

Effect of Internet Administered Mindfulness Training on Anxiety and Sleep Quality

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Abstract

Objective: To examine the effects of a daily, 10-minute mindfulness meditation intervention administered online through Mechanical Turk over a two-week period on the intensity of anxiety, perceived stress, and reported sleep quality in participants pre-screened for general anxiety symptoms. *Method:* One hundred and forty-eight participants pre-screened for mild or greater general anxiety symptoms and mild or greater difficulty sleeping were recruited through Mechanical Turk. Participants' baseline levels of anxiety, perceived stress, and sleep quality were assessed. They then were randomized to the mindfulness meditation intervention ($n = 74$) or wait list control group ($n = 74$). Following the two-week intervention period, participants completed post-questionnaires that assessed levels of anxiety, perceived stress and sleep quality. *Results:* Participants in the meditation group had significantly decreased levels of general anxiety and perceived stress, and increased sleep quality in comparison to the wait-list control group, $ps < .05$. *Conclusions:* Significant short-term benefits on anxiety, stress, and sleep quality resulted from a two-week, 10 minute a day mindfulness meditation training. Further research is needed to examine the duration of these benefits and the mechanisms of action that account for them.

Introduction

The prevalence of insomnia in people with anxiety disorders is higher than in the general population (Marcks & Weisberg, 2009). People with insomnia typically worry about whether they will get enough sleep, which contributes to more sleep deprivation, increasing both insomnia and anxiety symptoms in a vicious cycle (Jansson & Linton, 2007). Becoming immersed in rumination and worry can result in increased stress, arousal, and an inability to easily fall asleep or maintain sleep (Weise, Ong, Tesler, Kim, & Roth, 2013). Helping people to proactively respond more skillfully to their thoughts has been proposed as a potential pathway to help people become unstuck from this cycle of worry/anxiety and insomnia (Ong & Sholtes, 2010). Mindfulness meditation represents one such approach.

Mindfulness meditation teaches people to respond to thoughts by observing and “letting go” of them rather than becoming caught up in them. Mindfulness is formally defined as “a receptive attention to and awareness of present events and experience” (Brown & Ryan, 2003). Mindfulness incorporates concentration, awareness, and compassion and can be practiced in a simple breathing meditation (Ong, Ulmer, & Manber, 2012). It incorporates concentration by guiding focus to the breath, awareness by feeling what is happening in the present moment, and self-compassion as the practitioner lets go of judgments about the self when they get distracted and choose to gently return focus to the breath (Ong, et al., 2012). Mindfulness has been researched through the 8-week intensive Mindfulness-Based Stress Reduction (MBSR) intervention, which has been shown to reduce anxiety and depression (which is commonly co-morbid with anxiety) and increase sleep quality (Vøllestad, Sivertsen, & Nielsen, 2011). The main disadvantage to MBSR is that it can be time-intensive and expensive, preventing many people who have busy schedules or financial constraints from registering for an MBSR course. This study aims to examine the feasibility of using Amazon's Mechanical Turk as an online platform for recruitment in an intervention research study that will teach mindfulness meditation in substantially briefer sessions and overall duration than MBSR, without financial cost to the participant, and assess whether briefer training is feasible to deliver through this online platform and result in benefits for anxiety/worry, stress, and sleep symptoms.

Addressing the commonly co-morbid symptoms of anxiety and insomnia is important because daytime drowsiness and impairment are rated higher in people with decreased sleep, and driving while having inadequate sleep can be as dangerous as driving under the influence of alcohol (Connor, Whitlock, Norton, & Jackson, 2001). Worry and anxiety can lead to poor sleep related choices, such as drinking alcohol in order to fall asleep at night and watching television in order to avoid the anxiety of not being able to fall asleep. People with high trait worry were found to have a higher percentage of time awake while in bed (decreased sleep efficiency), higher heart rate while in bed, and a shorter reported sleep time than

people with low trait worry (Weise, et al., 2013). The current study used prescreening measures to target a population within Mechanical Turk that has mild or higher symptoms of anxiety *and* difficulty falling asleep – that is, targeting those with co-occurring anxiety and insomnia symptoms who may stand to benefit from a mindfulness intervention.

When participants diagnosed with an anxiety disorder completed MBSR, they reported higher quality and quantity of sleep, less symptoms of anxiety and depression, and less anxiety provoking worry and sleep disruptive thoughts (Vøllestad, et al., 2011). However, as noted earlier, a downside to MBSR is the large time commitment, requiring 8 weeks of mindfulness training involving a minimum of 45 minutes a day of meditation. Similar anxiety reducing, sleep enhancing results were found when MBSR was administered at a “low dose” of 20 minutes a day of meditation over an eight week period with an hour long weekly group meeting (Klatt, Buckworth, & Malarkey, 2008) and as an online version of MBSR that required 20 minutes a day of meditation (Boettcher, Åström, Pålsson, Schenström, Andersson, & Carlbring, 2014). A randomized, wait-list controlled study by Cavanagh and colleagues (2013) examined the efficacy of an online, 10-minute guided meditation freely accessed over a 2-week period to a general college population, and found reductions in symptoms of anxiety, depression, and perceived stress. If such benefits are possible with a broader adult population that report symptoms of general anxiety and insomnia, as the current study assesses, it will be easier to offer mindfulness training to anxious people with busy schedules who may not feel ready to commit 45 minutes a day to mindfulness meditation, but who feel more willing to try mindfulness meditation if it requires only 10 minutes a day.

Amazon’s Mechanical Turk is the online platform that was used for recruitment in the current study because it provides access to a more diverse group of participants than typical university samples, and Mechanical Turk participants report levels of general anxiety symptoms that match those of the general population (Mason & Suri, 2012; Shapiro, Chandler, & Mueller, 2013). Additional advantages to using Mechanical Turk for recruitment include rapid subject recruitment and a reduced barrier of entry for researchers. Mechanical Turk has successfully been used to conduct diverse behavioral research (e.g., Eriksson & Simpson, 2010; Suri & Watts, 2011), but to our knowledge, has not yet been used to conduct mindfulness intervention research. The study by Mason and Suri (2012) also explained how the downsides of having potentially unreliable data can be remedied by including prescreening measures such as the MMPI-2, test-check measures, and only allowing participants who have a 95% or higher successful acceptance rate for previous projects completed through Mechanical Turk.

The current study assesses the feasibility of recruiting participants and administering a mindfulness intervention study online in Mechanical Turk. We also examine the extent to which administering a brief mindfulness meditation intervention online to a population that has symptoms of anxiety and difficulty sleeping provides short-term benefits. More

specifically, first, we will examine the feasibility of using Amazon's Mechanical Turk to conduct brief, randomized mindfulness intervention studies. Second, we will test the hypothesis that brief mindfulness meditation training, delivered as an online intervention in Mechanical Turk, will improve anxiety / worry, stress, and sleep quality symptoms compared to a wait-list control group.

Methods

Preliminary Study

To initially explore how many participants would meet our eligibility criteria for the presence of at least mild (or greater) anxiety symptoms, we ran a preliminary study that tested 100 workers from Mechanical Turk (MTurk) with the General Anxiety Disorder 7-item questionnaire (GAD-7) and Insomnia Severity Index (ISI). Fifty-five out of the 100 workers who participated in this study indicated mild or higher symptoms of general anxiety and mild or greater difficulty falling asleep. Workers were then asked to rank five terms (mindfulness exercise, meditation exercise, attention exercise, focused breathing exercise and awareness exercise) from most effective to least effective for reducing anxiety, to examine which term might be best to use to “market” our study on MTurk. Out of the group that had mild or greater anxiety ($n = 64$), most of the participants found the “meditation exercise” to be the most effective for reducing anxiety (51.6%, $n = 33$), followed by “focused breath exercise” (18.8%, $n = 12$), “mindfulness exercise” (12.5%, $n = 8$), “attention exercise” (10.9%, $n = 7$) and “awareness exercise” (6.2%, $n = 4$). These preliminary findings guided how the brief mindfulness intervention was described to workers on Mturk, so that the presentation of the intervention was thought to be effective and appealing by our target population.

Participants

Participants were recruited using Amazon's MTurk, a crowd-sourcing Internet marketplace that has “workers” who accept “Human Intelligence Tasks”, or HITs, that are put online by “requesters”. The people who accept these HITs do any task that is possible online including surveys, memory tasks, transcription from audio to text, and translation from any number of languages. Workers find these HITs by searching the MTurk website, learning about new HITs from community worker forums, and from being alerted by their selected requester when a new HIT is released.

MTurk was programmed for the current study to automatically pre-screen potential participants (i.e., workers) to exclude anyone living outside of the United States, under the age of 18, and with a HIT approval rate of less than 95%. To screen out workers living outside of the U.S., study-eligible workers had to have a U.S. bank account associated with their MTurk account to prove that they live in the United States. Additionally, the latitude and longitude of the Geo-IP address of the computer used to complete the HIT was examined to determine and confirm their location in the U.S. A 95% HIT

approval rating means that 95% or more of the previous HITs the worker has completed on MTurk met the standards of the requester who provided the HIT (i.e., the worker adequately completed 95% of the MTurk jobs they took on in the past). Participants also completed a brief questionnaire on their levels of anxiety and difficulty with sleep, in which only participants with mild or greater anxiety symptoms and difficulty falling asleep were allowed to continue to participate.

The HIT was described on MTurk as a: “Two week study investigating the effects of brief mindfulness meditation”. We emphasized that this was a “two week study” to attract participants who were interested in committing the necessary time to the study. Once participants accessed the HIT through MTurk, they were given a link to the study’s Qualtrics site. Qualtrics (an online survey platform) was used for the consent form, baseline and post-intervention questionnaires, and daily meditation training. Participants were consented online by checking a box and clicking “continue” on an informed consent form on the Qualtrics survey platform.

Figure 1 presents detailed information about participant flow. Out of the 367 potentially eligible participants, 116 were ineligible based on their score from the General Anxiety Disorder 7-item scale (e.g., they did not have at least mild anxiety), and 78 participants were eliminated because they did not meet the criteria for mild difficulty falling asleep (e.g., they did not have at least mild difficulty falling asleep). The 148 participants who were study-eligible following the pre-screen and baseline measures were randomized into a mindfulness meditation group ($n = 74$) or a wait-list control group ($n = 74$). Table 1 presents the socio-demographics for the mindfulness meditation and control groups.

Participants next were shown their appropriate start dates for the remaining tasks of the study on the final Qualtrics survey page (3 days after finishing the baseline questionnaire for the meditation group, and 2 weeks and 3 days after finishing the baseline questionnaire for the wait-list control group) and also were reminded via email. The control group was asked to continue with their regular routine for the two-week period that the mindfulness group received the intervention, at which point both groups completed the post questionnaires. Following completion of the post questionnaires, the control group was given the opportunity to download the same 10-minute mindfulness meditations to listen to on their own time as a benefit of study completion.

Daily Brief Online Mindfulness Meditation Intervention and Feedback

Participants randomized to the mindfulness meditation group were sent an email every day for two weeks with a link to a MTurk HIT that included a 10-minute audio recording of a guided mindfulness meditation and a short survey of feedback questions. They were asked to listen to the meditation when they had free time in which they would not be interrupted by a different activity. Participants were asked to do the meditation in any sitting position in which they are comfortable, but could remain alert.

The meditation recording was adapted from the two types of mindfulness meditation techniques used in MBSR: mindfulness of breathing and the body scan meditation (Kabat-Zinn, 1994). These guided the participants' attention to the sensation of their breath and to sensations within the body, respectively. It included instructions to gently return their attention to the present moment sensation of the breath if they became distracted, and to feel compassion and non-judgment when they returned their attention. An example of an instruction given during the recording is: "Focus on the sensations of breath entering and leaving the body. There is no need to think about the breath – just experience the sensations of it... When you notice your awareness is no longer on the breath... gently bring your awareness back to the sensations of breathing." (see Arch & Craske, 2006). Full transcripts for the meditations can be found in Appendix A.

Measures

All measures were self-report questionnaires. The baseline questionnaire started with a pre-screen including the GAD-7 and ISI that were used to distinguish participants who were eligible to continue (i.e., had mild or greater anxiety symptoms and sleep difficulties). The baseline assessment then continued with the remaining questionnaires listed below. The post questionnaire included all of the baseline questionnaires except for the MMPI-2 *F(p)* scale and Attention Check Questions.

Screening Measures

The *Generalized Anxiety Disorder Assessment (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006)* and *Difficulty Falling Asleep questions from the Insomnia Severity Index (ISI; Bastien, Vallières, & Morin, 2001)* were given after participants completed the informed consent form to determine eligibility to participate in the study. The GAD-7 is a validated, seven-question measure for the presence and severity of general anxiety symptoms (Spitzer, et al, 2006). Participants also completed two questions (satisfaction with current sleep pattern and current difficulty falling asleep) from the insomnia severity index (ISI) described in more detail below. As noted, participants who reported at least mild or greater symptoms of general anxiety and difficulty falling asleep were considered eligible and were allowed to continue with the rest of the baseline questionnaires described below.

Data Integrity Checks

The *Infrequency-Psychopathology Scale* of the *Minnesota Multiphasic Personality Inventory II* (MMPI-2; Arbisi & Ben-Porath, 1995) is a 27-item true/false scale of the MMPI-2 that was designed to measure malingering of symptoms of mental illness, or "faking bad" and has been shown to have good construct validity. This scale was used to see if participants were faking psychological symptoms to complete the study in order to make money and not necessarily because they had anxiety or sleep difficulties and wished to participate in the research. This was also used to check for attention to

screen out any participants who were randomly answering questions without regard to content.

The *True or False Attention Check Questions* are four study-specific attention check questions designed to provide an additional means to rule out participants who were not paying attention to survey content. The four questions were randomly dispersed throughout the 27-question MMPI-2 scale and were used to exclude participants who answer less than 3 out of 4 of the questions correctly. The four questions included: “Many people experience stress sometime during their life” (correct response: True), “When I am experiencing sadness, I am happy” (Correct response: False), “When I am watching television, earthquakes occur because of my actions” (Correct response: False), and “When I’m thirsty I pour water on my feet” (Correct response: False).

Outcome Measures

The *Patient Health Questionnaire* (PHQ-9; Kroenke & Spitzer, 2002) is a 9-item, well-validated questionnaire that measures depressive symptoms and includes questions about pleasure in doing activities, feelings of depression, difficulty sleeping, and trouble concentrating (Martin, Rief, Klaiberg, & Braehler, 2006). The *Anxiety and Preoccupation about Sleep Questionnaire* (APSQ) is a 10-item questionnaire that has been shown to have factorial validity and internal consistency, and measures how much people worry about the quality and quantity of sleep that they get at night (Jansson-Fröjmark, Harvey, Lundh, Norell-Clarke, & Linton, 2011). It also assesses the extent to which people worry about how their sleep affects their daily functioning. The *Five Facet Mindfulness Questionnaire* (FFMQ; Baer, Smith, Lykins, Button, Krietemeyer, Sauer, & Williams, 2008) is a 39-item self-report scale that is used to measure how mindful participants are in their daily life and activities. The FFMQ has been shown to have construct validity by comparing the results of a group of regular meditators to people who do not meditate (Baer, et al., 2008). We included this questionnaire in the current study to measure how well participants learn to incorporate the skills of mindfulness into their everyday life. The *Perceived Stress Scale* (PSS; Cohen, Kamarck, & Mermelstein, 1983) is a 10-item scale that measures how much stress people perceive in their daily life. The PSS has been shown to have adequate reliability and construct validity. The *Insomnia Severity Index* (ISI; Bastien, et al., 2001) is a 7-item questionnaire that measures severity of insomnia over the last two weeks, including how satisfied and worried participants are with their current sleep and how much they consider their sleep problem to interfere with their daily functioning. It has been shown to be a reliable and valid measure for this purpose (Bastien, et al., 2001).

Mindfulness Intervention Feedback

The *Mindfulness Meditation Feedback Questions* were a study-specific set of questions that measures participants’ interest in learning meditation, their level of engagement in the daily meditation task, and their feedback on how effective

they thought they were in learning mindfulness meditation (see Appendix B). Subsets of the feedback questions were given to the meditation group at baseline, after each daily intervention, and in the post questionnaire. At the end of the baseline survey participants provided basic demographics information including gender, socioeconomic status, education, age, and location.

Statistical Analysis

Baseline comparisons of socio-demographic factors between the mindfulness meditation and waitlist control groups were assessed with *t*-tests for continuous variables (e.g. age), and chi-square tests were conducted for categorical variables (e.g. gender/sex). Independent-samples *t*-tests were conducted to compare groups at baseline on each outcome variable (GAD-7, ISI, PHQ-9, PSS, and APSQ). Univariate ANOVAs were conducted to compare the two groups on outcomes at post, controlling for baseline levels of each measure. That is, the ANOVAs compared outcomes after two weeks of daily 10-minute guided meditation in the mindfulness meditation condition compared to the wait-list control condition that received no meditation instructions over the same two-week period.

Results

Baseline Group Differences

No significant differences were found for the GAD-7 ($t = .34, p = .74$), ISI ($t = -.10, p = .92$), PHQ-9 ($t = -.56, p = .58$), PSS ($t = -.30, p = .77$), and the APSQ ($t = -.17, p = .87$) between the meditation group and wait-list control group at baseline (see Table 2). As presented in Table 1, no significant demographic differences were found at baseline between meditation and wait-list control conditions.

Outcomes (ANOVAs)

Of the 74 participants in each condition, 66 completed the post-questionnaire for the wait-list control and 40 successfully completed the meditations and post-questionnaire in the meditation group (see Figure 1). In order to be eligible for the post-questionnaire in the meditation group, participants had to have successfully listened to 11 out of the 14 days of meditation recordings.

At Post, there was a significant group difference for GAD-7 assessed symptoms of anxiety $F(1, 104) = 12.09, p = .001$, a significant group difference for PSS assessed symptoms of perceived stress $F(1, 104) = 39.09, p < .001$, a significant group difference for ISI assessed symptoms of insomnia $F(1, 104) = 8.34, p = .005$, a significant group difference for PSS assessed symptoms of perceived stress $F(1, 104) = 39.09, p < .001$, and a significant group difference on APSQ assessed worry about sleep $F(1, 104) = 11.57, p = .001$. Each of these group differences demonstrated lower symptom levels of anxiety, perceived stress, insomnia, and worry about sleep for the mindfulness group compared to the control group. At

Post, groups did not significantly differ on PHQ-9 assessed symptoms of depression $F(1, 104) = .038, p = .84$, or on FFMQ assessed mindfulness $F(1, 104) = 2.21, p = .14$. Table 2 presents a summary of the results.

Mindfulness Intervention Feedback

Within the mindfulness meditation group, feedback questions were given at Post to measure engagement and interest in the mindfulness meditation. Out of the 40 mindfulness meditation completers, participants responded as follows to the question: “How beneficial did you think this two week intervention was for you?”. 7.5% ($n = 3$) said that the two weeks of meditation was not beneficial at all, 10.0% ($n = 4$) a little beneficial, 30% ($n = 12$) somewhat beneficial, 22.5% ($n = 9$) mostly beneficial and 30.0% ($n = 12$) very beneficial. The second feedback question asked: “How frequently do you intend to continue practicing mindfulness meditation?”. Of the 40 mindfulness meditation completers 7.5% ($n = 3$) said they would not continue their meditation practice, 27.5% ($n = 11$) said they would practice once a week, 27.5% ($n = 11$) said they would practice two to four times a week, 27.5% ($n = 11$) said they would practice at least once a day, and 10% ($n = 4$) said they would practice two or more times a day. In summary, the majority of completers in the meditation group indicated that the intervention was “somewhat beneficial” (2) to “very beneficial” (4), $M = 2.57, SD = 1.24$ and reported that they would continue their meditation practice between “once a week” (1) and “at least once a day” (3), $M = 2.05, SD = 1.13$.

Discussion

The current study sought to answer whether MTurk could be used for longitudinal intervention research and whether a brief mindfulness meditation given over two weeks would have at least short-term effects on anxiety and sleep quality. To our knowledge, this was the first longitudinal mindfulness intervention study conducted on MTurk. Overall we found that MTurk as a recruitment platform for this study was successful in terms of cost and feasibility, addressing the study’s first aim. We also found that the mindfulness meditation group significantly improved the primary outcomes of anxiety, insomnia, and perceived stress symptoms, addressing the study’s second aim. The mindfulness meditation group did not lead to significant improvements in overall mindfulness skills, or depression symptoms, however.

There was a significant reduction in reported anxiety symptoms, sleep difficulties, and perceived stress in the mindfulness meditation group relative to the waitlist control group. These results are consistent with the previous finding that mindfulness meditation interventions – albeit more intensive ones – reduce anxiety symptoms (Hoffman, Sawyer, Witt, & Oh, 2010) and improve insomnia symptoms (Vøllestad, et al., 2011). They confirm the finding from another 2-week mindfulness intervention (Cavanagh, et al., 2013) that brief mindfulness training can positively affect anxiety and perceived stress outcomes. In addition to replicating these results, our study also found that symptoms of insomnia and levels of worry about sleep were significantly reduced. This means that people with co-occurring insomnia and anxiety symptoms

appear to benefit from only two weeks of brief mindfulness practice, administered exclusively through a remote online audio recording. If replicated, the fact that this study has shown that 10 minutes a day of mindfulness meditation training can assist in reducing symptoms of anxiety and insomnia, has important clinical implications. For example, future research may want to compare the addition of mindfulness meditation to the traditional treatment of CBT-I, especially for cases of comorbid insomnia and anxiety. One pilot study has found benefits of a combined CBT-I and mindfulness treatment (Ong & Sholtes, 2010), but to our knowledge a study that compares CBT-I by itself to CBT-I plus mindfulness training has not been attempted. Adding the current brief mindfulness meditation training to the protocol of CBT-I is significantly more feasible than adding a full MBSR course training.

There was no significant difference between groups on the Five Facet Mindfulness Questionnaire in this study. The FFMQ questionnaire measures the implementation of mindfulness skills into daily life (e.g. “When I take a shower or bath, I stay alert to the sensations of water on my body.”). The questionnaire can be scored with five different sub-scales (observing, describing, acting with awareness, nonjudging of inner experience and nonreactivity to inner experience). In the study examining the effects of a 10 minute guided mindfulness meditation given to college students over a two week period, Cavanagh et al. (2013) found a significant increase in FFMQ-measured mindfulness in the mindfulness meditation group. This could be from the additional tips that were given the second week through email that “provided suggestions on ways in which mindfulness could be brought into participants' everyday life, e.g. mindful eating, mindful walking.” (Cavanagh, et. al, 2013). In our study we did not provide information about how to incorporate mindfulness into everyday activities, which may explain why our mindfulness intervention did not significantly increase FFMQ scores. Another difference between the current study and the Cavanagh et al. (2013) study is that the unscreened sample of college students in the latter study could have the ability to incorporate mindfulness skills into their daily life more readily than the anxiety and insomnia-symptomatic adult population from the current study. Longer, more intensive MBSR programs have also been shown to increase levels of mindfulness in participants that have been diagnosed with an anxiety disorder (Vøllestad, et al., 2011). If participants from our group practiced mindfulness for a longer duration or at greater intensity they may have shown an increase in FFMQ scored mindfulness, as is shown in MBSR programs that have targeted samples with anxiety disorders.

There also were no significant differences found in depression results between groups. This contrasts with the Cavanagh et al. (2013) findings in which participants who completed the 2-week online mindfulness meditation training reported reduced depression symptoms. However, the depression measure used in the study by Cavanagh, et al. was the PHQ-4, which includes two depression based questions that are included in the PHQ-9, and two anxiety related questions

that are included in the GAD-7. Thus, it is not a “pure” depression measure. The results of the current study could be different because the depression questionnaire used in this study (PHQ-9) focuses entirely on depression instead of combining the results from anxiety and depression. It may be that the differences in depression over a two-week period were less significant in a group of participants that are pre-screened with anxiety symptoms because there was less room for improvement.

Addressing this study’s first aim, the ease of recruitment and low cost appear to make MTurk a viable option for future research with brief longitudinal intervention designs. The total dollar amount spent for the MTurk costs of this current study was \$746.57, including paying workers in the mindfulness meditation and wait-list control groups, the 116 participants who completed the \$.05 HIT who had been ineligible from the baseline questionnaire and the 10% HIT administration fee that MTurk charges. Current payment to workers was approximately \$2.00 an hour, which is higher than the median average wage on MTurk of \$1.38 an hour (Horton & Chilton, 2010).

Study Limitations

Participants in the mindfulness meditation group who did not participate completely were dropped from the study at two points during the intervention. The length of time workers took to complete a daily meditation HIT was examined to assess participation (if completed in less than 10 minutes then they could not have listened to the 10-minute recorded meditation) and whether they completed the HIT for each day. As presented in Figure 1, participants who failed to complete 11 out of the 14 total days of mindfulness meditation HITs were dropped from the study; that is, no further data were collected on them. Thus, there was a significant difference in retention rates between the meditation group (54.1%) and the control group (89.2%) that is discussed in more detail below. Retention rates were most likely affected by dropping non-compliant mindfulness meditation group participants because only 45 of the original 74 participants in that group were eligible to complete the post questionnaire, out of which 40 completed. If we had allowed all participants in the mindfulness group to complete the Post questionnaires (not only completers), it is likely that at least some of the 29 participants who were dropped would have completed the post questionnaire, increasing the retention rate in the mindfulness meditation group and facilitating an intent-to-treat analysis. Thus, on one hand, the fact that we discontinued data collection on participants with compromised daily HIT completion represents a limitation of this study, preventing the possibility of doing an intent-to-treat analysis. On the other hand, the current approach provides an analysis of the participants who participated more fully in the mindfulness meditation intervention, providing a good analysis of intervention completers.

There is the possibility of a placebo effect for the mindfulness meditation group in comparison to the wait-list

control group. That is, the mindfulness meditation condition could have created an expectation of treatment effect that could be the cause of the difference between groups for the changes in levels of anxiety, perceived stress, worry and insomnia symptoms. Additional research is needed that uses an active control, where the participants believe that they are being taught meditation, but are actually taught a sham meditation. Another option would be to compare the effects of meditation to another type of treatment such as listening to calming music or progressive muscle relaxation.

Conclusion

Acknowledging the limitations of the current study and the fact that further research is needed, we have demonstrated that brief mindfulness meditation administered online in MTurk over a two-week period can reduce reported symptoms of anxiety, perceived stress, insomnia, and worry about sleep. The current findings suggest that people who are too busy to commit to a complete MBSR program can practice mindfulness meditation affordably online over a brief period of time and still gain benefits. This study also successfully used Amazon's Mechanical Turk as a recruitment platform, demonstrating its potential for future studies to reduce costs and readily recruit adult participants.

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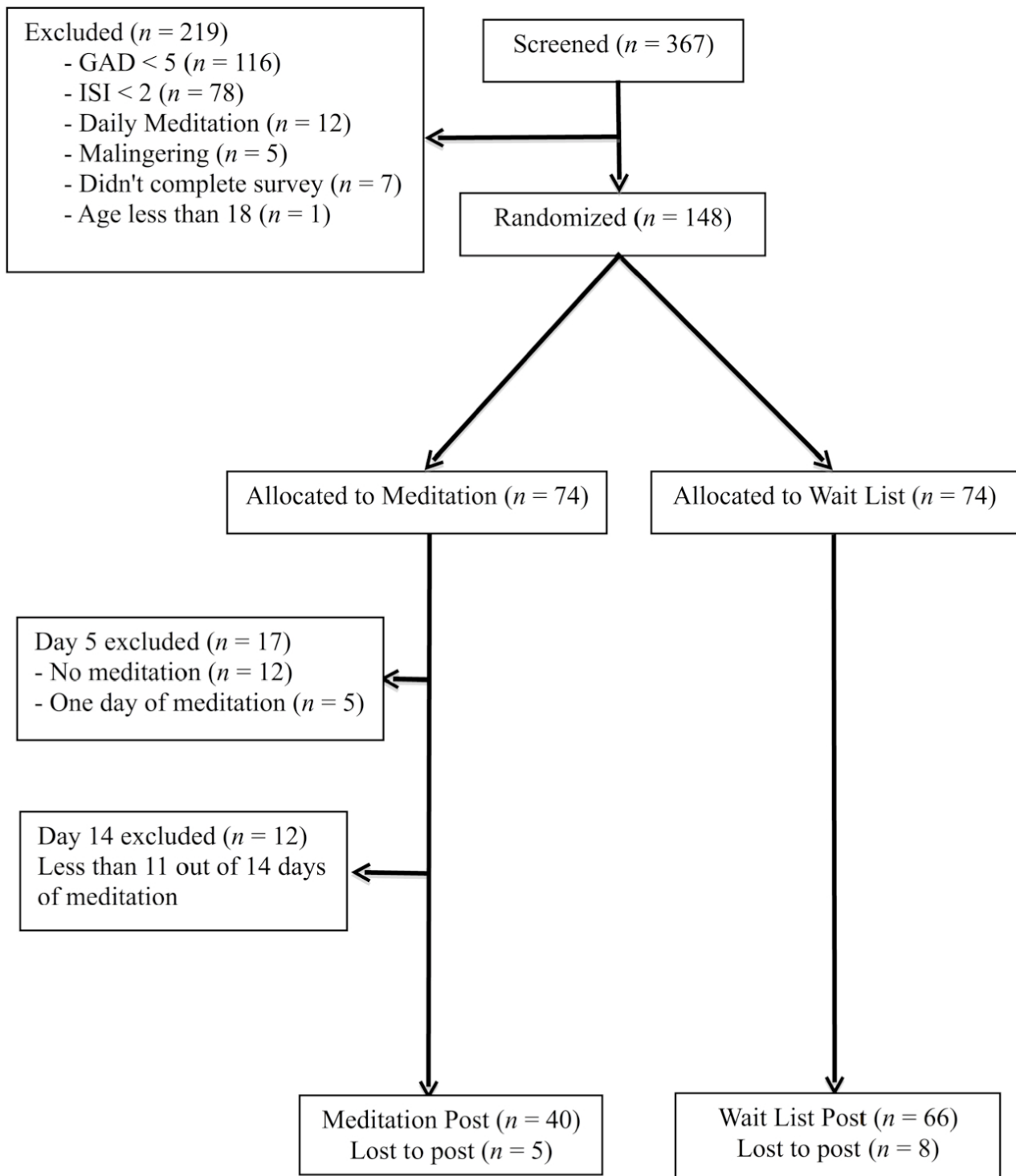
Table 1. Demographics for randomized participants

	Total	Meditation	Control	F value	<i>P</i> value	
Gender (Female)	56.8% 84/148		58.1% 43/74	55.4% 41/74	.11	.74
Age, <i>in years</i>	31.7 (9.9)		30.7 (9)	32.6 (10.7)	1.68	.24
Married/Cohabiting	53.4% 79/148		52.7% 39/74	54.1% 40/74	.03	.87
Single	46.6% 69/148		47.3% 35/74	45.9% 34/74		
Median Income	31-40K		31-40K	31-40K	1.93	.17
White	81.1% 120/148		81.1% 60/74	81.1% 60/74	0.00	1
Hispanic / Latina	2.7% 4/148		2.7% 2/74	2.7% 2/74		
Black / African American	6.1% 9/148		6.8% 5/74	5.4% 4/74		
Asian or Pacific Islander	6.1% 9/148		6.8% 5/74	5.4% 4/74		
Native American / Alaskan Native	.7% 1/148		0% 0/74	1.4% 1/74		
Biracial	3.4% 5/148		2.7% 2/74	4.1% 3/74		

Table 2. Means, standard deviation and between-subjects univariate analysis of variance for Meditation and Control groups

Measure & condition	Baseline questionnaire M (SD)	Post questionnaire M (SD)	F value	<i>P</i> value
GAD – 7 Meditation	11.92 (4.39)	6.02 (4.55)	12.09	.001
GAD – 7 Control	12.22 (4.43)	8.99 (4.88)		
ISI Meditation	13.4 (4.01)	10.15 (4.61)	8.37	.005
ISI Control	13.31 (4.26)	12.18 (4.75)		
PSS Meditation	41.12 (7.01)	37.25 (7.61)	39.09	<.001
PSS Control	40.7 (7.17)	44.15 (4.31)		
APSQ Meditation	66.82 (17.64)	50.32 (24.02)	11.57	.001
APSQ Control	66.13 (21.87)	62.04 (23.34)		
FFMQ Meditation	127.58 (18.37)	120.3 (13.6)	2.21	.14
FFMQ Control	120.75 (21.77)	117.94 (12.46)		

Figure 1. Participant flow chart

Figure 2. Mean GAD-7 scores and error bars for the standard error of the mean. ** = $p < .01$

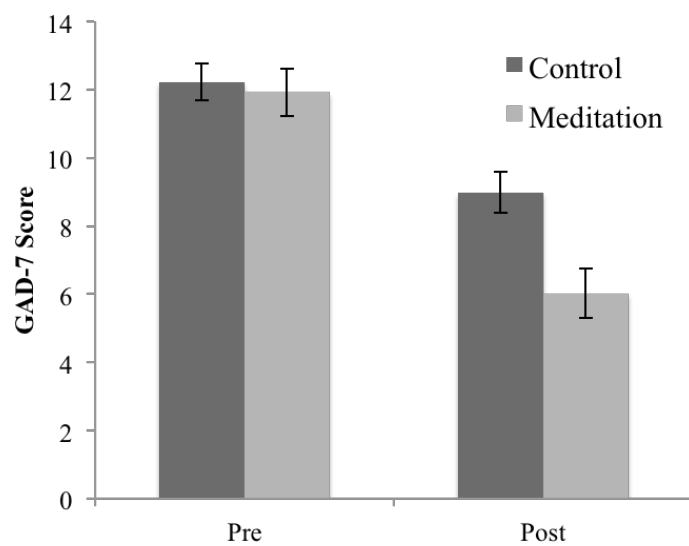


Figure 3. Mean ISI scores and error bars for the standard error of the mean. ** = $p < .01$

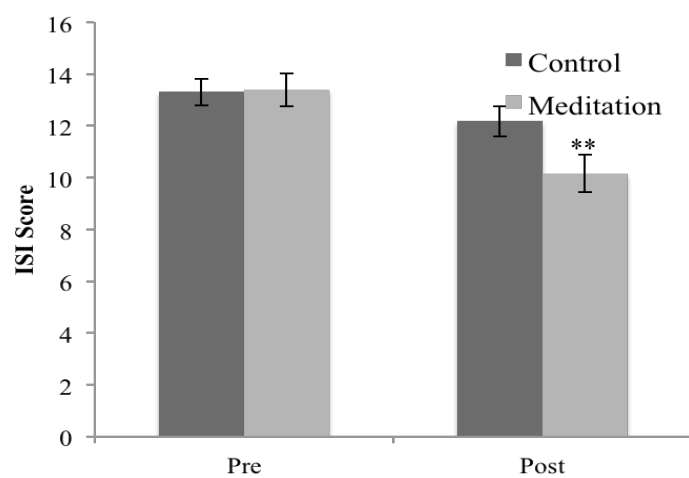


Figure 4. Mean APSQ scores and error bars for the standard error of the mean. ** = $p < .01$

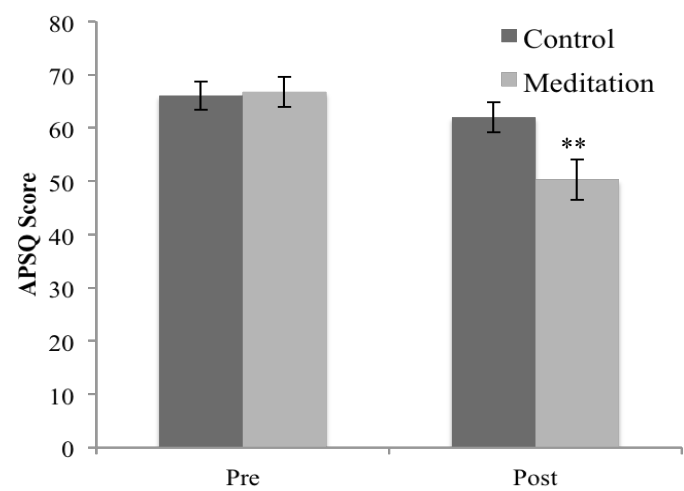


Figure 5. Mean PSS scores and error bars for the standard error of the mean. *** = $p < .001$

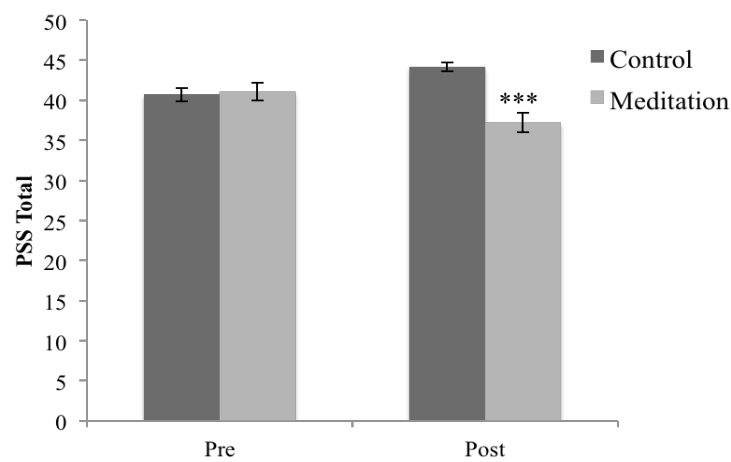


Figure 6. Mean PHQ-9 scores and error bars for the standard error of the mean.

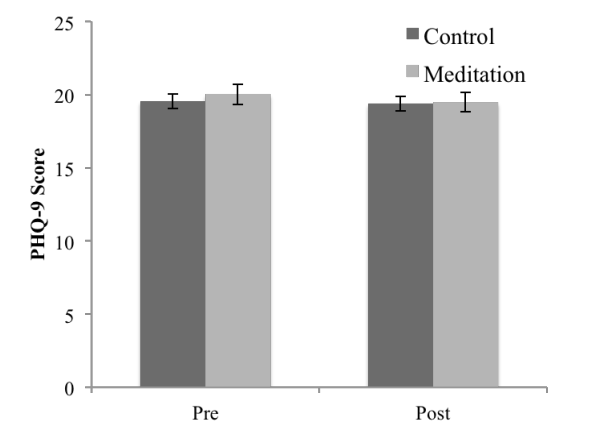
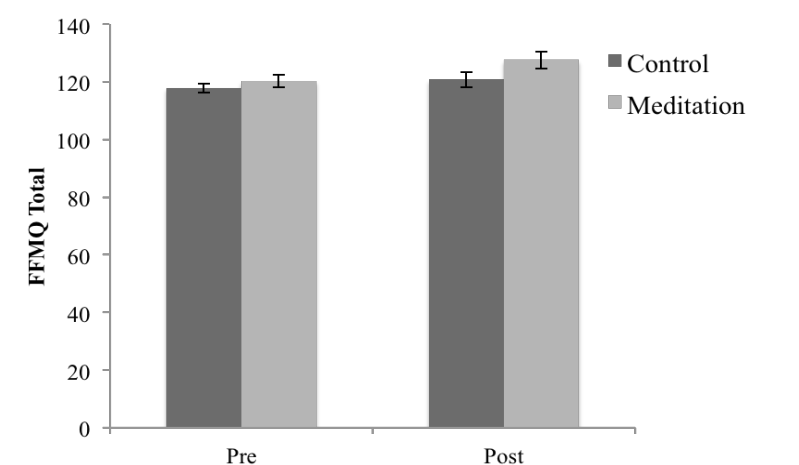


Figure 7. Mean FFMQ scores and error bars for the standard error of the mean.



Appendix A

Mindful Breath Meditation Transcription

Hello this is Travis Usinger from the University of Colorado.

(Additional information in first meditation only)

Welcome to the 2 week mindfulness meditation course for anxiety. Every day you will receive an email with a 10 minute guided mindfulness meditation. If you have any technical questions you can email me from the email address located below. Travis.Usinger@Colorado.edu.

(End of additional information from first meditation recording)

In mindfulness meditation we have a specific focus for our attention. Mindfulness is keeping your attention on a present moment sensation and returning our attention to that focus on the present moment sensation as we naturally become distracted.

Throughout this course the focus of our attention will be the sensation of the breath and a separate guided meditation for sensations in the body. We are training the mind to stop reacting to thoughts, and to allow ourselves to feel sensations and notice thoughts without having to do anything about them.

Some misconceptions about meditation are that we are clearing out the mind or removing thoughts when we are meditating. This is not true, mindfulness meditation is simply being aware of when you become distracted by thoughts, and choosing to gently return your focus to the intended point of focus.

Make sure you will have 10 minutes of uninterrupted time to focus on this meditation exercise. Pause this recording if you need to make any adjustments to prepare this time. If you have headphones or ear buds that you can connect to the device that you are listening to this from, that would be the ideal way to listen to this meditation.

Find a sitting position where you are comfortable, yet will stay alert and awake over the next 10 minutes. You can sit in a chair, with both feet flat on the ground and your knees uncrossed, or a seated position on the floor if that is comfortable for you.

As you sit we will begin the meditation practice by noticing what the contact with the chair or floor feels like. What area of your body is touching the chair or floor? Your legs, feet, and hip bones. The pressure of gravity pulling you towards the floor.

Now bring your attention to your entire body. Getting a general sense of what it is like to be in your body right now.

My voice will guide you to the feelings of your breath. The sensation of the breath may feel strong to you, or very subtle. There is no need to try and control or change how you are breathing, just bring your attention to your natural breath with curiosity and acceptance.

Most people can feel the breath more strongly in the abdomen or chest area. Choose one area to focus on, and keep that as your focus throughout this meditation.

As you breath, notice how your belly or chest rises on the inhale, and falls on the exhale.

Feel the sensation of expansion and contraction.

It is normal for your mind to wander while practicing mindfulness meditation. If this happens, you just return your attention to the point of focus with compassion and ease. You may have to repeat this same action of returning to the point of focus many times. Despite your mind wandering, if you return to the point of focus, you are practicing mindfulness meditation.

Notice the entire process of the breath. The inhale, slight pause, exhale, slight pause, and repeat. Become immersed in the sensations of the breath in the present moment.

Your body may be restless, but try to keep still as much as is possible. Adjust your body if you are in pain, but return back to stillness with a focus on the breath when you are in a comfortable position.

Continue to feel the sensations of the breath. Notice the warmth or coolness of the breath.

Your mind may tell you that you need to do something else, or think about something else. Instead gently return your attention to the breath.

Notice where one breath ends and the next begins.

Take notice of any areas in the chest or belly that feel tight, or open. Notice without trying to change or fix. Be curious to the sensations of the breath.

Notice when there is stillness and when there is movement with the breath. The stillness at the end of the exhale, the movement as the breath enters and leaves the belly or chest.

Continue to follow the sensations of the breath with 30 seconds of silence.

Take a few more breaths as we come to the end of the meditation.

Begin to actively move. Blinking the eyes, moving your fingers and hands and stretching your arms over your head. We are returning to an active mindset.

Thank you for listening to this guided mindfulness meditation. To receive credit for your participation, finish the questions below and we will continue our mindfulness training tomorrow.

Body Scan Meditation Transcription

If you notice thoughts that distract you from this meditation, this is normal. Return your focus to the sensations in the body. We will be feeling sensations like pins and needles, heaviness, lightness, heat, coolness, that naturally occur in the body. We will be feeling them without trying to change them. If you notice yourself thinking about what these sensations mean, return your attention back to simple sensations in the part of the body that I am guiding your attention to.

Find a comfortable sitting position where you will be able to stay alert and awake over the next 10 minutes. You can sit in a chair, with both feet flat on the ground and your knees uncrossed, or a seated position on the floor if that is comfortable for you.

As you sit we will begin the meditation practice by noticing what the contact with the chair or floor feels like. What area of your body is touching the chair or floor? Your legs, feet, and hip bones. The pressure of gravity pulling you towards the floor.

Now bring your attention to your entire body. Getting a general sense of what it is like to be in your body right now.

Guide your attention to the sensations in your head. Notice warmth and coolness. The feeling of your hair on your skin. The muscles and tension or ease in your face.

Slowly guide your attention down into your neck. Feeling any comfort or discomfort, without trying to fix anything. Be curious to the present moment sensation of what is happening in your body without trying to change it.

Slowly moving downward, feel your shoulders. Notice the heaviness or lightness.

Sink your attention to your left arm. Notice any tingling, temperature, or feelings of the skin against your clothing.

Feel your left hand. Without moving, feel the warmth or coolness in the hands and fingers.

If your mind becomes distracted with other thoughts just return your attention to the sensations in the body. It is completely normal to repeat this process multiple times during this meditation.

Focus on your right arm. Feel the weight, temperature, and any other sensations in this arm.

Continue to your right hand. Without moving, feel the warmth or coolness in the hands and fingers.

Remember to feel these sensations without trying to change what you are feeling. You may have feelings of pain or discomfort. If you need to move in order to become comfortable you can do that, but once you are comfortable, return to stillness in the body, feeling the sensations in the area that I am guiding you towards.

Back – scan up and down the length of your back. Moving your attention across this area to gather the senses of heat or coolness, heaviness or lightness, and comfort or discomfort. Be open and accepting of the sensations that you feel. Listening, without judging.

Chest

Belly

Feel the sensations of expansion and contraction of the breath. How the skin moves against your clothing. Feelings of warmth or coolness.

Hips

Left Leg

Left Foot - Tingling, heat, coolness

Right Leg

Right Foot

Scan through the entire body from head to toe. You can move your attention as fast or as slow through the different parts of your body as feels right. Moving your attention like a flashlight through the entire body. Illuminating the feelings and sensations. We will take about 30 seconds of silence as you continue to practice this scanning through your body at your own pace.

Take a few more breaths as we come to the end of the meditation.

Begin to actively move. Blinking the eyes, moving your fingers and hands and stretching your arms over your head. We are returning to an active mindset.

Thank you for listening to this guided mindfulness meditation. To receive credit for your participation, finish the questions below and we will continue our mindfulness training tomorrow.

Appendix B

Feedback Questions for Baseline

How did you find this study?
(string)

Have you heard about mindfulness before?
(Yes/No)

If yes, where?
(string)

How interested are you in learning meditation?

- 0 Not at all interested
- 1 A little interested
- 2 Somewhat interested
- 3 Mostly interested
- 4 Very interested

How likely do you believe you will be able to successfully learn meditation?

- 0 Not at all likely
- 1 A little likely
- 2 Somewhat likely
- 3 Mostly likely
- 4 Very likely

If you believe you won't be able to successfully learn meditation, why?
(string)

Feedback Questions for Daily Meditation

How often was your mind distracted during the meditation?

0 Not at all, completely focused

1 I was a little distracted

2 Somewhat distracted

3 I was mostly distracted

4 Completely distracted

Did you do any other activities during the meditation? (Please be truthful, you will be paid either way)
(Yes/No)

What activities did you do (if you weren't focused on the meditation)?
(string)

How effective did you think you were in doing the meditation?

0 Not at all

1 A little effective

2 Somewhat effective

3 Mostly effective

4 Completely effective

Feedback Questions for Post Questionnaire

How often did you practice mindfulness meditation during the last two weeks?

- 0 Not at all
- 1 One a week
- 2 Two to Four times a week
- 3 At least once a day
- 4 Two more more times a day

How beneficial did you think this two-week intervention was for you?

- 0 Not at all
- 1 A little beneficial
- 2 Somewhat beneficial
- 3 Mostly beneficial
- 4 Very beneficial

How frequently do you intend to continue practicing mindfulness meditation?

- 0 Not at all
- 1 One a week
- 2 Two to Four times a week
- 3 At least once a day
- 4 Two or more times a day