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An Eight-Week Mindfulness-Based Stress Reduction (MBSR) Workshop Increases Regulatory Choice Flexibility

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Individuals encounter a variety of emotional challenges daily, with optimal emotion modulation requiring adaptive choice among available means of regulation. However, individuals differ in the ability to flexibly and adaptively move between engaging and disengaging emotion regulation (ER) strategies as per contextual demands, referred to as regulatory choice flexibility. Greater regulatory choice flexibility is associated with greater mental health, well-being and resilience, warranting the development of interventions to increase such flexibility. We hypothesized that a mindfulness-based stress reduction (MBSR) program would fulfill this goal. To test our hypothesis, we recruited college students to either participate in an 8-week MBSR workshop or join a waiting list for a later workshop (i.e., control participants). After the workshop's completion, all participants were invited to the laboratory and completed several computerized tasks examining their regulatory choice flexibility when exposed to universally emotion-laden stimuli as well as stimuli specifically related to the students' social and political environment. The regulatory choice patterns of participants who underwent MBSR training were found to be more flexible than those of participants who had not yet completed the workshop, with the former more likely than the latter to favor an engaging ER strategy (i.e., reappraisal) when faced with low-intensity stimuli and a disengaging strategy (i.e., distraction) when faced with high-intensity stimuli. The findings' importance is discussed.

Keywords: emotion regulation, choice, flexibility, mindfulness, MBSR

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ER refers to the processes that influence which emotions we experience, when we experience them, and how we experience and express them (Gross, 1998, 2002, 2015). Various ER strategies have been identified, and these can roughly be charted along a disengagement-engagement continuum (Gross, 2002). For example, distraction constitutes a disengaging ER strategy, as one focuses attention away from emotional information and toward unrelated thoughts. Cognitive reappraisal, on the contrary, constitutes an engaging ER strategy in which one caters to emotional information while changing its meaning so as to alter its emotional impact.

According to Gross (2002), emotions can be regulated at different stages of the emotion generation process, from situation selection, through attention deployment and cognitive change, to the modification of the emotional expression. Consequently, the impact of different ER strategies depends on when and how they influence the emotion-generative process (Goldin, McRae, Ramel, & Gross, 2008), and how well the features of each strategy are suited to the intensity of the stimulus at hand. For example, distraction exerts its influence very early in the emotion-generative process and thus can occur at the immediate onset of encountering a stimulus, whereas reappraisal exerts its influence only later in the process and requires initial engagement with a stimulus before its meaning can be changed (Goldin et al., 2008; Sheppes & Meiran, 2007, 2008; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011).

For a long time, the leading notion in ER research was that cognitive reappraisal leads to healthier outcomes and greater psychological well-being than other, less engaging strategies (Gross, 2002; for a review, see Webb, Miles, & Sheeran, 2012). Recently, however, there is a growing understanding that a regulatory strategy that is adaptive in one context can prove less adaptive or even

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maladaptive in a different context (Schönfelder, Kanske, Heissler, & Wessa, 2014; Sheppes, Scheibe, Suri, & Gross, 2011; Sheppes et al., 2014). Demonstrating this, Sheppes and his colleagues have found that individuals' preferences for engaging versus disengaging strategies are associated with the effectiveness and benefits of using each strategy when dealing with stimuli of different emotional intensities (Sheppes, 2014; Sheppes & Levin, 2013). Because the early onset of disengaging strategies like distraction provides stronger modulation of affect (e.g., Shafir, Schwartz, Blechert, & Sheppes, 2015; Sheppes & Meiran, 2007), they found a clear preference for disengagement-distraction over engagement-reappraisal when individuals are confronted with high-intensity stimuli (e.g., Hay, Sheppes, Gross, & Gruber, 2015; Sheppes et al., 2011, 2014). Conversely, when faced with low-intensity stimuli, individuals show a preference for engagement-reappraisal (Sheppes, 2014; Sheppes & Levin, 2013), as it is similarly effective to distraction for low intensities while also affording long-term benefits such as better recall for stimuli (e.g., Shafir et al., 2015; Sheppes & Meiran, 2007).

These studies have given rise to the notion of regulatory choice flexibility, suggesting that an *adaptive* regulatory profile is not restricted to a specific ER strategy, but rather is a flexible one, suited to situational and contextual demands (Bonanno, 2005; Kashdan & Rottenberg, 2010; Levy-Gigi et al., 2016; Waugh, Thompson, & Gotlib, 2011). The ability to choose the most adaptive regulation strategy in each situation is hypothesized to require a diverse repertoire of regulatory strategies, high sensitivity to context, high responsiveness to emotional feedback (i.e., internal information about one's own emotions and external information about others' responses), and deliberate executive control that can override automatic emotional responses (Birk & Bonanno, 2016; Bonanno & Burton, 2013; Sheppes & Levin, 2013).

Several empirical studies support the notion that flexible deployment of varied ER strategies across contexts is more beneficial for healthy human functioning and resilience than the regular employment of a specific ER strategy (Bonanno & Burton, 2013; Bonanno, Papa, Lalande, Westphal, & Coifman, 2004; Levy-Gigi et al., 2016; Rodin et al., 2017; Sheppes et al., 2011, 2014; Waugh et al., 2011). For example, Levy-Gigi and her colleagues (2016) examined interpersonal differences in regulatory choice flexibility, operationalized as the tendency to favor engaging strategies for low-intensity stimuli and disengaging strategies for high-intensity stimuli. They found that greater regulatory choice flexibility moderated the relationship between the extent of exposure to traumatic experiences and the prevalence of posttraumatic stress symptoms among firefighters. More specifically, the extent of exposure was only correlated with symptom prevalence among firefighters low in regulatory choice flexibility, with no such relationship found among those high in regulatory choice flexibility. In a slightly different design, Birk and Bonanno (2016) asked participants to choose whether they would like to switch to employing distraction after initially engaging in cognitive reappraisal. They found that individuals who tended to switch from cognitive reappraisal to distraction when confronted with more intense emotion-provoking stimuli reported greater life satisfaction, but only when the switching response was in line with internal (bodily) emotional feedback.

As individuals vary in regulatory choice flexibility (Bonanno, 2005; Kashdan & Rottenberg, 2010; Levy-Gigi et al., 2016; Waugh et al., 2011), not all similarly enjoy its benefits for mental health and well-being. Interventions to increase regulatory choice flexibility could therefore be important means of promoting these positive outcomes. We suggest that mindfulness in general, and the MBSR program (Kabat-Zinn, 1990), in particular, could serve this goal, for the reasons detailed below.

Mindfulness, ER, and Regulatory Choice Flexibility

Mindfulness is a psychological construct drawn from the Buddhist tradition, which refers to a self-regulated attentional stance oriented toward present-moment experience, characterized by curiosity, openness, and acceptance (Dahl, Lutz, & Davidson, 2015). At its very essence, mindfulness practice involves developing skills for dealing with negative thoughts and emotions in an adaptive and flexible manner (Baer, 2003; Chambers, Gullone, & Allen, 2009; Shapiro, Carlson, Astin, & Freedman, 2006), described as "Right Effort" in Buddhist texts (for details, see Batchelor, 2011). Cultivating a diverse regulatory repertoire is an explicit goal of the practice, examples of which can be traced back to ancient Buddhist texts. For example, the Discourse on the Forms of Thought (or Vitakkasanthana Sutta, Majjhima Nikaya 20; Bhikkhu, 1997) lists various strategies to deal with negative thoughts, ranging from engaging strategies (such as deep experiential investigation of the negative mind-state or positive reappraisal of negative situations) to disengaging strategies (such as "[bringing] about forgetfulness and lack of attention to those [negative] thoughts"; Batchelor, 2011; de Silva, 1985). Thus, similar to the regulatory choice literature, this ancient text argues that an adaptive regulatory strategy is context-dependent. At certain times, focusing attention on the disturbing situation is more adaptive, whereas at other times (e.g., when certain thoughts are simply too strong or disturbing to confront), a more adaptive approach would be to focus attention away from them (Batchelor, 2011).

The ability to identify the most adaptive approach for each moment lies, according to Buddhist psychology, in the ability to dissolve the powerful effects of habitual responses to experiences (Batchelor, 2011). In the view of Buddhist psychological theories, when an object comes into awareness (e.g., the image of a wounded person) an associated "feeling tone" arises as well, which is the immediate and spontaneous affective experience of this awareness process (Grabovac, Lau, & Willett, 2011). The quality of this spontaneous feeling tone can be pleasant, unpleasant, or neutral (neither pleasant nor unpleasant). The key to Buddhist psychology is the understanding that these spontaneous feeling tones are accompanied by a habitual reaction—expressed as thoughts, memories, and emotions—to pursue pleasant feelings and to avoid those that are unpleasant (termed as attachment and aversion reactions, respectively). Thus, an image of a wounded person may spontaneously arouse an unpleasant feeling that is immediately accompanied by a habitual aversive response to this feeling, perhaps expressed as very negative emotions, or difficult thoughts and memories. These habitual responses are themselves accompanied by a feeling tone that provokes further habitual responses, and the process can thus feed itself. In mindfulness practice, sensory and mental events are allowed to naturally arise and fall away, without subsequent automatic processing stemming from either attachment or aversion (Grabovac et al., 2011). Importantly, the mental events related to the image of the wounded person will still be experienced as a feeling tone (in our example,

unpleasant), but with no aversion and thus no mental proliferation. The powerful effects of mental, emotional, and physical habits are thus dissolved, increasing one's ability to identify the most adaptive approach at any given moment (Batchelor, 2011).

Modern mindfulness programs, such as the MBSR (Kabat-Zinn, 1990) program developed by Jon Kabat-Zinn and its derivative, mindfulness-based cognitive therapy (MBCT; Segal, Williams & Teasdale., 2002), are largely based on Buddhist practices. Consequently, a central feature of MBSR and MBCT is the cultivation of a greater flexibility in regulatory responses (Batchelor, 2011). This is achieved through various meditative exercises that foster the ability to orient and manipulate the aperture of attention and increase sensitivity to sensations, feelings, and thoughts (Dahl et al., 2015; Kabat-Zinn, 1990; Lutz, Slagter, Dunne, & Davidson, 2008). For example, one practice in MBSR/MBCT, called "body scan" (Kabat-Zinn, 1990, pp. 75–93; Segal, Williams, & Teasdale, 2002, pp. 110–117), involves mobilizing attention sequentially from body part to body part (disengaging from the previous part and engaging with the new part), narrowing the attention aperture to the specific bodily area at any given moment and increasing sensitivity to the sensations within it. In another MBSR/MBCT exercise, participants cultivate the ability to bring stable attention and awareness to their sensations when breathing, while simultaneously disengaging from thoughts, sounds, and other bodily sensations that constantly enter one's stream of consciousness (Kabat-Zinn, 1990, pp. 59–74; Segal et al., 2002, pp. 146–147, 164–165). In yet a third practice, participants cultivate receptivity and willingness to stay in contact with all components of the experience, reducing reflexive avoidance and the need to employ escape behaviors (Kabat-Zinn, 1990, pp. 59–74; Segal et al., 2002, pp. 146–147, 164–165).

Such mindfulness practices have been found to increase executive control and cognitive flexibility (e.g., Moore & Malinowski, 2009) and decrease automatic responses to emotional experiences (e.g., Erisman & Roemer, 2010; Jha, Krompinger, & Baime, 2007). A central component in these practices is the cultivation of awareness to subtle thoughts, sensations, feelings, shifts in affective tone, and incoming sensory information (Dahl et al., 2015; Jha et al., 2007), leading to increased body awareness and sensitivity to emergent affective cues in the experiential field (Carmody & Baer, 2008; Cebolla et al., 2016). Teper, Segal, and Inzlicht (2013) suggested that this increased sensitivity to affective cues refines the signaling of the need for executive control, and, in turn, enhances ER abilities. Indeed, a surge of recent studies has offered evidence of beneficial emotional outcomes associated with mindfulness, and especially its relation to enhanced ER abilities (for a review, see Roemer, Williston, & Rollins, 2015).

In line with the understanding of mindfulness practice from the Buddhist perspective, Roemer and colleagues (2015) have suggested that mindfulness may be particularly useful in promoting flexible and context-relevant ER choice. Indeed, when integrating findings from mindfulness interventions with recent understandings in the field of ER research, mindfulness practice seems to tap into some of the aforementioned capacities suggested to underlie individual differences in regulatory choice flexibility (Birk & Bonanno, 2016; Bonanno & Burton, 2013; Sheppes & Levin, 2013)—namely, having access to a diverse repertoire of regulatory strategies, increased sensitivity to emotional feedback, and deliberate executive control.

Given that MBSR programs seem to foster a wider repertoire of regulatory abilities spanning the disengagement-engagement continuum (e.g., letting go of thoughts and emotions to focus on one's breath, or acceptance of and engagement with all aspects of experience), increase awareness to subtle thoughts, sensations, feelings, and incoming sensory information carrying affective cues (Carmody & Baer, 2008; Cebolla et al., 2016; Dahl et al., 2015; Jha et al., 2007), decrease automatic reactivity (e.g., Erisman & Roemer, 2010; Jha et al., 2007), and increase executive control and cognitive flexibility (Moore & Malinowski, 2009), we expect that MBSR participants will demonstrate an increased ability to skillfully and flexibly choose among ER strategies in different contexts.

The Present Research

The goal of the present study was to test the hypothesis that an MBSR training program would increase individuals' ability to flexibly choose between ER strategies in an adaptive manner: that is, choose disengaging-distraction when viewing high-intensity emotional stimuli and engaging-reappraisal when viewing low-intensity stimuli. In particular, we investigated whether MBSR training would increase regulatory choice flexibility in response to: (a) validated laboratory images with universally emotion-inducing content, drawn from the International Affective Picture System (IAPS; Bradley & Lang, 2007) and used in previous ER choice studies (e.g., Sheppes et al., 2011), and (b) personally relevant emotion-inducing stimuli presenting participants' more immediate social and political environment, used in ER choice studies in the particular context presently under examination (Pliskin, Halperin, Bar-Tal, & Sheppes, 2018). While the widely used laboratory images served as a means to reproduce previous findings (Pliskin et al., 2018; Sheppes et al., 2011, 2014), the social-political real-life images served to investigate whether the effects would generalize to situations closer to real-life settings, as should be expected from a real-life intervention designed to increase people's well-being and coping with stress stemming from their daily environments.

To address these goals, individuals who enrolled in several MBSR courses were invited to the lab to complete a well-established and validated ER choice protocol (Sheppes et al., 2011, 2014). Participants who were actually undergoing an MBSR intervention during the data collection period were considered the experimental group (MBSR group), while participants who were waiting for their course to begin in the following semester (only *after* data collection on ER choice has ended) were considered the control group. Using the ER choice protocol, we investigated differences in individuals' choice between cognitive reappraisal and distraction as a function of stimulus emotional intensity and the experimental condition. Our hypothesis was that participants in the MBSR group will demonstrate greater regulatory choice flexibility than those in the control group. In other words, we expected that following an MBSR workshop, individuals will have a more pronounced tendency to choose distraction over reappraisal when regulating responses to high-intensity stimuli and reappraisal over distraction when regulating responses to low-intensity stimuli. We expected to find these differences not only when choosing how to regulate the experience of universally accepted laboratory images, but also the experience of images pertaining to stressors in partic-

ipants' immediate social-political environment, related to events encountered as part of their daily life.

Method

Participants

Participants were 111 Jewish Israelis (67 female, 44 male; ages 21–40, M_{age} = 25.12, SD = 5.1) who were enrolled in any of eight MBSR workshops at three universities across Israel. Participants in one group were recruited as part of an elective MBSR course in an undergraduate psychology program, whereas the other participants were university students recruited through advertisements that offered individuals the opportunity to participate in a MBSR workshop for a significant discount, in return for participation in a follow-up study. The workshops were offered during the fall and spring semesters and participants signed up for the workshops based on personal scheduling considerations (in some cases students' schedules enabled them to choose between two options and in others they had only one). Participants who chose to take part in the three fall workshops and those in the undergraduate elective course were assigned to the experimental group (MBSR group), whereas those who signed up for the four spring workshops were assigned to the control group. Importantly, all participants, from both the experimental and control groups, had actively enrolled in MBSR courses, and except for the elective course, all participants paid the enrollment fee *prior* to the beginning of data collection. This enabled us to ensure motivation and interest in mindfulness practice was equal across conditions. Data was collected from all participants twice—once before the MBSR group began its courses (Time 1 [T1]) and once after this first round of courses ended (Time 2 [T2]). Thus, at T2, participants in the MBSR group had already completed 8 weeks of mindfulness practice, whereas participants in the control group had yet to complete any mindfulness practice and were waiting for their courses to start immediately after the completion of data collection.

Fifteen participants were excluded at T1 from the study following prescreening for depression and posttraumatic stress disorder. Four MBSR group participants did not have T2 data, with two having canceled their participation in the course close to its beginning due to time-scheduling difficulties, one unable to appear at the lab at T2 due to medical issues, and one electing to terminate participation in the middle of the rating task as the sociopolitical emotion-provoking images distressed him or her. T2 data was also missing for seven control group participants did not have T2 data, of whom four canceled their participation in the course at the last minute due to scheduling difficulties and one was excluded from the ER choice task due to previous knowledge of the task. The recorded data for the additional two participants was lost due to technical reasons.

The final sample consisted of 85 Jewish Israelis (48 female, 37 male; M_{age} = 26.78, SD = 4.5): 37 participants in the MBSR group (who underwent mindfulness training between T1 and T2) and 48 in the control group (who began their mindfulness training only after T2 data was collected).

Procedure and Measures

The study was approved by the institutional ethics review committee of the Interdisciplinary Center Herzliya. Mindfulness was cultivated using the MBSR program, developed by Jon Kabat-Zinn (1990). This "gold standard" model of a mindfulness intervention (Van Dam et al., 2018) is a structured, group-formatted, 8-week program that consists of weekly 2.5-hr sessions led by a skilled instructor, complemented by a 1-day retreat. It confers skills such as body scan, sitting meditation, yoga and movement exercises, and mindfulness practice in daily life. Additionally, participants are given guided meditation recordings and worksheets to promote regular home practice. Seven of the MBSR workshops in the present study followed this exact outline. The eighth workshop was embedded within an elective undergraduate course and was thus extended over 13 weekly 1.5-hr sessions, as well as one full-day retreat. All four instructors were certified MBSR instructors, having completed a professional teacher training program in MBSR provided by Bangore University in the United Kingdom and having each accumulated at least two years of experience teaching mindfulness. The teacher of the undergraduate course was one of the authors (NLB), and her identity as one of the study leaders was concealed from participants to avoid bias.

All participants in the experimental group attended almost all MBSR classes (M = 83.2%, SD = 14.25) and completed a moderate amount of weekly hours of home practice (M = 56.48 min per week, SD = 34.41, based on self-report). Before the MBSR group started its workshops (T1), all participants signed informed-consent forms and completed a 30-min online questionnaire. The T1 questionnaire included a 15-item scale measuring mindfulness trait (using the Mindful Attention Awareness Scale; Brown & Ryan, 2003), with each item (e.g., "I could be experiencing some emotion and not be conscious of it until sometime later") rated on a 6-point scale ranging from 1 (*almost always*) to 6 (*almost never*). All responses were reverse coded so that higher scores indicated higher trait mindfulness (Cronbach's alpha = .89). The T1 questionnaire also included demographic questions, prompting participants to report their sex, age, religiosity, relative income, and former experience with mindfulness practice. The questionnaire's content was designed to allow us to control for any preexisting between-groups differences.

Once the MBSR group completed its workshop (T2), participants from both groups were invited to the lab for a 60-min session that consisted of two computerized tasks: an intensity rating task (using procedures by Bradley & Lang, 2007), followed by an ER choice task (adapted from Sheppes et al., 2011). Following Sheppes and his colleagues (2011), we included IAPS images (Bradley & Lang, 2007) as our *general stimuli,* but we complemented these with images documenting real-life events in the Israeli-Palestinian conflict, collected from various resources (for further details, see Pliskin et al., 2018) as our *sociopolitical stimuli*. The images from the two collections were intermixed, and all were presented in random order in each task. We included the rating task because we anticipated interpersonal differences in intensity ratings for the sociopolitical stimuli (Pliskin et al., 2018), of relevance to differences in regulatory choice flexibility. This design allowed us to factor in subjective emotional intensities per participant per stimulus, rather than assuming objective intensity levels for each stimulus. The order of the two tasks was fixed, such that the rating task always preceded the ER choice task. This is because reappraisal may substantially affect intensity ratings upon second exposure (Blechert, Sheppes, Di Tella, Williams, & Gross, 2012;

Thiruchselvam et al., 2011), preventing any meaningful collection of intensity ratings following a regulation task.

In the rating task, each image (60 in total) was presented for 1,500 ms, after which participants were prompted to rate the intensity of their negative experience on a single scale (anchored at 1 = *not negative at all* and 9 = *extremely negative*). We employed this short display period to reduce habituation effects in the ER choice task due the prior exposure of the images during the rating task, closely following previous studies with similar procedures (Pliskin et al., 2018).

The ER choice task was based on the well-established paradigm developed by Sheppes and his colleagues (2011). Before this task, participants underwent a training phase in which they viewed negative emotion-provoking images and were instructed either to think about something that was emotionally neutral (distraction) or to think about an image in a different way, so as to reduce its negative impact (cognitive reappraisal). Two training trials were presented for each strategy, with the strategies' order counterbalanced between participants. This was followed by a three-trial choice training phase in which participants were asked to describe their chosen strategy aloud and were corrected by the experimenter as needed. The regulatory choice task itself comprised 60 experimental trials, each consisting of a fixation point (1,500–2,000 ms), followed by a brief appearance of a target image (500 ms), followed by a prompt to choose between reappraisal and distraction (with the strategies' onscreen position counterbalanced between participants), followed by a prompt to prepare to employ the chosen strategy (2,000 ms), followed by a longer presentation of the target image in which to employ the strategy (5,000 ms), finally followed by an intensity rating scale. Participants were given two minute-long breaks during the task in 20-trial intervals.

Individual responses per image on the intensity scale in the rating task were used to determine intensity for each image for each participant separately, resulting in a spectrum of intensities. Since for the general stimuli we also had the predetermined ratings archived in the IAPS inventory (Lang et al., 1993), we conducted an additional analysis for the general pictures using the predetermined ratings instead of the individual ratings (reported in the online supplementary materials), following common practice in analyzing ER choice paradigms (Sheppes et al., 2011).

To examine the effect of mindfulness on ER choice flexibility, we applied a cross-classified multilevel modeling approach that allows for the analysis of cross-level, hierarchical data while addressing the fact that variation may stem from three different sources: the measurement level, Type I clusters, and Type II clusters. In our analyses, each subject was repeatedly measured on the response to varying emotional pictures, and each picture was repeatedly measured across subjects. A failure to integrate both sources of higher levels of variation may result in some biased estimation (e.g., Im, Kim, Kwok, Yoon, & Willson, 2016). This is especially true for cross-level interaction analyses which cannot be addressed without knowledge about the cross-classified structure of the data. In our case, the cross-classified model allowed us to correct for biases due to individual differences in strategy preferences, and preferred ER strategies for a given picture (see Figure S1 in the online supplementary materials for a visual description of the cross-classified multilevel model used in our analysis). As suggested by Heck, Thomas, and Tabata (2012) for logistic regression models, for variation at Level 1 we employed the 3.26 value for unexplained variation. In order to perform all levels of analysis (including analysis of cross-level interactions) in one software, we used the Mplus V.8.0 software (Muthén and Muthén, 2017) for all multilevel analysis, using the Bayesian estimator in a cross-random analysis.

Results

Preliminary Analysis

Analysis of all T1 measures indicated no significant individual differences between the two experimental groups.[1] The analysis of premanipulation mindfulness trait, however, indicated a significant difference between groups ($t_{(83)} = 2.18$, $p = .03$), such that participants in the control group ($M = 3.87$) tended to be higher in mindfulness than those in the MBSR group ($M = 3.47$). Despite these differences, the analyses reported below yield essentially unchanged findings when we adjust for mindfulness trait.[2]

The Effect of Mindfulness on ER Choice in Response to General Stimuli

To assess regulatory choice flexibility, we examined the probability of distraction choice in the choice task as our main outcome. For higher intensity ratings, we expected to see a higher probability of distraction choice than for lower intensity ratings, with a sharper rise representing a more pronounced preference for the adaptive strategy for each intensity and thus greater regulatory choice flexibility[3]. Table 1 and Figure 1 display results of the cross-classified multilevel approach for general pictures ($n = 20$ across the 85 participants). The intraclass correlation (ICC) was much higher for the picture level ($ICC_{picture} = .13$) than for the subject level ($ICC_{subject} = .06$), indicating that the choice of strategy differed by picture, whereas this variation across subjects was lower. Overall, these numbers indicate that 19% of the variance can potentially be explained by higher-level factors. We found that distraction was the preferred strategy for pictures of subjectively higher intensity ($b = 0.29$, posterior $SD = 0.05$, $p < .001$, odds ratio (OR) = 1.3), complementing the general preference for distraction over reappraisal ($b = 0.07$, posterior $SD = 0.02$, $p < .001$, $OR = 1.1$).

The hypothesized Intensity × Group (MBSR vs. control) interaction effect on ER choice was also significant ($b = 0.08$, posterior $SD = 0.03$, $p < .01$, $OR = 1.1$), which means the preference for one strategy over the other at different levels of intensity differed between the MBSR group and the control group. As the interaction relates to two different levels, we tested its effect at the measurement level only (Level 1), holding the groups constant at this level. Calculation of the sources of the interaction effect were based on the multilevel cross-classified logistic regression coefficients. For the graphical presentation of the interaction effects we transformed the linear regression values into probability terms ($0 < p' < 1$). For simplicity, probabilities were calculated at low and high in-

[1] For full details of these analyses, see the online supplemental materials.
[2] Analyses adjusting for mindfulness trait are reported in the online supplementary materials.
[3] For additional analyses similar to previous ER choice research (e.g., Sheppes et al., 2011) see the online supplementary materials.

Table 1
Cross-Classified Multilevel Analysis for General-IAPS Pictures

Analysis level	Estimate	Posterior *SD*	95% CI
Unconditional model			
Level 1			
Level 2 subject			
Threshold	.36*	.16	[.01, .64]
Variance	.24***	.06	[.14, .38]
ICC subject	.06		
Level 2 picture			
Variance	.53***	.23	[.27, 1.17]
ICC picture	.13		
Main effects model			
Level 1			
Subject rating	.07***	.02	[.04, .11]
Level 2 subject			
Threshold	1.69***	.26	[1.18, 2.19]
Group	−.08	.13	[−.34, .18]
Variance	.24***	.06	[.14, .39]
Level 2 picture			
Picture rating	.29***	.05	[.20, .38]
Variance	.09***	.05	[.04, .22]
Interaction model			
Level 1			
Subject rating	.04	.02	[−.004, .09]
Subject Rating × Group	.08**	.03	[.02, .13]
Level 2 subject			
Threshold	1.04*	1.004	[.01, 3.50]
Group	−.05	.13	[−.31, .20]
Variance	.24***	.06	[.15, .38]
Level 2 picture			
Picture rating	.29***	.05	[.19, .40]
Variance	.09***	.05	[.03, .22]

Note. $n_{subject}$ = 85; $n_{picture}$ = 20. CI = confidence interval; ICC = intraclass correlation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

tensity levels (±1 standard deviation below and above the mean of intensity level, where the mean was centered to zero). Figure 1 presents the probability to choose distraction over reappraisal at different intensity levels, as well as the linear regression slopes and their significance. As can be seen in the figure, the MBSR group chose distraction over reappraisal less frequently than the control group at lower intensity levels, but favored this strategy more than did the control group at higher intensity levels. In other words, participants in the MBSR group demonstrated greater regulatory choice flexibility, better adapting their choice of ER strategy to the intensity of the stimulus at hand.

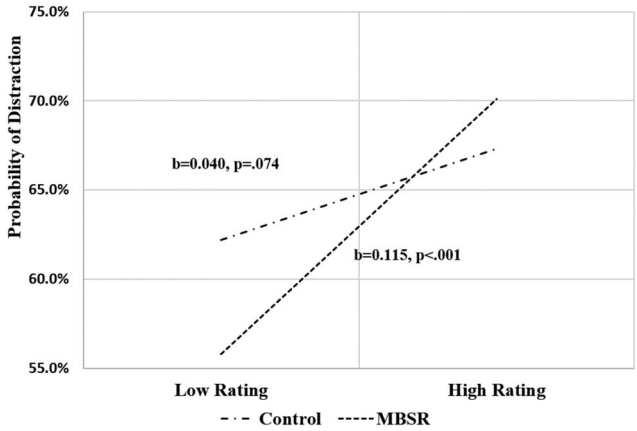

Figure 1. Interaction decomposition for general International Affective Picture System (IAPS) pictures.

We repeated this analysis using the predetermined IAPS ratings (Bradley & Lang, 2007) instead of subjective ratings, obtaining similar results (the rating on group interaction was $b = 0.33$, $p < .01$, $OR = 1.4$; see the online supplementary materials for further details). Similar effects were also found when employing the same repeated measures analysis of variance used in previous studies on ER choice (e.g., Sheppes et al., 2011; see the online supplementary materials).

The Effect of Mindfulness on ER Choice in Response to Sociopolitical Stimuli

We next ran the same cross-classified multilevel analysis to predict ER choice for the sociopolitical pictures (Table 2 and Figure 2). The ICC was not high, but nonetheless exceeded common requirements for multilevel modeling ($ICC_{subject}$ = .07, $ICC_{picture}$ = .08), indicating that 15% of the variance can potentially be explained by higher level factors. Again, distraction was the preferred strategy at higher levels of subjective intensity (b = 0.37, posterior SD = 0.4, $p < .001$, OR = 1.4), and there was also

Table 2
Cross-Classified Multilevel Analysis for Sociopolitical Pictures

Analysis level	Estimate	Posterior *SD*	95% CI
Unconditional model			
Level 1			
Level 2 subject			
Threshold	.17	.10	[−.02, .38]
Variance	.27***	.06	[.19, .40]
ICC subject	.07		
Level 2 picture			
Variance	.32***	.09	[.20, .54]
ICC picture	.08		
Main effects model			
Level 1			
Subject rating	.08**	.02	[.05, .11]
Level 2 subject			
Threshold	2.39***	.25	[1.95, 2.85]
Group	−.07	.12	[−.31, .18]
Variance	.25***	.05	[.17, .38]
Level 2 picture			
Picture rating	.37***	.04	[.31, .45]
Variance	.04***	.02	[.02, .08]
Interaction model			
Level 1			
Subject rating	.06**	.02	[.02, .10]
Subject Rating × Group	.06**	.03	[.01, .11]
Level 2 subject			
Threshold	1.89***	.38	[.84, 2.51]
Group	−.07	.12	[−.30, .17]
Variance	.25***	.05	[.17, .37]
Level 2 picture			
Picture rating	.35***	.03	[.31, .42]
Variance	.04***	.02	[.02, .08]

Note. $n_{subject}$ = 85; $n_{picture}$ = 40. CI = confidence interval; ICC = intraclass correlation.
** $p < .01$. *** $p < .001$.

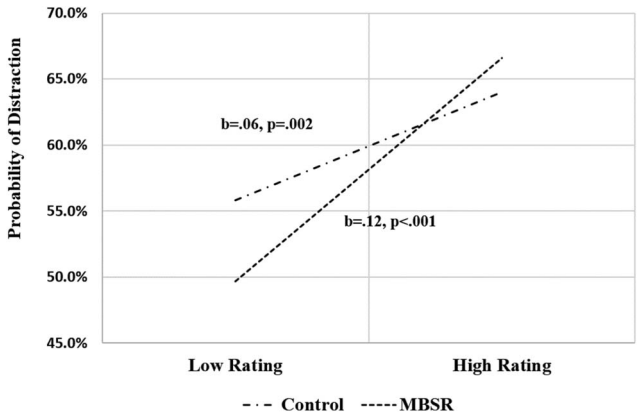

Figure 2. Interaction decomposition for sociopolitical pictures.

a main effect for the overall propensity to choose distraction over reappraisal ($b = 0.08$, posterior $SD = 0.02$, $p < .01$, $OR = 1.1$). Here too, the hypothesized Intensity Rating × Group interaction emerged significant ($b = 0.06$, posterior $SD = 0.02$, $p < .01$; $OR = 1.1$). Figure 2 presents the sources of this interaction effect. As with the general pictures, MBSR participants were less likely than control participants to choose distraction over reappraisal at low levels of intensity, but more likely to prefer this strategy at higher levels of intensity.

To assess whether there is an effect of stimuli type, we repeated this analysis, this time taking together the general pictures and sociopolitical pictures for all 85 subjects. The ICC of subjects remains .06, and the ICC of pictures reduced to .09. Table 3 shows that distraction strategy was more likely if the picture was general rather than political ($b = 0.23$, posterior $SD = 0.08$, $p < .01$. $OR = 1.3$) when controlled by rating at the picture level. In other words, for pictures that received the same intensity rating, participants tended to choose distraction more when the pictures were from the general batch relative to the sociopolitical batch. By adding interaction terms, we could determine the sources of this difference. We found that rating and group interaction showed a significant effect on strategy choice (interaction = 0.06, posterior $SD = 0.02$, $p < .01$, $OR = 1.1$), but no other interaction was in effect.

Discussion

In the present study, we examined whether an MBSR program can increase regulatory choice flexibility, meaning the ability to more adaptively choose between engaging (reappraisal) and disengaging (distraction) ER strategies as per contextual demands (Sheppes et al., 2011). As hypothesized, MBSR training (vs. the lack of such training) was found to significantly foster the capability to adaptively choose between these ER strategies in response to general emotional stimuli of different intensities. While the tendency to favor disengagement more as intensity increases characterized all participants, it was significantly more pronounced in the MBSR group than in the control group. This tendency to flexibly choose between ER strategies also emerged when participants viewed sociopolitical emotional stimuli related to the population's regional reality. Taken together, these findings suggest that MBSR can provide a way to train individuals to more flexibly choose how to regulate their emotions in their daily lives.

These findings have several important implications. To begin with, to the best of our knowledge, this study provides the first evidence that regulatory choice flexibility can be taught. Increased regulatory choice flexibility is presumed to promote greater mental health and wellbeing (Bonanno, 2005; Kashdan & Rottenberg, 2010; Levy-Gigi et al., 2016; Waugh et al., 2011). Therefore, from a preventive health care point of view, interventions that cultivate regulatory choice flexibility can become a central pathway of increasing resilience and well-being in children and adults.

More specifically, our study points to MBSR as an effective intervention to increase regulatory choice flexibility. The notion that mindfulness practice can cultivate more flexible ER choice patterns is not surprising, considering the suggested underlying mechanism of mindfulness's benefits and the Buddhist origins of the practice. In its essence, Buddhism deals with fostering skillful means of dealing with difficult thoughts and emotions (Batchelor, 2011; Chambers et al., 2009). Right Effort, a central doctrine in Buddhist psychology, encourages the practitioner to develop (by practicing attention and awareness to the present moment) the flexibility to choose the most adaptive approach to dealing with each specific situation. Whereas one situation may warrant the cultivating of alternative thoughts as a means of changing negative emotions (i.e., reappraisal), in another situation it may be more useful to shift attention away from the negative emotion-provoking stimulus (Batchelor, 2011).

Although MBSR is a western version of Buddhist mindfulness practice, a recent analysis of MBSR from a Buddhist perspective (Batchelor, 2011) has recognized parallels to the Buddhist Right Effort approach in the MBSR protocol, as well as in its clinical adaptation (MBCT). According to Dahl and colleagues (2015), MBSR belongs to a family of practices that cultivate the capacity to intentionally initiate, direct, or sustain attentional processes, enabling one to manipulate the aperture of attention, to monitor and detect more information, and to disengage and reorient toward specific chosen objects. Such abilities increase meta-awareness and strengthen the capacity to be aware of thoughts, emotions, sensations, and perceptions and the ability to reduce experiential fusion with emotional experiences (Dahl et al., 2015), leading to greater psychological flexibility (Bishop et al., 2004; Roemer et al., 2015). To our knowledge, our study is the first to demonstrate the effects of mindfulness practice on regulatory choice flexibility.

Another implication of our study is its contribution to the understanding of the mindfulness construct. First, our findings contribute to the ongoing discussion in the literature on whether mindfulness and ER are distinct or overlapping constructs (e.g., Roemer et al., 2015). Our findings support the former view, that mindfulness is not simply a specific ER strategy, but rather plays a wider role in ER processes (Chambers et al., 2009; Garland, Farb, Goldin, & Fredrickson, 2015; Hayes & Feldman, 2004; Roemer et al., 2015), affecting more central regulatory stages. In addition, our findings contribute to the ongoing search for the cognitive mechanisms that underlie the positive outcomes of mindfulness practice (e.g., Brown & Ryan, 2003; Carmody, Baer, Lykins, & Olendzki, 2009; Chiesa & Serretti, 2009). Although evidence establishing the beneficial effects of mindfulness practice on mental resilience and well-being is continuously growing, the underlying mechanisms behind this relationship remain unclear

Table 3
Cross-Classified Multilevel Analysis for General-IAPS and Sociopolitical Pictures

Analysis level	Estimate	Posterior *SD*	95% CI
Unconditional model			
Level 1			
Level 2 subject			
Threshold	.21*	.10	[.03, .41]
Variance	.24***	.05	[.17, .35]
ICC subject	.06		
Level 2 picture			
Variance	.36***	.08	[.25, .54]
ICC picture	.09		
Main effects model			
Level 1			
Subject rating	.08***	.01	[.06, .11]
Level 2 subject			
Threshold	2.04***	.17	[1.69, 2.35]
Group	−.08	.11	[−.30, .15]
Variance	.23***	.05	[.16, .34]
Level 2 picture			
Picture rating	.32***	.03	[.26, .36]
Condition (0 = politic, 1 = general)	.23**	.08	[.07, .38]
Variance	.05***	.01	[.03, .09]
Two-way interaction model			
Level 1			
Subject rating	.06***	.02	[.03, .09]
Subject Rating × Group	.06**	.02	[.02, .10]
Condition × Group	.02	.09	[−.15, .02]
Subject Rating × Condition	−.02	.02	[−.06, .02]
Level 2 subject			
Threshold	1.35	1.86	[−.22, 4.49]
Group	−.09	.12	[−.32, .14]
Variance	.23***	.05	[.16, .34]
Level 2 picture			
Picture rating	.34***	.03	[.28, .39]
Condition	.24**	.09	[.07, .42]
Variance	.05***	.01	[.03, .09]
Two-way interaction model			
Subject Rating × Group × Condition	−.01	.04	[−.08, .06]

Note. $n_{subjects} = 85$; $n_{picture} = 60$. CI = confidence interval; ICC = intraclass correlation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

(Dahl et al., 2015). Integrating our findings with previous work on the relation between regulatory choice flexibility and resilience and well-being (Bonanno & Burton, 2013; Bonanno et al., 2004; Campos, Mumme, Kermoian, & Campos, 1994; Levy-Gigi et al., 2016; Sheppes et al., 2011, 2014; Thompson, 1994), we suggest that increased regulatory choice flexibility is a central mediator of the beneficial effects of mindfulness on these outcomes.

Additionally, the present findings may provide support for the notion that different regulatory choice patterns are partially a product of individual differences in sensitivity to context, availability of a diverse repertoire of regulatory strategies, responsiveness to emotional feedback (Bonanno & Burton, 2013), and ability to recruit executive functions that can override automatic associative processes (Sheppes & Levin, 2013). As reviewed above, a central feature of all mindfulness practices is the cultivation of present-moment awareness to thoughts, perceptions, sensations, and feelings, fostering greater sensitivity to internal experience (Dahl et al., 2015; Hölzel et al., 2011; Shapiro et al., 2006; Teper et al., 2013) and external information (Bishop et al., 2004; Hölzel et al., 2011; Jha et al., 2007; Shapiro et al., 2006), all attributes of values to the individual differences proposed in the regulatory choice flexibility literature. Furthermore, mindfulness practices foster a wide repertoire of regulatory abilities spanning the disengagement-engagement continuum (Batchelor, 2011; Bishop et al., 2004; Bhikkhu, 1997), making them ideal for the development of flexible ER choice patterns. Future research should directly examine the contribution of each of these components to the increase in regulatory choice flexibility observed following mindfulness practice.

Finally, our findings that MBSR can affect regulatory choice flexibility even for emotional stimuli depicting real-life intergroup conflict events may have applications to the field of conflict resolution. Recent studies in this field have demonstrated the potential benefits of interventions that cultivate ER strategies for decreasing negative emotions that fuel intergroup conflict (e.g., Alkoby, Halperin, Tarrasch, & Levit-Binnun, 2017; Halperin & Gross, 2011; Halperin, Pliskin, Saguy, Liberman, & Gross, 2014; Halperin & Pliskin, 2015; Lee, Sohn, & Fowler, 2013). At the same time, it is becoming increasingly clear that there is no one ER strategy more beneficial than others across situations. Engaging-reappraisal strategies may not always be beneficial and effective, especially when conflictual situations are characterized by fre-

quent high emotional intensities (Sheppes, Catran, & Meiran, 2009; Sheppes & Meiran, 2007, 2008). Similarly, other strategies such as disengagement-distraction can hinder elaborative processing of stimuli and the ability to respond adaptively to similar future situations (Bradley, Codispoti, Cuthbert, & Lang, 2001; Wilson & Gilbert, 2008). Because all strategies have their shortcomings as well as benefits, interventions that support ER choice flexibility are especially important in conflict contexts. In our previous study (Alkoby et al., 2017), we demonstrated that MBSR can reduce negative emotions and perceptions of threat, and increase support for compromise in the context of intractable conflict. Taken together with our previous study, we suggest that MBSR can be a powerful intervention in conflict-ridden societies, potentially sustaining greater mental resilience and even promoting support for conflict resolution.

Limitations

Our study has several limitations. First, we identified premanipulation differences in trait mindfulness between the MBSR group and the control group, with the latter higher in mindfulness trait than the former. Although the analyses yielded essentially unchanged findings when we adjusted for mindfulness trait, we cannot rule out that the groups differed in some aspects of flexibility at T1. Since mindfulness has been associated with greater cognitive and psychological flexibility (Moore & Malinowski, 2009; Silberstein, Tirch, Leahy, & McGinn, 2012), we would expect the control group to exhibit greater ER choice flexibility than the MBSR group, contrary to our findings—and these preexisting differences, if anything, allowed us a more conservative test of the effects of mindfulness training. Another limitation of our study is that we do not have direct assessments of the acquired mindfulness skills following the MBSR workshop and thus cannot directly link between individual differences in acquired mindfulness skills and ER choice flexibility.

Importantly, the difficulty to interpret the observed differences in mindfulness trait and the lack of measures of change in mindfulness skills relates to a more general limitation inherent in the contemporary mindfulness research field. Indeed, much attention has been given recently to the difficulties to operationalize and measure mindfulness (Van Dam et al., 2018). Trait mindfulness self-report questionnaires, in particular, have been criticized as being vulnerable to limitations of introspection and social desirability biases, producing confusing results (such as findings that binge drinkers were higher on trait mindfulness than meditators; Leigh, Bowen, & Marlatt, 2005) and not correlating with meditation practice (Manuel, Somohano, & Bowen, 2017). In addition, no consensus has been reached regarding ways to measure change in mindfulness abilities following practice. To somewhat mitigate these inherent challenges in the mindfulness research field, we used MBSR—the gold standard model of mindfulness-based interventions (Van Dam et al., 2018)—to operationalize change in mindfulness abilities. Nonetheless, future studies should better assess preexisting differences in various aspects of flexibility, the relation between acquired mindfulness skills and increase in ER choice flexibility, as well as differences between individuals who choose to enroll in mindfulness programs and those who do not or between those who complete the workshop and those who do not.

Another limitation of our study is that the choice paradigm employed in our case (based on Sheppes et al., 2011) operationalizes flexibility as the competence to choose the appropriate strategy for a single emotional dimension, namely, emotional intensity. Additional factors such as the complexity of the negative emotion (simple or complex), the valence of the emotions (positive or negative), the discrete emotion at hand, relevant goals, and the availability of cognitive resources (Sheppes et al., 2011) were not tested and should be evaluated in the future to better understand the role of mindfulness in enhancing regulatory choice flexibility.

In addition, the current study employed only reappraisal and distraction as motion regulation strategies, as they represent a continuum of cognitive ER strategies ranging from engagement to disengagement (Sheppes et al., 2011). Nonetheless, other strategies, such as situation modification and response modulation, exist, and these may be implemented in different contexts presenting different emotional challenges (for a review, see Gross, 2002). Furthermore, mindfulness practice fosters the ability to reduce experiential fusion with emotional experiences, enabling one to be with difficult emotions without the need to immediately reappraise or judge them (Chambers et al., 2009; Dahl et al., 2015; Roemer et al., 2015). However, participants in our study were not given the option of "just being" with the emotional stimulus, thus preventing us from examining potential additional important effects. Future studies should examine whether mindfulness can facilitate choice among a wider array of ER strategies, in a wider range of contexts.

The present study also has several limitations relating to the generalizability of its findings. First, our participants were all college students, and it is not clear whether our findings would generalize to other populations. Due to their busy schedules, students also tended to be less committed participants and they practiced mindfulness less often than recommended in their workshops (M = 56.48 min per week, SD = 34.41, based on self-report). Future studies should examine the effects of mindfulness on regulatory choice flexibility in different populations as well as among people trained on mindfulness practices more extensively. Second, the current study measured regulatory choice flexibility only immediately after the MBSR workshops, with our design not allowing us to examine long-term changes in flexibility. Future studies may aim to test whether the increase in regulatory choice flexibility following mindfulness training is sustained across time.

Finally, although our results attained statistical significance, it is important to note the small effect sizes. We attribute this to the small sample size, the relatively short span of the intervention, the minimal practice time of the students, preexisting differences in mindfulness trait, and possible ceiling effects related to the fact that we studied healthy young adults. Indeed, our findings provide some indication that our sample was somewhat unique: while in previous studies, participants undergoing no intervention (i.e., theoretically similar to our control participants) usually chose distraction over reappraisal about 70% and 30% of the time for high- and low-intensity stimuli, respectively (e.g., Sheppes et al., 2011), in our study the differences in percentage across intensity levels was lower. Future studies should replicate our findings among larger samples, more committed participants, populations in which ER flexibility is low, and in a setup that maximizes the difference in the emotional response at different intensity levels.

Conclusion

This study is the first to show that a mindfulness intervention, using a general MBSR protocol focusing on personal well-being, can increase flexible and adaptive ER choice. The results of this study may have implications for educational programs and activities dedicated to enhancing ER capabilities and for understanding the relationship between mindfulness and enhanced resilience and well-being.

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