promote a shift in focus toward acceptance and a mode of nonjudgmental attitude to life experiences (Bishop et al., 2004; Garland et al., 2015) through regular mindfulness meditation practice and mindful activities embedded in daily routines. Mindfulness practice consists of observing thoughts, feelings, and bodily sensations without judging them and instead adopting an accepting, curious, and open-minded attitude. Being mindful does not involve suppressing or changing direct experiences (e.g., feelings, thoughts, and bodily sensations) but rather changing the manner in which these experiences are perceived and interpreted (Cavanagh et al., 2013). Mindfulness can also be considered a skill that allows individuals to maintain mindful awareness throughout the day and during any challenging life situation. Hence, research has shown that participants in mindfulness practice can learn to respond more efficiently to situations that trigger strong emotional reactions (Baer, 2003). In this way, mindfulness can be understood as a self-regulating process that can help reduce negative aspects (e.g., the use of inefficient emotion regulation strategies) and increase positive aspects (e.g., automatic positive thoughts) of psychological functioning (Bishop et al., 2004). Although the vast majority of studies have focused on traditional mindfulness-based stress reduction (MBSR) interventions (Kabat-Zinn, 1990; Khoury et al., 2015) and mindfulness-based cognitive therapy (MBCT) programs (Parsons et al., 2017), some studies have also investigated self-help interventions based on mindfulness principles (Baer, 2003; Parsons et al., 2017). Self-help programs allow people to practice mindfulness at home without the presence of a therapist. The activities are not performed in a group setting but individually, meaning that participants can do them at any time they wish (Spijkerman et al., 2016). The flexibility of self-help protocols makes interventions such as mindfulness more accessible and cost-effective. MBIs have been shown to be very beneficial in terms of psychological outcomes (Khoury et al., 2015) on stress (Nyklíček & Kuijpers, 2008; Raab et al., 2015; van Wietmarschen et al., 2018) and negative affectivity, such as anxiety (Antoine, Andreotti, et al., 2018) or depressive states (Goyal et al., 2014). Most studies have shown beneficial effects on negative automatic thoughts (Frewen et al., 2008; Mehdipour et al., 2017) about the world or oneself, selfcriticism (Halamová et al., 2018), rumination, and difficulties with emotional regulation more generally (Brockman et al., 2017; De Vibe et al., 2018; Lindsay et al., 2018). In addition, compared with classic mindfulness interventions, self-help programs have shown very similar and important benefits for psychological outcomes

(Antoine, Andreotti, et al., 2018; Congard et al., 2019; Halamová et al., 2018; Spijkerman et al., 2016).

Other studies have shown the importance of considering inter-individual differences (Antoine, Andreotti, et al., 2018) when analyzing the effects of self-help interventions. More specifically, intra-individual differences have shown to be important in MBI as participants with initial low levels on measured variables benefit more from the intervention than participants with initially high levels (Antoine, Andreotti, et al., 2018).

In 1989, Ryff stated that, in psychology research, much more attention has been paid to unhappiness and suffering than to the effects of positive psychological functioning. Unfortunately, this statement can still be made today, with many MBI studies focusing on negative variables such as maladaptive emotion regulation strategies or psychopathology symptoms (Khoury et al., 2015; Nyklíček & Kuijpers, 2008; Shapiro et al., 2011). However, psychological health is also reflected in many positive variables. If our aim is to improve people's psychological health through MBIs, the multiple aspects that contribute to psychological health and that create a balanced state of well-being (Diener, 1984) must be considered. Therefore, investigating whether the positive counterparts of the previously studied variables are affected by mindfulness practice seems important. In this respect, positive thoughts and self-compassion as well as adaptive emotion regulation strategies represent particularly interesting objects of study because their negative counterparts have been shown to be influenced by MBIs (Brockman et al., 2017; Frewen et al., 2008; Halamová et al., 2018).

Negative thoughts are classic targets of cognitive interventions, including MBCT (e.g., Frewen et al., 2008; Mehdipour et al., 2017). Patients are trained to become aware of their automatic negative thoughts and to identify their influence on their emotional states to avoid being taken over by cognitive bias or ruminations, thus facilitating more positive thoughts and a more balanced cognitive system (Diener et al., 2009). By improving participants' attentional skills, which allow them to focus on more positive information (Hanley et al., 2021), and by enhancing their positive interpretations of ambiguous situations, mindfulness might be able to significantly increase positive cognitions (Garland et al., 2015).

Negative thoughts often take the form of fear or disapproval of the world and others or even self-criticism. Conversely, compassion toward others and self-compassion have been the subjects of encouraging work in mindfulness studies and have shown important benefits (Raab et al., 2015; Sakai et al., 2019; Sevel et al., 2019; Shapiro et al., 2011; van Wietmarschen et al., 2018). Indeed, mindfulness aims to support the formation of an attitude characterized by greater acceptance and openness to oneself and others, thus encouraging participants to be more self-compassionate.

Although MBIs aim to help participants not only achieve a more positive mental state or greater happiness but also build better skills for awareness and observation of the self and others (Shankland & André, 2014), the investigation into the influence of mindfulness on emotion regulation seems indispensable because emotion regulation processes play an essential role in psychological health (Brockman et al., 2017; Tavakoli & Kazemi-Zahrani,

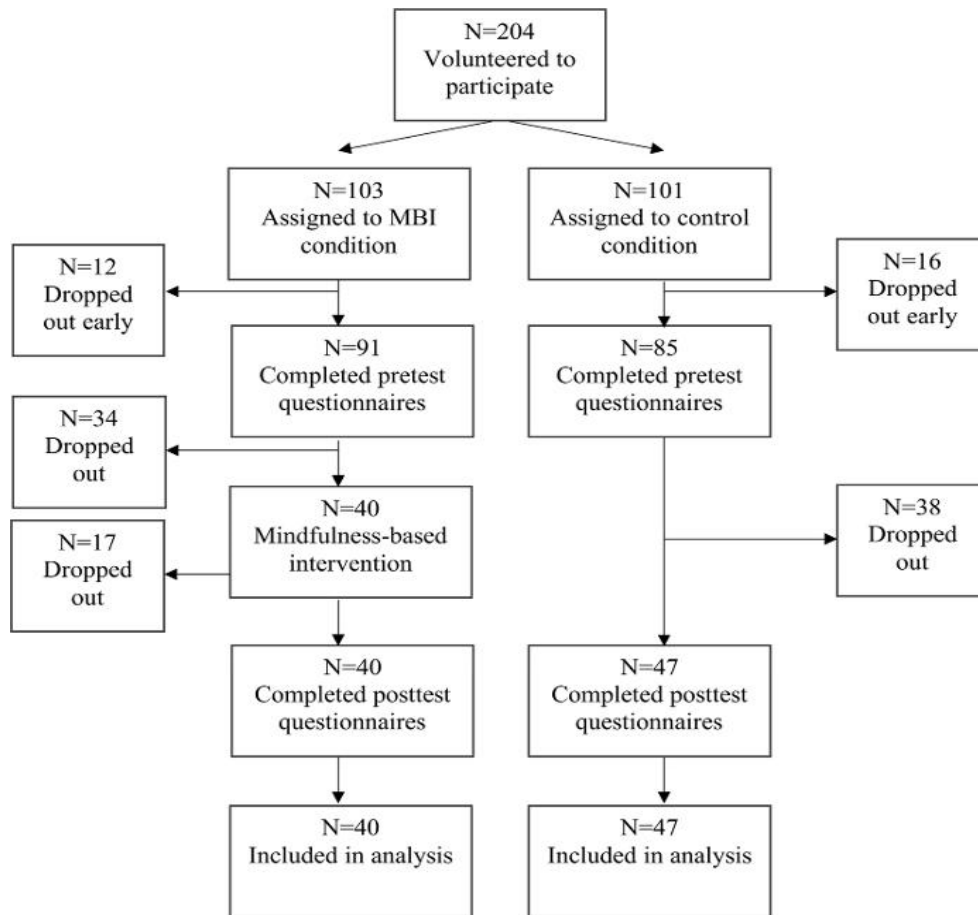
2018). The use of emotion regulation strategies which are considered maladaptive or adaptive in the literature (Aldao et al., 2010) is linked to the emergence of positive or negative emotions, respectively (Pavani et al., 2016). Hence, the use of maladaptive emotion regulation strategies is linked to many mental health problems and mental disorders (Aldao et al., 2010). Therefore, an investigation into these processes seems indispensable for mindfulness studies.

This study had two objectives. The first was to analyze the impact of MBI on automatic thoughts, self-compassion, and emotion regulation strategies. We hypothesized that the MBI would have a beneficial effect on both the positive and negative aspects of these variables. The second objective was to explore the differential effects of MBIs. The aim was to investigate the differential effects on positive and negative aspects of psychological functioning, based on group assignment and individuals' initial level on tested variables.

## **Methods**

### **Participants**

A nonclinical sample of 204 participants was recruited by psychology students from the Universities of Lille and Nîmes (France) through social networks and within their social and professional environments. To be eligible to participate in the study, participants had to be 18 years or older, speak French, and have a smartphone. No other criteria were applied during the recruitment process. As shown in Fig. 1, 28 participants dropped out before they completed the pre test assessment. Thirty-four participants who were assigned to the MBI group dropped out before having started the program. After the pretest assessment and the beginning of the MBI sessions, participants were reminded of the details of the MBI program. Seventeen participants dropped out during the intervention phase. Thirty-eight participants dropped from the control group during the wait-list period. Reasons for drop-out were not systematically collected. A total of 87 participants aged 18 to 72 years ( $M = 39.2$ ,  $SD = 14.8$ ) participated until the end of the study and were included in the analyses; among these 87 participants, 47 were randomly assigned to the control group, and 40 were assigned to the mindfulness group. We conducted a sensitivity analysis which allowed to determine the minimum effect size that the study was able to detect, based on the number of recruited participants ( $N = 87$ ), the required alpha level ( $\alpha = 0.017$ ), and a power of 0.8. This analysis has shown that the minimal detectable effect lies at  $f^2 = 0.06$ . Thus, the study was able to detect small to medium effect sizes.



**Fig. 1** Summary of procedure from participant recruitment to analysis

## Procedure

This study received ethical approval from the French Ethical Research Committee for Behavioural Sciences of Lille University. Once participants were informed about the aim and conduct of the study, they received a written project description and a consent form. All participants who signed the consent form were randomly allocated to one of the two conditions (mindfulness or control) using a stratified block randomization scheme. Randomization was based on two criteria: sex and previous mindfulness practice experience. Before participants were informed about their group allocation, they were asked to complete a battery of questionnaires (pretest assessment) comprising questions on demographic and various affect variables. After the pretest assessment, participants were informed about their group allocation. Participants allocated to the MBI then had to start their daily mindfulness activity and continue it for 6 weeks. The control group was a waiting list control group and did not have to complete any activity or intervention. After the 6 weeks, all participants (in both the MBI and control groups) had to complete posttest questionnaires once again assessing the affect variables from the pretest. After the completion of posttest questionnaires, we proposed to the control group participants that they participate in the MBI program themselves. The MBI was created by the research team and a trained mindfulness practitioner based on MBSR (Kabat-Zinn, 1990) principles with the following specificities. (1) The intervention was home-based and provided through recorded audio instructions. Audios were recorded by an accredited psychologist with a specific training in mindfulness meditation and

several years of experience in clinical application of mindfulness as well as several scientific publications on mindfulness practice. Participants received by mail the MBI program with detailed instructions and the investigators' contact information. All participants received the same material, according to the day of participation (Tables 1 and 2). The MBI audio files for all sessions could be easily downloaded from a website. (2) The sessions had to be completed individually and not in a group. (3) The average length of the sessions was 20 min, and sessions were provided for 42 days (6 weeks) (Congard et al., 2019). We chose this MBI because it was previously found to have significant effects on affect and emotion regulation (Antoine, Andreotti, et al., 2018) and because it is well suited to be used as a self-help, home-based intervention such as ours. Participants were invited to do a daily (7 days a week) mindfulness activity as suggested by a supplied schedule. Participants could choose the moment during the day when they wished to do their mindfulness practice. (4) The program consisted of five different themes. During the first 5 weeks, a new theme was proposed every week. Week 6 consisted of a mix of all themes. The following mindfulness themes were proposed (Tables 1 and 2): week 1: bodily awareness; week 2: awareness of all senses; week 3: mindful walking; week 4: thought awareness; week 5: loving-kindness. Participants were also invited to implement the learned mindfulness practice in their daily live.

**Table 1** Overview of the MBI program content. Audio-guided mindfulness activity + informal mindfulness practice, recommended to participants for implementation in their daily life

Day	Week					
	1: Bodily awareness	2: Awareness of all senses	3: Mindful walking	4: Thought awareness	5: Loving-kindness	6: Global (mix)
1	Mindful breathing + 3 mindful breathing exercises	Mindful of all senses	Mindful walking + 1 mindful daily action	Mindful of thoughts	Mindful loving-kindness	Mindful walking + 1 mindful daily move
2	Mindful breathing + 3 mindful breathing exercises	Mindful of all senses + mindful tasting	Mindful walking + 1 mindful daily move	Mindful of thoughts	Mindful loving-kindness	Mindful breathing + 3 mindful breathing exercises
3	Mindful breathing + 3 mindful breathing exercises	Mindful of all senses + mindful watching	Body scan	Mindful of thoughts	Mindful loving-kindness	Mindful of all senses + mindful tasting
4	Body scan	Mindful of all senses + mindful of sounds	Mindful walking + 1 mindful daily action	Mindful confrontation of thoughts	Body scan	Mindful confrontation of thoughts
5	Body scan	Mindful of sounds + mindful listening	Mindful walking + 1 mindful daily move	Mindful confrontation of thoughts	Mindful loving-kindness	Mindful of thoughts
6	Body scan	Mindful of sounds + mindful communication	Mindful walking + 1 mindful daily action	Mindful confrontation of thoughts	Mindful loving-kindness	Mindful of sounds
7	Body scan	Mindful breathing + 3 mindful breathing exercises	Mindful of all senses + mindful tasting	Mindful of sounds + mindful of sounds	Mindful confrontation of thoughts	Mindful loving-kindness

## Measures

At baseline, demographic variables such as participants' age, sex, family and professional situation, education, and previous mindfulness experience were assessed. We also assessed several psychological variables. The Automatic Thoughts Questionnaire (ATQ-30; Hollon & Kendall, 1980) was used to evaluate the strength of participants' beliefs in 30 automatic negative statements about the self. Automatic thoughts refer to instantaneous cognitions that a person has in response to a trigger. Examples for negative automatic thoughts are statements like "My life's not going the way I want it to," "There must be something wrong with me," or "No one understands me." Participants were asked to indicate the frequency of such thoughts on a 5-point Likert scale from 1 ("Not at all") to 5 ("Very much"). The ATQ-30 was previously translated into a French version (Bouvard et al., 1992) but has not yet been validated. The reliability within the present sample was high ( $\omega = 0.96$ ).

The Automatic Thoughts Questionnaire-Positive was used to evaluate the strength of participants' beliefs in 30 automatic positive thoughts (ATQ-P; Ingram & Wisnicki, 1988).

Examples for positive automatic thoughts are statements like “I’m proud of my accomplishments,” “I will be successful,” or “Life is exciting.” The frequency of each belief was assessed on a Likert scale from 1 (“Not at all”) to 5 (“Very much”). The French version of the ATQ-P was validated (Forest, 2003) with a high internal consistency ( $\alpha = 0.97$ ). In our sample, McDonald’s omega was also high ( $\omega = 0.95$ ).

The Self-Compassion Scale (SCS; Neff, 2003) was used to assess the level of participants’ self-compassion. Similar to the original version, the French version is composed of six different subscales: self-kindness (e.g., “I’m tolerant of my own flaws and inadequacies”); common humanity (e.g., “I try to see my failings as part of the human condition”); mindfulness (e.g., “When I’m feeling down I try to approach my feelings with curiosity and openness”); self-judgment (e.g., “When times are really difficult, I tend to be tough on myself”); isolation (e.g., “When I’m feeling down I tend to feel like most other people are probably happier than I am”); overidentification (e.g., “When something upsets me I get carried away with my feelings”). Although the overall SCS score can be used (Kotsou & Leys, 2016), using a two-factor model has been shown to be more valid (Brenner et al.,

**Table 2** Description of main themes of the audio MBI activities

Main theme	Details
Bodily awareness	Allowing to get a better awareness of the different parts of the body and associated sensations. Paying attention to the rhythm of breath. Becoming aware of internal and external corporal reactions which are associated with an internal state
Awareness of all senses	Observing the different senses (sight, hearing, smell, taste, touch) and the impact of internal and external factors on bodily sensations (e.g., feeling the wind in the hair; hearing sounds from close/further sources)
Mindful walking	Moving around with awareness, becoming aware of sensations of the different parts of the body during movements. Becoming aware of automatic movements associated with actions or movements that we execute daily
Thought awareness	Facing the own thoughts and becoming aware of the flow of thoughts. Becoming aware of the type and the valence of automatic thoughts and of their emergence. Face difficulties and become aware of the consequences on the body, on emotions, and cognitions. Welcome these sensations and practice to contemplate external difficulties without modifying them
Loving-kindness	Being loving and kind to oneself by accepting thoughts and sensations. Becoming aware that attention can be taken away by a thought, emotion or external sensations like a sound. Learning to bringing back the attention to the main focus (e.g., breathing) with kindness and acceptance by adopting a metacognitive posture

2017). A two-factor model comprises six specific factors (six subscales) and two general factors (positive and negative self-compassion). The subscales that measure self-kindness, common humanity, and mindfulness can be summarized in the general factor positive self-compassion. The subscales that measure self-judgment, isolation, and overidentification can be summarized in the general factor negative self-compassion. The 26 items are scored on a 5-point Likert scale ranging from 1 (“Almost never”) to 5 (“Almost always”). The reliability in our sample was high for the positive selfcompassion subscale ( $\omega = 0.90$ ) as well as for the negative self-compassion subscale ( $\omega = 0.91$ ).

The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001) was developed to identify cognitive emotion regulation strategies that are used after experiencing negative events or situations. Thirty-six items are organized into nine subscales: self-blame (e.g., “I feel that I am the one to blame for it”); other-blame (e.g., “I feel that others are responsible for what has happened”); rumination (e.g., “I dwell upon the feelings the situation has evoked in me”); catastrophizing (e.g., “I continually think how horrible the situation has been”); putting into perspective (e.g., “I think that it hasn’t been too bad compared to other things”), positive



refocusing (e.g., “I think of something nice instead of what has happened”); positive reappraisal (e.g., “I think I can learn something from the situation”); acceptance (e.g., “I think that I have to accept the situation”); refocus on planning (e.g., “I think about how I can best cope with the situation”). Items are scored on a Likert scale from 1 (“Almost never”) to 5 (“Almost always”). As suggested by the authors, the scale can be used to generate scores for all more adaptive regulation strategies (putting into perspective, positive refocusing, positive reappraisal, acceptance, and refocus on planning) and all less adaptive regulation strategies (self-blame, other-blame, rumination, and catastrophizing). The internal consistencies for all items belonging to more adaptive strategies ( $\omega = 0.90$ ) and to less adaptive strategies ( $\omega = 0.83$ ) were high. Garnefski et al. (2001) refer to “theoretically less adaptive” and “theoretically more adaptive” groups of emotion regulation strategies. This terminology considers the relative efficacy of strategies, depending on the situation in which they are used. Indeed, a specific strategy might be adaptive in one situation but not in another. The link to emotional problems must also be considered a circular causal rather than a unilateral causal mechanism which does not allow to qualify a specific strategy as definitely adaptive or maladaptive. Following Garnefski et al. (2001), the terminology of “more adaptive” and “less adaptive” strategies will be used in this manuscript.

## Data Analyses

Drop-out participants were compared to participants who remained in the study with ANOVAs realized in JASP Version 0.11.1. The pretest data from both groups were compared using *t*-tests for continuous variables and chi-square analyses for categorical variables using JAMOVI Version 1.1.2.0. ANCOVAs were conducted to determine group effects using JASP. ANCOVA is a well-suited method for examining between-group differences in randomized control designs (Huck & Melean, 1975).

Further statistical analyses of the pretest and posttest data were conducted using RStudio software version 1.2.5019 for Mac. Graphs were created using the same software. We analyzed the data using generalized linear models (GLMs). These models allowed us to evaluate how group assignment, individual differences at pretest, and the valence of each variable influenced posttest scores (e.g., Antoine, Andreotti, et al., 2018; Brockman et al., 2017). The starting model for all outcomes tested whether group assignment/valence/pretest scores significantly influenced posttest scores. We then conducted a likelihood ratio chi-square test to determine whether adding one or more interaction terms between covariate and fixed factors would improve the goodness of fit of the model.

To counteract the potential risk linked to multiple hypotheses’ testing, we carried out a Bonferroni correction for the GLM analyses. The desired minimum alpha level is set at 0.05 and three interactions were tested. Thus, the minimum desired adjusted alpha level is set at  $\alpha = 0.017$  ( $\alpha = 0.05/3 = 0.017$ ).

## Results

Data from participants assigned to the MBI group who dropped out after pretest ( $N = 34$ ) or during the intervention ( $N = 17$ ), from participants who completed the intervention ( $N = 40$ ), from participants who left the control group before posttest ( $N = 38$ ), and from control

participants who completed posttest assessments ( $N = 47$ ) were compared across all six baseline assessments (positive/negative thoughts and self-compassion, more/less adaptive emotion regulation strategies) (Table 3). ANOVAs showed a significant difference after Bonferroni correction ( $\alpha = 0.05/6 = 0.008$ ) for positive self compassion ( $p = 0.003$ ). Post hoc comparisons showed that participants assigned to the MBI group who left the study during the intervention had significantly lower positive self-compassion scores than participants who completed the intervention ( $p < 0.001$ ). No other significant differences were found. Group comparison of demographic factors (age, gender, highest level of completed education, activity, marital status, previous meditation experience) revealed no significant differences between MBI and control groups (Table 4).

**Table 3** Descriptive and ANOVA results at T0 between group (MBI and control) and drop-out or drop-in participants

	MBI		Control			ANCOVA	
	Drop-out after pretest ( $n = 34$ )	Drop-out during intervention ( $n = 17$ )	Drop-in ( $n = 40$ )	Drop-out during waitlist ( $n = 38$ )	Drop-in ( $n = 47$ )	$F(4,171)$	$p$
	$M$ ( $SD$ )	$M$ ( $SD$ )	$M$ ( $SD$ )	$M$ ( $SD$ )	$M$ ( $SD$ )		
Positive automatic thoughts	96.62 (18.87)	93.12 (18.71)	102.38 (18.31)	100.53 (20.43)	99.87 (18.24)	0.94	.44
Negative automatic thoughts	69.74 (25.8)	73.29 (26.58)	55.63 (21.81)	63.92 (26.32)	56.66 (20.71)	3.21	.01
Positive self-compassion	3.15 (0.91)	2.69 (0.94)	3.63 (0.78)	3.39 (0.92)	3.39 (0.77)	4.14	.003
Negative self-compassion	4.10 (0.97)	4.37 (1.04)	3.68 (0.87)	3.90 (1.10)	3.84 (0.97)	1.86	.12
More adaptive cognitive emotion regulation strategies	3.21 (0.72)	2.82 (0.77)	3.22 (0.73)	3.18 (0.68)	3.01 (0.64)	1.44	.22
Less adaptive cognitive emotion regulation strategies	2.62 (0.70)	2.61 (0.54)	2.43 (0.47)	2.55 (0.62)	2.48 (0.65)	0.61	.65

**Table 4** Characteristics of participants included in the MBI and control groups

Variable	Value	MBI group ( $n = 40$ )	Control group ( $n = 47$ )	$t$ ( $p$ )	$\chi^2$ ( $p$ )
Age	Mean	40.20	38.28	-.601 (.55)	
	SD	13.7	15.00		
	Range	18–68	21–72		
Gender	Female ( $n$ )	34	44		1.73 (.19)
	Male ( $n$ )	6	3		
Highest level of completed education	Brevet diploma <sup>1</sup> ( $n$ )	1	1		3.12 (.68)
	Baccalaureat <sup>2</sup> ( $n$ )	7	10		
	Bac + 2 <sup>3</sup> ( $n$ )	7	13		
	Bachelor's degree <sup>4</sup> ( $n$ )	14	10		
	Master's degree <sup>4</sup> ( $n$ )	9	9		
	Doctor's degree ( $n$ )	2	4		
Activity	Student ( $n$ )	11	17		1.68 (.64)
	Professional ( $n$ )	25	23		
	Unemployed ( $n$ )	2	3		
	Retired ( $n$ )	2	4		
Marital status	Single ( $n$ )	20	27		0.48 (.49)
	In a relationship ( $n$ )	20	20		
Prior meditation experience	Yes (%)	18	15		1.57 (.21)

<sup>1</sup>French certification of knowledge and skills acquired at the end of middle school

<sup>2</sup>French diploma which represents the completion of secondary education and qualifies for entry to university

<sup>3</sup>Baccalaureat and 2 years of higher education

<sup>4</sup>Or equivalent diploma

The first objective was to analyze the impact of an MBI on automatic thoughts, self-compassion, and emotion regulation strategies. We hypothesized that MBI has beneficial effects on these variables.

ANCOVAs were used to test if the posttest means of the MBI and control groups differed significantly after controlling for pretest scores (Table 5). Results showed a significant group

effect for positive automatic thoughts with an increase in the number of positive automatic thoughts observed for the MBI group relative to controls.

However, there were no significant group differences for negative automatic thoughts, with a decrease observed in both groups. For positive self-compassion, a similar pattern as for positive automatic thoughts was observed.

**Table 5** Descriptive statistics (mean and standard deviation) and ANCOVA results for the group effects for all studied scales

	T0		T1		T0		T1		ANCOVA		
	MBI <i>M</i>	Control <i>(SD)</i>	MBI <i>M</i>	Control <i>(SD)</i>	MBI <i>M</i>	Control <i>(SD)</i>	MBI <i>M</i>	Control <i>(SD)</i>	<i>F</i> (1,84)	<i>p</i>	Partial $\eta^2$
Positive automatic thoughts	102.38	(18.31)	99.87	(18.24)	109.63	(18.05)	98.40	(19.18)	14.45	<.001	.15
Negative automatic thoughts	55.63	(21.81)	56.66	(20.71)	47.33	(16.41)	52.28	(22.47)	2.19	.14	.03
Positive self-compassion	3.63	(0.78)	3.39	(0.77)	4	(0.78)	3.52	(0.81)	5.62	<.02	.06
Negative self-compassion	3.68	(0.87)	3.84	(0.97)	3.01	(0.90)	3.62	(0.96)	10.71	<.005	.11
More adaptive cognitive emotion regulation strategies	3.22	(0.73)	3.01	(0.64)	3.48	(0.68)	2.97	(0.68)	10.55	<.005	.11
Less adaptive cognitive emotion regulation strategies	2.43	(0.47)	2.48	(0.65)	2.17	(0.40)	2.37	(0.63)	4.04	<.05	.05

Positive self-compassion increased for the MBI group but decreased for the control group. For negative self-compassion, a main group effect was found, with a larger decrease in negative self-compassion for the MBI group relative to controls. The ANCOVAs to explore group differences in emotion regulation strategies showed significantly higher scores for more adaptive emotion regulation strategies for the MBI group than for controls. Similarly, there was a group effect, for less adaptive emotion regulation strategies with significantly lower posttest scores for the MBI group than for the control group.

The second objective was to explore differential effects of MBIs. The exploratory hypothesis was that the effects of the MBI on automatic thoughts, self-compassion, and emotion regulation strategies depend on the valence of the tested variable, group assignment, and individuals' initial level on tested variables.

To conduct the planned analyses, all negative scores were reversed, with higher scores indicating a lower level of negative automatic thoughts, negative self-compassion, and less adaptive regulation strategies. Second, all scores were standardized (*z* scores) to neutralize differences in the response scales between variables. Separate GLMs were used with posttest scores for each variable entered as dependent variables, the pretest score of each variable entered as a covariate, and group (MBI, control) and valence of the variable (negative or positive) entered as fixed factors. This allowed us to estimate whether the different independent variables and their interactions significantly influenced posttest scores (Table 6). For each pair of variables (positive and negative automatic thoughts, positive and negative self-compassion, and more adaptive and less adaptive cognitive emotion regulation strategies), we then conducted a likelihood ratio chisquare test (Table 7) to compare the goodness of fit between models. The plots (Figs. 2, 3, and 4) represent each GLM (ATQ, SCS, and CERQ) and show the change in participants' scores from pretest to posttest.

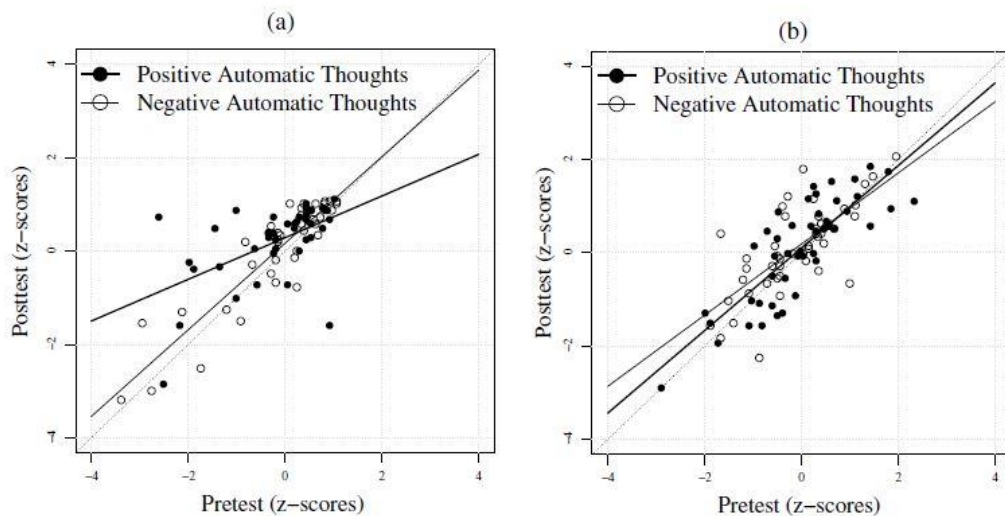
**Table 6** GLM results

	Estimate	Std. error	t	p
<b>Automatic thoughts</b>				
Intercept	0.19	.09	2.04	.04
Group	-0.02	.14	-0.14	.89
Pretest	0.76	.10	7.31	<.001
Valence	-0.09	.13	-0.67	.51
Group*Pretest	0.17	.14	1.19	.23
Group*Valence	0.21	.19	1.08	.28
Pretest*Valence	0.12	.14	0.89	.38
Group*Pretest*Valence	-0.60	.19	-3.12	<.001
<b>Self-compassion</b>				
Intercept	0.23	.12	2.02	.04
Group	0.10	.17	0.6	.55
Pretest	0.55	.13	4.14	<.001
Valence	0.03	.16	0.16	.87
Group*Pretest	0.36	.19	1.89	.06
Group*Valence	0.05	.25	0.21	.84
Pretest*Valence	0.17	.17	0.97	.33
Group*Pretest*Valence	-0.61	.26	-2.37	.02
<b>Cognitive emotion regulation</b>				
Intercept	0.04	.11	0.34	.74
Group	0.2	.16	1.24	.22
Pretest	0.80	.11	7.59	<.001
Valence	0.12	.15	0.81	.42
Group*Pretest	-0.41	.16	-2.47	.01
Group*Valence	-0.02	.23	-0.07	.95
Pretest*Valence	-0.25	.16	-1.53	.13
Group*Pretest*Valence	0.69	.23	3	<.001

The GLM analyses showed that the interaction between group assignment, pretest scores, and valence of the variable was significant at a level of  $\alpha = 0.017$  for automatic thoughts ( $p < 0.001$ ) and emotion regulation strategies ( $p < 0.001$ ) and at a level of  $\alpha = 0.05$  for self-compassion ( $p = 0.02$ ).

**Table 7** ANOVA omnibus tests of generalized linear models

Model	Automatic thoughts			Self-compassion			Cognitive emotion regulation		
	LR $\chi^2$	df	p	LR $\chi^2$	df	p	LR $\chi^2$	df	p
Group	1.06	1	.30	1.15	1	.28	2.38	1	.12
Pretest	259.60	1	<.001	109.91	1	<.001	141.79	1	.64
Valence	0.20	1	.67	0.57	1	.45	0.55	1	.46
Group*Pretest	2.24	1	.13	0.05	1	.83	0.22	1	.64
Group*Valence	2.13	1	.14	0.48	1	.49	0.21	1	.65
Pretest*Valence	3.61	1	<.001	0.64	1	.42	0.64	1	.42
Group*Pretest*Valence	9.75	1	<.001	5.63	1	.02	8.99	1	.003



**Fig. 2** GLM results representing change in participants' scores from pretest to posttest for positive and negative automatic thought scores for MBI group (a) and control group (b)

The analyses indicated that the interaction between group assignment, pretest scores, and valence of the variable significantly influences the level of automatic thoughts. The likelihood ratio test (Table 7) confirmed that the final model, including an interaction between the covariate and the fixed factors, improved the model significantly ( $p < 0.001$ ). The plots (Fig. 2) allowed to specify the direction of this effect. Although no important changes were observed in the control group, a substantial change in positive automatic thoughts was observed in the MBI group. The previous ANCOVAs also showed that the MBI was more beneficial for positive than for negative thoughts. More specifically, participants in the MBI group did not show significantly lower levels of negative thoughts but higher levels of positive thoughts. Figure 2 shows that this increase was only present for participants with a low level of positive thoughts at pretest, indicating that participants with initially low levels of positive thinking benefitted more from the intervention than participants who had already a high frequency of positive thoughts at pretest.

For self-compassion scores, GLM analyses showed that the interaction between all independent variables (pretest scores, group, and variable valence) was significant only at  $\alpha = 0.05$  ( $p = 0.02$ ) (Table 6). Figure 3 shows a general improvement of self-compassion scores for the MBI group, compared to the control group. More specifically, for participants in the MBI, scores of positive self-compassion improved more than negative self-compassion scores decreased.



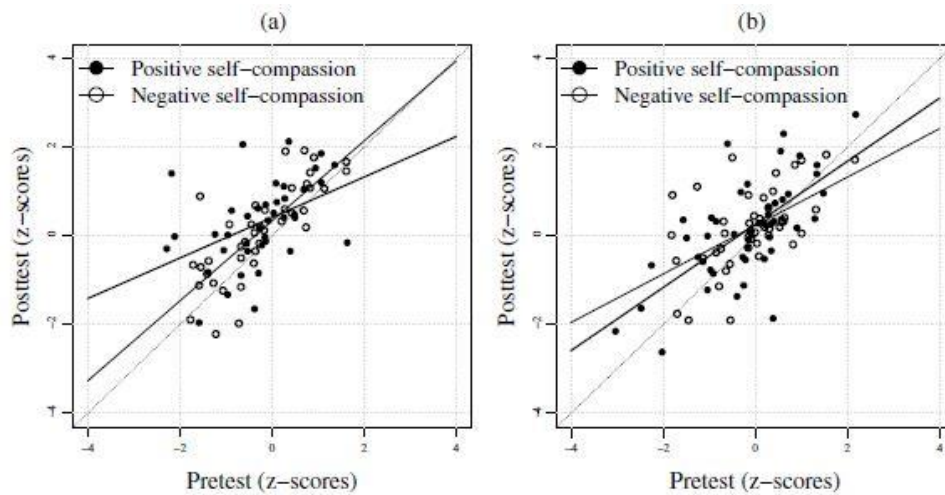


Fig. 3 GLM results representing change in participants' scores from pretest to posttest for positive and negative self-compassion scores for MBI group (a) and control group (b)

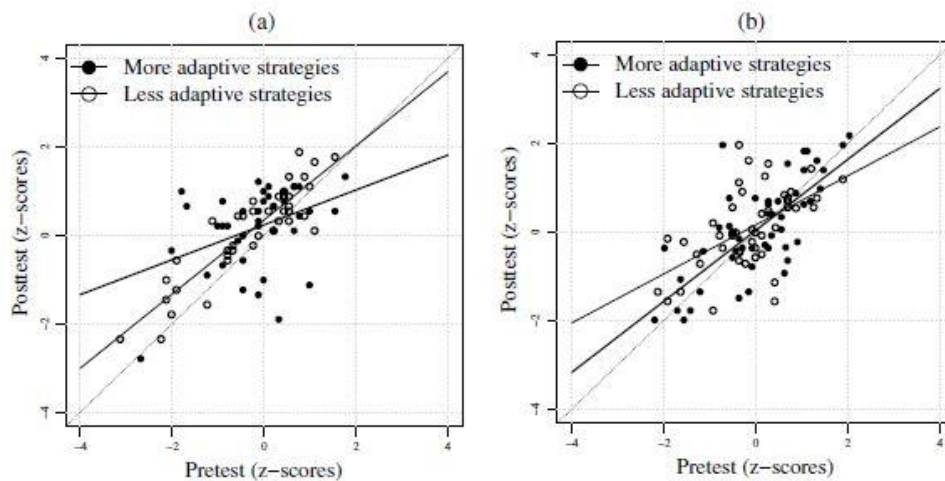


Fig. 4 GLM results representing change in participants' scores from pretest to posttest for more adaptive and less adaptive cognitive emotion regulation strategy scores for MBI group (a) and control group (b)

Regarding this improvement in positive self-compassion, participants with low positive self-compassion at pretest benefitted more from the intervention than participants with already high levels of positive self-compassion at pretest. Almost no change was observed for negative self-compassion.

For cognitive emotion regulation strategies, GLM analyses showed a significant interaction between all factors and the covariate (Table 6) and the likelihood ratio test confirmed that the full interaction model was the significantly best fit ( $p = 0.003$ ). The data indicated that the less adaptive emotion regulation strategies decreased from pretest to posttest in the control group but only for participants with a particularly high level of use of these strategies at pretest. No change was observed for more adaptive emotion regulation strategies. For the MBI group, the slopes were opposite to those of the control group (Fig. 4). Although a slight decrease in the use of less adaptive emotion regulation strategies was observed, the effect on more adaptive strategies was more substantial. Once again, the MBI showed a larger effect on the more positive valenced variable than on the negative counterpart. More specifically, participants with a low level of use of more adaptive strategies at pretest benefitted most

from the intervention. The opposite effect was found for some participants with a medium level of use of more adaptive strategies at pretest: certain participants who indicated at pretest that they were using many adaptive emotion regulation strategies did not improve the use of these strategies during the intervention and Fig. 4 even shows a decrease of more adaptive strategies. A slightly larger benefit for participants with a high level of use of less adaptive strategies at pretest than for participants with an average or a low level of use of these strategies was observed (Fig. 4). In other words, participants who indicated at pretest that they were using many less adaptive strategies and few more adaptive strategies benefitted more from the MBI than participants whose strategy use was already more adapted.

## **Discussion**

This study investigated the effects of a 6-week self-help MBI. Our first hypothesis was confirmed: the MBI showed beneficial effects on automatic thoughts, self-compassion, and emotion regulation strategies. This corroborates results from previous studies (Antoine, Andreotti, et al., 2018a, b; Spijkerman et al., 2016) which showed that self-help MBIs represent an interesting approach for mindfulness practices in general. Regarding our second objective, the results of the model comparisons showed an almost consistent larger effect on positive aspects of variables than on negative ones. This finding means that the intervention affected positive and negative variables but that the effects were more salient on positive aspects of psychological functioning. Moreover, the described effects were importantly influenced by individual differences (Brockman et al., 2017; Tavakoli & Kazemi-Zahrani, 2018).

As previously shown, MBIs have beneficial effects on cognitions (Frewen et al., 2008; Garland et al., 2015; Lindsay et al., 2018). First, positive automatic thoughts increased significantly for the MBI group. However, levels of negative thoughts at posttest were not significantly different between groups. This effect could be explained by the nature of mindfulness interventions because they do not focus specifically on negative or positive thoughts but emphasize acceptance of the emergence of any kind of thought. The analyses for automatic thoughts also showed that the effect of the MBI was more important for positive thoughts. An increased number of positive cognitions might result from broadened attentional skills allowing attention to select mood-congruent stimuli (Hanley et al., 2021). In other words, MBI might help participants decenter from current negative situations through a broadened metacognitive state. Garland et al. (2015) hypothesized that mindfulness practices allow for the positive tuning of information. Reflections on formerly negatively perceived situations might be positively valenced, which might also be why the posttest negative thoughts levels were not significantly different between groups.

Our results are also consistent with previous findings on the beneficial effects on self-compassion (Raab et al., 2015). The study found a significant decrease in negative self-compassion and an increase in positive self-compassion. This finding can be linked to the practice of general skills in the acceptance of oneself and others. As Neff (2003) stated, being mindful helps individuals experience and accept various emotions instead of avoiding or repressing them, thus improving self-compassionate attitudes. The increase in positive self-compassion might be part of a virtuous circle among different variables, such as positive

thoughts and emotions, allowing participants to engage in an upward spiral toward greater psychological well-being. Emotion regulation strategies also play an important role in these processes (Pavani et al., 2016). Indeed, improved self-compassion is linked to a decrease in maladaptive coping tendencies (Raab et al., 2015).

Our MBI had beneficial effects on both more adaptive and less adaptive strategies, indicating that participants were able to improve the use of regulation strategies that have important effects on general emotional states. The differential analysis for emotion regulation strategies showed a significantly stronger effect of the MBI on more adaptive emotion regulation strategies than on less adaptive strategies. MBIs promote a general accepting attitude, hence furthering self-acceptance and decreasing self-blame. They also aim to enhance acceptance toward others and life circumstances, thus affecting strategies such as blaming others. In addition, through the refinement of observational and metacognitive skills, MBIs enhance cognitive and emotional flexibility. Therefore, the selection and adaptation of emotion regulation strategies to life situations can be enhanced (Tavakoli & Kazemi-Zahrani, 2018). Furthermore, more adaptive cognitive emotion regulation strategies are part of the broadening link between positive affect and cognitions. More positive thoughts allow participants to engage in more efficient strategies and vice versa.

To summarize, our results showed important improvements in both negative and positive aspects of psychological functioning, suggesting that MBIs are beneficial for both aspects, with stronger effects for positive aspects. As mentioned at the beginning of our paper, the common aim of all psychological interventions is to improve psychological health and well-being, which can be achieved through a balance between the positive and negative aspects of affect and affect-related variables. This result indicates that a focus on negative variables can lead to a bias in understanding the effects of mindfulness practice. The experience of a large diversity of emotions and the use of various emotion regulation strategies allow an emotional experience to be less polarized and give it more flexibility. This is a beneficial capacity and can be furthered by MBIs, as shown by this study. In addition, other studies (e.g., Pavani et al., 2016) indicate that the improvement in the positive aspects of psychological functioning is important because it allows for engagement in an “upward” spiral to greater well-being. This has been conceptualized in flourishing theories that show that the experience of positive emotions helps to build resources, and to use more adaptive mechanisms, and thus to improve well-being and life satisfaction by reinforcing each other (Frederickson & Losada, 2005; Fredrickson et al., 2008; Lindsay et al., 2018). These results are important for future mindfulness studies because they show that positive variables are as important to evaluate as negative variables in the context of mindfulness interventions and their effects on psychological health.

It is important to note that the focus on negatively valenced variables in interventions and literature is linked to the origins of mindfulness-based interventions. Indeed, traditional MBIs follow the “mindfulness-based stress reduction” (MBSR) principles which induce a focus on the reduction of stress and the investigation of variables which measure distress rather than happiness. However, the current results show that this might be a reductionist approach. It seems indispensable to include a larger panel of positively and negatively valenced variables



when measuring effects of MBIs. In addition, when a traditional MBSR intervention is implemented, its content should be considered carefully. We suggest that more MBIs could include components which target both distress and happiness and thus represent a balanced vision of psychological functioning. This could increase the likelihood of benefits for participants' and patients' psychological well-being.

Regarding differences in results based on individual differences, we observed that participants scoring particularly low on the positive pretest scales experienced stronger effects than those who scored higher. This effect has commonly been observed in intervention studies (Antoine, Andreotti, et al., 2018), usually because low-scoring participants have greater potential for improvement than participants already scoring high at pretest. For these participants, the experience and practice of mindfulness might have been a new experience, thus inducing new types of strategies and thoughts and making the psychological functioning overall more flexible. For participants with high levels of positive thoughts, positive self-compassion, and more adaptive emotion regulation at pretest, the MBI was neither harmful nor beneficial which can be an indicator of an initially balanced and adapted psychological functioning, at least regarding positively valenced variables. This is an important finding to take into consideration when selecting a psychological intervention which is best fitted to everyone.

### **Limitations and Future Research**

Due to limited resources in terms of availability of participants for the whole length of the program, we opted for a sensitivity analysis rather than an a priori power analysis. Thus, we aimed at a recruitment of approximately 100 participants. As the results show, the study had enough power to detect the described effects. The sensitivity analysis informed us that the study was able to detect small to medium effect sizes which shows. Another limit concerns the use of self-assessment methods (subjects report their own perceptions on different constructs). This can artificially increase correlations between measurement instruments, owing to response styles, social desirability, and priming effects which are independent from the true correlations among the measured constructs (Podsakoff et al., 2012).

In future studies, we suggest that the analysis of global scores (e.g., more adaptive, less adaptive regulation strategies) could be completed by an analysis of individual sub scale scores. Effects of sub-groups of individuals or single individuals (e.g., Fig. 4 shows a decrease from pretest to posttest of more adaptive strategies in the MBI group for a few individuals) could be even better understood using more specific analyses.

This study was conducted with participants without psychopathological or health issues. Because most mental health disorders directly influence emotions, emotion regulation, and various other variables (Aldao et al., 2010), the lack of mental health disorders among the study participants might have influenced the strength of the study outcomes. Studies including participants with psychological difficulties or disorders might find stronger effects from the potential for improvement among such participants. In addition, the results are based on an exploratory research approach. Thus, the clinical relevance of these outcomes, especially for clinical populations, has to be established by confirmatory research.

Reasons for drop-out were not collected and can only be hypothesized. At the different stages of study, participants might have felt overwhelmed by the considerable number of questions they had to answer or by the length of the intervention. Motivation difficulties or dissatisfaction with the MBI program as well as practical reasons such as lack of time could also have been a reason for drop-out. A qualitative evaluation of reasons for drop-out should be included in future studies.

Importantly, we found a statistically significant difference between drop-out participants (who had completed pretests) and participants who continued the program. This is a valuable information for future studies as dropout participants had a significantly lower level of positive self-compassion. We could hypothesize that aspects of the MBI, which refer to self-awareness and self-observation, might have been too overwhelming for participants who have initial difficulties in being self-compassionate. These individual differences are worth being considered during recruitment and study participation. A more individualized support with personalized recommendations for practice might be necessary to reduce drop-out rates and to avoid leaving individuals with a lower level of psychological health without psychological support.

Regarding the relatively high drop-out rates, it is important to note that this might be characteristic for homebased MBIs. Indeed, the latter are designed for a larger public whereas the traditional MBSR interventions are more specific and require an important personal implication prior to the beginning of the program.

In future studies, it would also be insightful to study medium- and long-term results through a follow-up protocol and to add an active control condition (e.g., alternative intervention), which would allow for better comparisons between the MBI and control groups. The number of completed MBI sessions and adherence data could also be included in future studies. The inclusion of those indicators was planned. However, reporting the completion of MBI sessions on a daily basis appeared to be a difficult task for participants, which was reflected in their personal feedback and in an important number of missing reports and irregular data points. Thus, the representativeness of those measures has been estimated to be insufficient and the latter has been excluded from analyses.

Overall, this study showed that a regular home-based MBI has beneficial effects on automatic thoughts, selfcompassion, and cognitive emotion regulation strategies. The benefits seem to be particularly important for positive thoughts, positive self-compassion, and more adaptive emotion regulation strategies—and for participants with initially low scores for these variables. These first exploratory results suggest that future studies should investigate positive and negative aspects of psychological health more systematically and continue to study individual differences related to these variables. Such research could provide a reference for the more appropriate representation of the effects of mindfulness studies and for the development of interventions that are better suited to participant's needs and characteristics.

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