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A Longitudinal Training Study to Delineate the Specific Causal Effects of Open Monitoring Versus Focused Attention Techniques on Emotional Health

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ABSTRACT

Background: Emotional dysregulation is a core mechanism of mood disorders. Meditation-based interventions can ameliorate a wide range of psychological problems. However, in order to develop structured treatment and preventative protocols for emotional disorders, it is crucial to understand how different types of specific meditation practices improve emotion regulation abilities. Mindfulness-based techniques are broadly separated into two practices – open monitoring (OM) and focused attention (FA). This study directly investigated the potential practice-specific benefits of OM versus FA techniques as tools for improving emotion regulation skills from pre-to-post training.

Method: Novice participants were randomized into an 8-week long OM or FA intervention that was previously developed through a science of behavior change approach. Healthy emotional skills were assessed using experience sampling methodology and inventories. Participants were assessed before, during, and after the interventions to investigate if the type of training may explain longitudinal changes in emotional skills.

Results: Both OM and FA attentional training practices improved acceptance of stressors and reduced distress and rumination. We also found divergent effects of OM versus FA training: Compared to OM, FA training improved abilities to use reappraisal strategy to regulate emotions in naturalistic settings at the end of 8-weeks training. FA training (versus OM) also led to greater self-regulation abilities.

Conclusion: Our findings suggest that a FA training has specific causal impacts on emotion regulatory skills, and it can be selectively implemented in interventions to target emotional disorders.

Difficulties with emotion regulation could be a core mechanism of mood and anxiety disorders. [1,2] Various meditation-based interventions are found to ameliorate a wide range of psychological problems; however, it is not clear which meditation techniques are useful in developing what kinds of cognitive and emotional skills. [3,4] It is crucial to understand *how* different *types* of specific meditation practices improve emotion regulation abilities to develop structured treatment and preventative protocols for emotional disorders. [5]

How can emotion regulation be trained? Based on a commonly accepted theoretical framework, [3,6] mindfulness-based interventions can be broadly separated into two practice types – *open monitoring* (OM) and *focused attention* (FA). The OM technique entails nonreactive monitoring and awareness of stream of experiences without explicit focus on selected objects. OM can improve emotional processing and regulation. [3] Previous research with adult community and clinical samples has found an inverse relationship between OM and negative affect, distress, repetitive thoughts, depression, and emotional reactivity. [7–13] A positive link between OM and emotion regulation has been reported using mostly correlational [11,13,14] and some experimental work. [5,15,16] FA practices involve focusing attention to a chosen object, detecting mind wandering, and redirecting attention back to the selected object. FA expertise can improve attentional regulation, [3,15] such as disengagement from distracters and sustained attention, [17] which may in turn reduce habitual responding, [18] and emotionally reactive behavior. FA improves attentional resources [19] which in turn may reduce emotional interference. [3]

OM and FA practices are suggested to have separable and unique cognitive, affective, behavioral and neurophysiological components.

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[15,20–25] For instance, attentional regulation is involved in both practices. In OM, attention is focused toward difficult experiences while in FA attention is focused away from negative experiences. Though there is evidence that both OM and FA practices can bolster emotional skills broadly, it remains unclear which aspects of emotion regulation are enhanced by OM versus FA, and whether these are actual causal relationships. Various confounding factors can make it difficult to compare or incorporate the unique benefits of OM and FA separately in targeted evidence-based interventions. [26,27] For instance, some meditation practices may not be strictly OM or FA focused and may be a combination of the two. Some studies may have examined meditators with previous experience in a combination of mindfulness practices. [28] Expert meditators were found to be significantly different from novice meditators on measures of brain oscillatory rhythms (gamma and alpha frequency bands) and OM versus FA can lead to different brain predictive processes. [29] Furthermore, self-selection of practices may be associated with individual differences that may indirectly bias interpretation of outcomes for OM versus FA mechanisms underplay.

Jacobsen and colleagues [30] have adopted a classic dismantling design to delineate cognitive behavioral therapy into its cognitive and behavioral components. A similar approach to delineate practice-specific effects of meditation training has been developed by Britton and colleagues. [15] They have created and empirically validated two structurally equivalent interventions to dismantle Mindfulness-Based Cognitive Therapy (MBCT [31]) into OM and FA protocols. MBCT over Mindfulness Based Stress Reduction [32] was chosen to dismantle into OM and FA interventions because MBCT has a published session-by-session manual with standardized handouts [31] and precise, published treatment fidelity guidelines for therapists. [33] Britton and colleagues [15] have empirically shown their 8-week OM versus FA interventions to vary by the practice-specific skills and to be comparable on program structure and duration, and program material treatment. At the same time, they are "single-ingredient" programs that isolated OM and FA practices into differentially valid training protocols.

1. The current study

Limited work has systematically examined the effectiveness of OM versus FA in developing adaptive emotion regulation strategies to increase positive state. Given these limitations in the field, we evaluated the potential of OM versus FA practices as a tool for improving emotional skills to regulate and recover from emotionally distressing circumstances. Few strengths of our methodological approach include: First, we recruited novices with no prior meditation experiences to longitudinally learn OM or FA technique, which helped avoid confounds such as prior experience with one or both techniques and self-selection bias. Second, this study adopted existing validated protocols [15] that were developed for research purposes through a mechanism-focused science of behavior change (SOBC) experimental medicine approach [34] to isolate OM and FA interventions. This allowed us to compare mechanisms that improve emotion regulation abilities. Third, experience sampling assessments before, during, and after the course of OM versus FA training provided an accurate measure of the effects of these trainings on emotional skills and maximized ecological validity. [35]

We hypothesized that compared to the OM group, the FA group would get better at utilizing reappraisal (i.e. modifying emotional meaning and significance of an emotional situation) as an emotion regulation strategy to manage their daily stressors over the course of the study. This is because attentional regulation is required to reappraise emotions, [36] and a recent study found that the FA group showed a larger increase from pre-to-post than OM in attentional focus and attentional shifting. [15]

Compared to FA, OM was found to have higher non-reactivity, increase emotional awareness (naming emotions and labeling thoughts), [15] and divergent thinking. [22] Accordingly, compared to the FA group, we predicted the OM group to show higher emotional awareness and less negative affect. We also expected both trainings to have overlapping benefits on some aspects of emotional functioning. For instance, both groups were predicted to improve in use of the acceptance strategy. [15] For each outcome, we were specifically interested in comparing the OM versus FA practice-specific benefits over time.

2. Method

2.1. Participants

A community sample was recruited by advertising through fliers on public bulletin boards (e.g., in stores and libraries). 34 participants (67% females) with M_{age} = 37.13 years (SD = 13) took part in this study. 52.9% of the participants were Caucasian, 23.5% were Asian/Asian American, 11.8% were Hispanic/Latino, 2.9% were African American, 2.9% were biracial/mixture of backgrounds, and 5.9% others.

Through a structured phone screening interview, potential participants self-reported if they had any mental or physical health concerns that might be influenced by meditation training, including: neurological disease, head trauma, or neurosurgical procedure, psychiatric disease within the last year, use of psychotropic medication, or substance abuse dependence within the last year. Exclusion criteria included any prior meditation or similar practices (e.g., yoga or tai-chi) to avoid biasing intervention effects. 42 participants were screened, and 8 participants did not meet the inclusion criteria. Eligible participants were randomly assigned to an 8-week training program focused either on OM or FA meditation. The block randomization method was used which allows subject randomization into almost equal sample sizes. [37] Randomization was performed via the *blockrand* package for R [38] and a block size of 4 was used. Allocation concealment was achieved by separating the act of randomization from the research personnel who were responsible for recruiting, screening, and enrolling participants. This was achieved by blinding study team members responsible for recruiting, screening, and enrolling from knowledge about random assignment details. The study team member with the randomization list who was responsible for random assignment had not interacted with the enrolled participants and was blinded to study participant information at the time of treatment allocation (other than they were eligible and enrolled in the study).

Participants were never made aware that there were two treatment conditions. When participants visited the lab for assessments, the outcome assessors were not blind to treatment allocation. However, assessors' interaction with participants was kept minimal. All questionnaire-based assessments in the lab were completed by participants in a separate room without the presence of the experimenter. More importantly, the experience sampling data, which constitutes our primary outcome, was conducted in participants' naturalistic settings without any assessor. In addition, the training instructor (for both treatments) was blind to the research goals of the study and had no knowledge about any outcome measures that were collected during the study. The study protocol was approved by the Institutional Review Board at Yale University. Participants were compensated $40 for their participation.

2.2. Procedure

Upon arrival in the lab during Visit 1, the consent form procedures were completed. Next, participants completed pre-training questionnaires (see Measures). Then, participants' phones were setup for experience sampling data collection. Experience sampling data was collected for 5 weekdays of week 1, 5, and 8 of training.

FA and OM interventions were taught to participants by using existing validated 8-week training programs that were developed for research purposes. [15] The validated weekly content and format of these protocols and a comparison to the standard MBCT is available. [15]

Participants underwent approximately 3 hours per week of training for 8 weeks (FA or OM). Each session had a specific format that was structurally comparable in terms of practices: weeks 1-4 included practice instructions, weeks 5-8 focused on applying the practices to manage acute negative affect. For instance, week 4 session was to stay present and the FA group was trained to do so by focusing on meditation objects or anchors (e.g., breath) while the OM group was trained to stay present by verbal labelling or objectless noting. The sessions used guided meditation, audio and video recordings and course materials to administer the protocol. In addition to attending the in-person training, as homework, participants also do 45 min per day of formal meditation practice. The session-to-session activities and techniques have been detailed in Appendix 1-3. [15]

In order to control for the influence of environment, all the treatment sessions were conducted at the same location. To control for the effect of the instructor, the same instructor taught all sessions for both trainings. The instructor was trained in MBCT and had more than twenty years of mindfulness practice and teaching experience. The instructor used detailed training manuals and course materials to teach the courses. Data was collected in two rounds around the same time of the year, between months of March and May. First round of data was collected in Spring 2015 and it had eleven OM and eleven FA participants (three FA participants dropped out). Second round was collected in Spring 2016 and it had six OM (one participant dropped out) and 6 FA participants (three participants dropped out).

After the 8-week long meditation training was complete, participants visited the lab for a Visit 2 where they were re-assessed on measures used during Visit 1 to investigate any pre-to-post changes that occurred in emotion-relevant factors. In addition, participants completed the MAIA, [39] which was only assessed post-training.

2.3. Measures

2.3.1. Experience sampling assessments

Experience sampling method (ESM [35]) is a structured technique to assess the momentary thoughts, feeling, and actions of individuals in their daily living environment. It enabled us to sample participants' emotional experiences while they were in their natural settings without relying on memory retrieval processes. Participants' affective experiences were assessed via an automated system called SurveySignal that uses participants' phones to setup real-time text messaging. [40] By using their own phones, participants were able to conveniently report their experiences related to personally relevant situations in their naturalistic settings.

On each experience sampling day, participants' phones would automatically receive text messages with a Qualtrics survey link [41] between 9 a.m. and 9 p.m. at random times once in the morning, afternoon, and evening (i.e., 3 times a day), for 5 days of a week during the first week of training (week 1), halfway through training (week 5), and last week of training (week 8). The study used a semi-random beep design in order to prevent anticipatory behavior of participants, which is likely present when the timing of the next beep is known. [42] Each experience sampling event took about 1-2 minutes to complete during which they clicked on the Qualtrics link to report their state affect and emotion regulation efforts during the time since they last completed a report (as detailed below).

2.3.1.1. Positive and negative affect. The modified differential emotion scale [43] was used to assess positive affect (PA) and negative affect (NA) levels experienced by participants. [44] At each experience sampling event, participants rated their "current" state in that moment on a 0 ("Not at all") to 5 ("Extremely") for each the seven individual positive emotions (i.e., interest/alertness, amusement/joy, awe/amazement, love, peace, pride, and gratitude) and five negative emotions (i.e., shame/embarrassment, disgust, nervous/stress, sadness, and irritable). An average positive and negative affect was calculated for each week per participant by averaging positive and negative words respectively.

2.3.1.2. Emotion regulation efforts. After reporting their affect, participants were asked to report whether they had used any listed emotion regulation strategies since the previous sampling moment. [42,45] A single item that described the strategy was presented for each strategy and participants were asked to indicate frequency of use for each strategy, "How much were you doing each of the following?" on a 6-point scale from 0 (not at all) to 5 (very much so). For the reappraisal strategy, participants rated how much were they doing the following: "Since the previous text today, I have changed the way I think about what causes my feelings." Similarly, for acceptance strategy they rated, "Since the previous text today, I allowed space for whatever is going on, rather than trying to create some other state." For the calming strategy they rated, "Since the previous text today, I tried to calm my body by taking deep breaths or relaxing muscles." An average frequency of use for each strategy by each participant was calculated for each week.

2.3.2. Pre and post visit related questionnaires

Pre-to-post changes in affective states were examined by comparing the following measures:

2.3.2.1. Psychological distress. Depression, anxiety, and stress scale (DASS-short [46]) is a 21-item self-report measure of general psychological distress state due to three shared components – depression, anxiety, and stress. We included this measure to get a composite measure of changes in general distress pre-to-post training. The reliabilities were .807 and .884 for pre- and post-assessments respectively.

2.3.2.2. Rumination. Rumination is self-attentiveness motivated by perceived threats, losses, or injustices to the self. [47] A 12-item rumination scale [47] was measured. Each item can be rated on a 5-point scale (from "strongly disagree" to "strongly agree"). The reliabilities were .966 and .955 for pre- and post-assessments respectively.

2.3.2.3. Multidimensional Assessment of Interoceptive Awareness (MAIA). MAIA [39] measures interoceptive body awareness with eight sub-scales: noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting. It's a 32-item questionnaire with a 6-point scale (from never to always). The post-assessment reliability was .895.

2.4. Data analyses plan

For experience sampling data, linear mixed-effects models were fit separately for each outcome measure with two fixed factors: week (*within-subjects:* 1,5, and 8) and group (*between-subjects:* OM versus FA). For pre and post training questionnaire data, a pre-to-post-test change analysis using random effect change score models were fit separately for each outcome measure with visit (*within-subjects*: 1 and 2) and group (*between-subjects*: OM versus FA) as predictors. Random intercepts were defined for participants in all the models. Models were fit via restricted maximum likelihood estimation on all available data using the R language for statistical computing. [48] Statistical inference on the fixed effects was conducted via separate likelihood ratio tests for each fixed-effects parameter. The likelihood ratio test for each parameter is calculated as the difference between -2 times the natural logarithm of the likelihood for the full model against a nested (restricted) model without the parameter. This test follows an approximate chi-square distribution with degrees of freedom equal to the difference in parameters between the full and restricted model. To facilitate interpretation, standardized effect sizes of relevant effects are reported by calculating the model-derived standardized mean difference (SMD) of interest that can be interpreted as the difference between two means in standard deviation

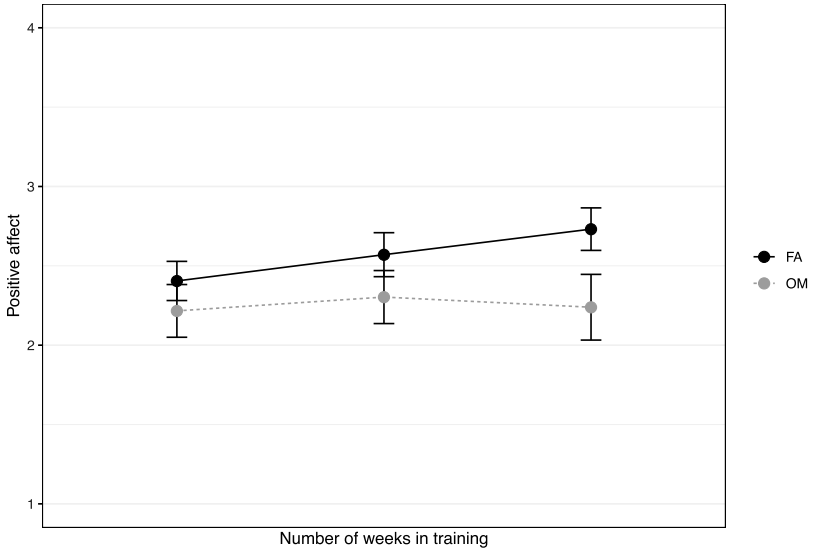

Fig. 1. Positive affect as a function of time (week 1, week 5, and week 8) and training-type (FA versus OM).

units (conceptually analogous to Cohen's d). Our a priori comparisons of interest were: the difference between OM vs FA groups at Week 8 and practice-specific improvements from pre-to-post training for each meditation training. For follow-up tests decomposing higher order interactions, reported *p* values and effect sizes were corrected for multiple comparisons using the Tukey method. Approximate degrees of freedom for follow-up *t* tests are calculated via the Kenward-Roger method. [49] Mixed models were fit using the *lme4* package [50] and likelihood ratio tests were calculated via the *afex* package. [51]

3. Results

3.1. The effects of meditation training on experience sampling data

3.1.1. Positive and negative affect

A non-significant effect of time was found on self-reported positive affect, $\chi^2(2) = 5.13$, $p = .08$. The FA group reported a significant increase in positive affect from week 1 to week 8, $t(56) = 2.56$, $p = .03$, SMD = .54 (Fig. 1). In addition, the FA group also reported higher positive affect for week 8 than the OM group, $t(51.7) = 2.045$, $p = .046$, SMD = .79. The effect of group and groupxtime interaction were not significant. No significant effect of group or time on negative affect was found.

3.1.2. Daily emotion regulation strategies

3.1.2.1. Acceptance. A significant effect of time on average use of acceptance strategy was found, $\chi^2(2) = 19.29$, $p < .0001$, Fig. 2. Both FA and OM groups reported using acceptance more over the course of training, from week 1 to 5 (FA: $t(56.2) = 2.76$, $p = .02$, SMD = .61; OM: $t(54.3) = 2.21$, $p = .08$, SMD = .46) and from week 1 to 8 (FA: $t(56.5) = 3.07$, $p = .01$, SMD = .70; OM: $t(54.9) = 3.08$, $p = .01$, SMD = .68). The effect of group or groupxtime interaction were not significant.

3.1.2.2. Reappraisal. A significant effect of group ($\chi^2(1) = 4.62$, $p = .03$) and time ($\chi^2(2) = 17.61$, $p = .0001$) on average use of reappraisal strategy was also found. The groupxtime interaction was significant, $\chi^2(2) = 20.30$, $p < .0001$, Fig. 3. An increase in reappraisal use over time was driven by the FA group. Compared to week 1, the FA group reported using reappraisal strategy more frequently after week 5 of training, $t(55.9) = 4.47$, $p = .0001$, SMD = .86, and week 8 of training, $t(56) = 5.76$, $p < .0001$, SMD = 1.14. No significant difference from week 1 to 5 or 8 were found for the OM group. Furthermore, the FA group's reappraisal usage was also higher than the OM group in week 8, $t(52.5) = 3.7$, $p = .0005$, SMD = 1.31.

3.1.2.3. Calming. A significant effect of group, $\chi^2(1) = 6.61$, $p = .01$, and time, $\chi^2(2) = 11.36$, $p = .003$, on average use of calming strategy was found. The group x time interaction was not significant. Compared to week 1, the FA group reported using significantly more calming strategies by week 5, $t(57.3) = 3.49$, $p = .003$, SMD = .89, and week 8, $t(57.7) = 2.45$, $p = .045$, SMD = .65 (Fig. 4). In addition, the FA group reported using calming strategy more frequently than the OM group during week 5, $t(61) = 2.72$, $p = .01$, SMD = .998, and week 8, $t(65.9) = 2.41$, $p = .02$, SMD = .921. Thus, for the FA group there was also an overall increase in use of calming strategy frequency by week 8. For the OM group, no significant differences were in use of calming strategy by week 5 or week 8 when compared to week 1.

3.2. The effects of meditation training on post-training self-report

3.2.1. General psychological distress

A significant effect of time was found, $\chi^2(1) = 10.44$, $p = .001$. A main effect of group and group X time interaction was not found. This implies that psychological distress symptoms decreased for the OM, $t(29.9) = 2.75$, $p = .01$, SMD = .62, as well as the FA group, $t(32.5 = 3.35$, $p = .002$, SMD = .898, and did not differ for the two groups post-training, $t(56) = .73$, $p = .47$, SMD = .26.

3.2.2. Rumination

A main effect of time was also found on average rumination levels, $\chi^2(1) = 5.67$, $p = .02$, while no effect of group or groupxtime interaction was found. Rumination levels decreased for the OM group, $t(29.3) = 2.06$, $p = .048$, SMD = .49, as well as the FA group, $t(29.5) = 2.37$, $p = .02$, SMD = .63, and no difference between the groups was found at week 8, $t(51) = .50$, $p = .62$, SMD = .19.

3.2.3. MAIA

The measure MAIA [39] was included after the study had started so we don't have pre-meditation assessments for it. The FA group was significantly higher in interoceptive awareness (composite) than the OM group, $t(22.53) = 2.58$, $p = .02$. The measure comprised of eight subscales (noticing, not-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting). On further examination of the subscales, the FA group was specifically

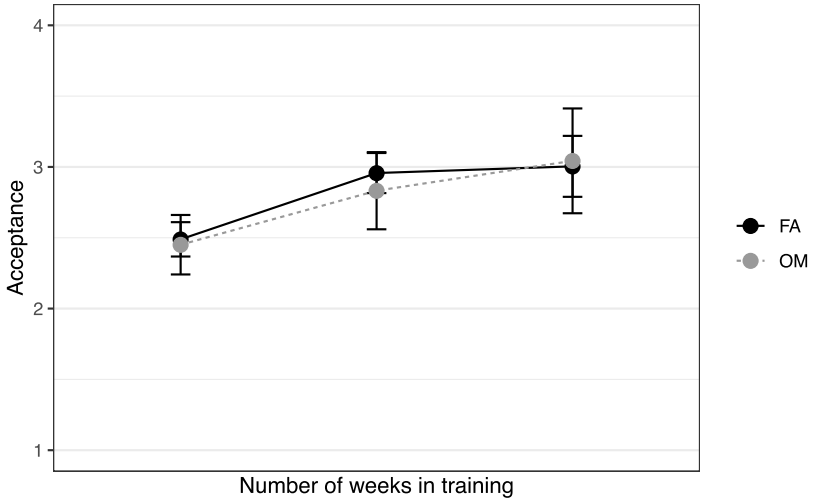

Fig. 2. Frequency of use of acceptance strategy as a function of time (week 1, week 5, and week 8) and training-type (FA versus OM).

higher than the OM group in perceived emotional awareness, $t(23.85) = 2.58, p = .02$, Cohen's d = .98, and self-regulation abilities, $t(16.25) = 2.17$, $p = .04$, Cohen's d = .91. There was also a non-significant effect (yet moderate effect size) of attentional regulation, $t(21) = 1.86, p = .08$, Cohen's d = .67. No significant difference between the groups was found in other abilities, including noticing, not-worrying, not-distracting, body listening, or trust.

4. Discussion

The current work investigated how two different types of mindfulness-based techniques (OM versus FA) may improve healthy emotion regulation abilities. Novices learned either OM or FA training interventions over the course of 8-weeks. [15] We utilized experience sampling and self-report methods to examine longitudinal changes in emotion regulation skills. Both the meditation techniques were effective in reducing symptoms of general psychological distress and rumination from pre-to-post meditation training. However, compared to the OM training, FA training led to higher emotional awareness, self-regulation, and use of reappraisal strategy, as discussed below.

The FA training directly improved emotional regulation in specific ways from pre-to-post training. A systematic study of different types of emotion regulation strategies elucidated specific technique-related improvements. Reappraisal can be an effective way to manage emotions and even positively deal with stressors. [52] As expected, an increase in use of reappraisal strategy was found in the FA group from pre-training to post-training to manage their daily stressors. In past work, FA participants were found to improve in attentional shifting, [15] which may be the underlying mechanism leading to an increased use of reappraisal by FA trainees to manage their daily stressors. The current findings imply that FA-focused training can support mechanisms that improve abilities to reappraise emotions.

Poor self-regulation is associated with affective and behavioral disorders. [53] The current study found that after 8-weeks of training, the FA group also reported higher emotional awareness and self-regulation than the OM group with moderate to large effect sizes. Moreover, the FA group reported an increase in experience of positive affect in naturalistic settings from first to last week of meditation training. Together, these findings suggest that training novices to use FA techniques may teach them to better regulate their emotion and behavior thereby improving their emotional health.

Contrary to expectations, the OM group did not report higher emotional awareness, higher calmness, and less negative affect than the FA group. This is inconsistent with an earlier study, which found that the OM group reported higher emotional awareness (naming emotions and labeling thoughts [15]). It is important to note that in addition to different self-report measures for assessing emotional awareness, participants in that study had different inclusion criteria (e.g., had mild-

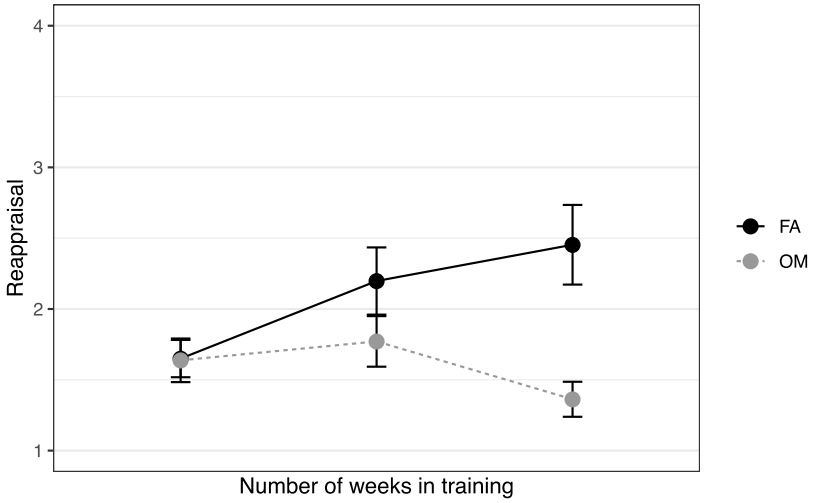

Fig. 3. Frequency of use of reappraisal strategy as a function of time (week 1, week 5, and week 8) and training-type (FA versus OM).

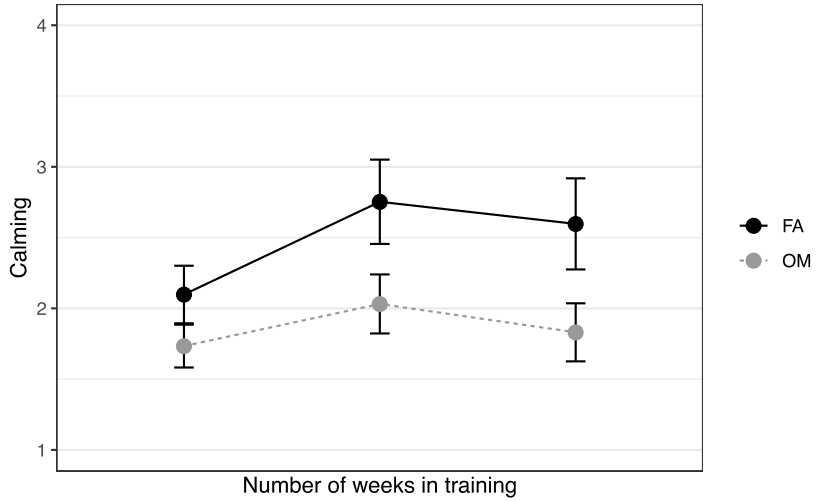

Fig. 4. Frequency of use of calming strategy as a function of time (week 1, week 5, and week 8) and training-type (FA versus OM).

severe depression and persistent negative affect) while the current study excluded participants with depression, which may explain the divergent findings. It is also possible that OM techniques may be more difficult to learn and implement than FA techniques. As such, 8-weeks of OM training may not be a sufficient dosage for all novices, and a longer dosage may lead to more effective results. Despite these open questions, similar to the effects of FA, OM training increased use of acceptance strategy to manage daily stressor in naturalistic settings. Finally, both OM and FA trainings also led to within-subjects improvements in psychological distress and rumination symptoms. These findings suggest that both OM and FA practices can improve some general wellbeing in novices.

There are a few limitations on this study. First, this longitudinal study has a small sample size. Nevertheless, these novel findings provide a proof-of-concept in showing the benefits of FA techniques on emotional health and provide a useful benchmark for designing future intervention with appropriate sample size based on effect sizes obtained in this study. Second, we did not conduct any follow-up data collection that would have informed us if participants continued practicing the techniques they learned and if there were any "lasting" effects of the interventions. Third, because we decided to add the measure MAIA [39] once the study was in the intervention-phase, we only collected post-training data for this measure. Even though significant between-group differences were found in emotional awareness and self-regulation, it would have been useful to know how within-group changes occurred due to FA training from pre-to-post training. Fourth, we only had two active interventions and did not have a control group. Finally, while the current study was designed to train participants for a commonly used duration of 8 weeks, it is possible that longer duration of OM training may lead to different results. [54] Future work should examine the effect of each technique as a function of dosage.

5. Conclusion

Focused attention training can improve reappraisal and self-regulation abilities. The current findings are encouraging and provide empirical data to inform development of structured treatment and preventative protocols. Our findings imply that within MBCT, an FA-focused training has a specific impact on emotion regulatory skills, and it can be selectively implemented in interventions to target clinically meaningful emotional disorders.

CRediT authorship contribution statement

Monika Lohani: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Project administration, Funding acquisition, Supervision. **Kara McElvaine:** Writing - review & editing, Project administration. **Brennan Payne:** Writing - review & editing, Formal analysis. **Kate Mitcheom:** Project administration. **Willoughby Britton:** Funding acquisition, Resources, Writing - review & editing.

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