Monitoring Mindfulness Practice Quality: An Important Consideration in Mindfulness Practice

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Abstract

Mindfulness-Based Stress Reduction (MBSR) is an experientially based group intervention empirically supported to reduce psychological symptomology. Although MBSR has shown to be an effective intervention, little is known about which facets of the intervention are important in producing positive outcomes. This study tested several aspects of mindfulness practice (total practice duration, practice frequency and practice quality) with the primary focus being on validating (i.e., predictive and convergent validity) a new measure of mindfulness practice quality (PQ-M). The PQ-M fit a 2-factor solution via a Maximum Likelihood Exploratory Factor Analysis (n = 99). Using longitudinal multilevel modeling on a smaller subsample (n = 19), preliminary support was found for changes in practice quality over the course of the MBSR intervention. Further, change in practice quality was associated with improvements in psychological symptoms. While this study was exploratory, these finding suggest that practice quality is a relevant factor to promote positive outcomes and may guide mindfulness instructors in providing highly tailored interventions.

Monitoring Mindfulness Practice Quality: An Important Consideration in Mindfulness Practice

Among psychologists in practice as well as psychotherapy outcome researchers, mindfulness has become an increasingly prominent area of interest over the last several years due to its capacity for promoting client well-being and reducing psychological symptoms (Baer, 2003; Brown, Ryan, & Creswell, 2007; Grossman, Nieman, Schmidt, & Walach, 2004). A growing body of literature, including several meta-analytic investigations, supports the efficacy of mindfulness interventions for reducing anxiety, depression, and distress, along with enhancing well-being and psychological health (Chiesa & Serretti, 2009; Grossman et al., 2004; Hofmann, Sawyer, Witt, & Oh, 2010). Mindfulness practices have shown promise for a wide range of psychological, psychosomatic and medical conditions, from psoriasis (Kabat-Zinn et al., 1998) and fibromyalgia (Kaplan, Goldenberg, & Galvin-Nadeau, 1993) to addiction (Zgierska, et al., 2008).

Mindfulness has been defined as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 1994; p. 4) or similarly as an intentionally receptive present-moment attention. This is in contrast to a common mode of attention, which is argued to be generally "non-mindful," involving a sense of being on "automatic pilot" or reacting habitually and automatically to life situations (Segal, Williams, Teasdale, 2001). Several measures of mindfulness have been developed and validated primarily through comparing experienced meditators with mediation naïve controls (Baer et al., 2008) or examining within-subject changes as a result of a mindfulness intervention (Lau et al., 2006). Some of the most commonly used mindfulness

measures are the Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003), Five Factor Mindfulness Questionnaire (FFMQ; Baer et al., 2006), and the Toronto Mindfulness Scale (TMS; Lau et al., 2006).

One noteworthy type of mindfulness intervention, Mindfulness-Based Stress Reduction (MBSR), developed by Jon Kabat-Zinn (1982; 1990), uses a variety of practices (e.g., breath meditation, mindful yoga) to cultivate mindfulness. The MBSR program consists of eight weekly group sessions of 2.5 hours in duration. Participants receive training in a variety of meditative practices and are asked to complete daily home mindfulness practice with the aim of cultivating greater mindfulness to deal more effectively with stressors in daily life. Similar to other mindfulness interventions, MBSR has been found to improve quality of life and psychological health across a host of outcomes, including reduction in stress, depression, and anxiety (Grossman et al., 2004; Chiesa & Serretti, 2009).

Although MBSR is supported as an effective intervention, little is known about which facets of the intervention are involved in producing positive outcomes. One aspect speculated to be important for positive outcomes is the total duration of formal home mindfulness practice, at times referred to as mindfulness "dose effects." In MBSR, participants are typically instructed to formally practice mindfulness (i.e., while doing nothing but the practice) for 45-minutes a day, 6 days per week. While formal practice is theorized to be a crucial element in outcome, research on what makes for a necessary or appropriate dosage of practice has yielded inconclusive findings (Dobkin, 2008; Vettese, Toneatto, Stea, Nguyen, Wang, 2009). For example, while both Carmody and Baer (2008) and Speca, Carlson, Goodey, and Angen (2000) found that total duration of formal (home) practice (i.e., total dosage) matters for a host of outcomes (e.g., psychological and medical symptoms reduction, psychological well-being, and perceived stress), a number of other

studies (Astin,1997; Carmody, Reed, Kristeller, & Merriam, 2008; Davidson et al., 2003) found no relationship between dosage and outcomes.

Ironically, despite the fact that home practice is considered a crucial component of MBSR and related interventions, there has been little speculation (other than low statistical power to detect significant effects due to small study sample sizes) about what may be responsible for the inconsistency of these findings. Interestingly, none of these studies has explored the *quality* of mindfulness practice independently or in conjunction with dosage. Several important questions at present remain unanswered. For example, is a high quality of practice important for cultivating mindfulness? Further, is high dosage or high quality of practice more important for MBSR outcomes? The literature on homework in Cognitive Behavioral Therapy (CBT) suggests that homework completion and adherence result in stronger psychological outcomes than treatments without this component (Kazantzis, Whittingthon, & Dattilio, 2010; Scheel, Hanson, & Razzhaviaihina, 2004) . However, whereas adherence in CBT typically involves patients' attempts at completing a task and reporting back to the therapist about it, adherence to mindfulness is different. Adherence involves not only attempting the specific practice (e.g., seated meditation) but also adhering to "how" one is practicing (or practice quality). For example, if we assume that fostering present-moment attention in mindfulness practice is important to develop stronger levels of mindfulness, then merely attempting practice itself may not be sufficient. The practitioner would presumably not cultivate mindfulness if, during the practice, she was asleep. Therefore, we need to look outside the CBT homework literature into other psychotherapy research and the broader learning theory literature. Examination of these bodies of literature suggests that practice quality is an important factor for predicting favorable outcomes. Paivio, Hall, Holowaty, Jellis & Tran, (2001) found that quality of engagement (as measured by the Level of Engagement Scale) in a specific therapeutic task,

coupled with frequency (which they call "dose") was predictive of global and specific symptom reduction. In the broader learning theory literature, Ericsson, Krampe and Tesch-Roemer (1993) stated that a critical factor in skill acquisition is formal effortful practice, which is in contrast to informal, playful or hobby-like engagement. If mindfulness practice is like other forms of training (e.g. learning to play violin), quality rather than sheer dosage may prove the key to understanding the effect of practice (Ericsson et al., 1993). While such inquiries are interesting and logically relevant, no measure of practice quality (or even consensus on what practice quality involves) has been developed or explored in the existing literature. This topic warrant further examination and was the focus of the present study.

To address this gap in the literature, we developed a measure of mindfulness practice quality named Practice Quality -Mindfulness (PQ-M). Mindfulness practice quality is defined as a *balanced perseverance/resolve in (a) receptive (b) present-moment attention, during the act of formally practicing mindfulness meditation*. This construct was initially conceived while attempting to better understand the important elements in the first author's personal practice experience with mindfulness meditation. Perseverance in the formal practice session was preliminarily thought of as continually coming back to the present moment focus of attention. To develop a broader conceptualization of this area, expert meditators' teachings on perseverance and resolve were studied. Based on lectures from Annie Nugent and Joseph Goldstein (see audio files on dharmaseed.org) along with discussions with the four MBSR instructors in the study, it was concluded that a particular type of perseverance was important while formally practicing mindfulness. A preliminary scale was constructed to assess perseverance that integrated a series of plausible dimensions associated with the conceptualization of what was operationalized as "practice

quality". The measure was then developed from the preliminary scale for review and pilot testing.

In establishing face validity for the PQ-M, it was discussed with six expert teachers of mindfulness mediation who assessed the measure for appropriate content, understandability, and for its ability to capture the essence of a quality practice. The six expert teachers held a Masters or PhD degree, had previously attended a 7-day MBSR professional training, and had several years of mindfulness practice experience (range 5 - 33 years). After several rounds of scale edits (changing the scale from likert to a visual analog, dropping irrelevant items and changing the wording on others) and pilot testing with 10 practitioners of mindfulness meditation, the measure was further revised and again presented to the 6 experts who unanimously agreed the scale appropriately measured mindfulness practice quality. The finalized seven-item measure was named "Practice Quality-Mindfulness" (PQ-M).

The overall aim of this exploratory study is to enhance understanding of practice-related factors (e.g., practice quality, dosage, and frequency) potentially predictive of outcomes for MBSR participants. In addition, a primary aim of this study is the development and testing of a measure of *mindfulness practice quality*. This measure of mindfulness practice quality is defined as a *balanced perseverance/resolve in (a) receptive (b) present-moment attention, during the act of formally practicing mindfulness meditation*. This perseverance involves two primary constructs of *receptivity* and *attention*. The *receptivity* component involves an awareness brought to presenting experience with a sense of curiosity, willingness, and/or self-compassion/acceptance. Receptivity is not to be confused with a feeling (necessarily) and can be thought of more as perseverance/resolve in "turning toward" or "leaning into" a sense of receptivity (or compassion, or willingness to experience what is arising in the formal practice),

repeatedly, when attending to present-moment experience. The *present-moment attention* component involves attending to the present moment, including an item related to experience as it manifests in the body (i.e., bodily sensations). In short, the essence of mindfulness practice (as it is used in MBSR) involves perseverance in coming back *again and again and again* to the present-moment experience with a sense of receptivity to each moment-to-moment experience during the formal practice. Further details of this measure are given in the Methods section and Appendix.

The validation of a practice quality instrument may provide clinicians and researchers with a tool to improve and better understand mindfulness intervention outcomes. Specifically, findings from this study may direct MBSR teachers in higher quality instruction and in making clearer recommendations for practice. Further, the results may inform researchers about developing and testing more specific theoretical models as they relate to the outcomes of mindfulness practice. Finally, the measure may be useful as a tracking tool for mindfulness participants to monitor their mindfulness practice.

In summary, this project combines two research areas (mindfulness interventions and learning theory research) by developing a new measure of mindfulness practice quality. We explore the measure's reliability and validity, and test its predictive validity by assessing its relation to outcomes of health and well-being. It is hypothesized that mindfulness practice quality will not only predict outcomes but also remain significant when controlling for other theoretically relevant practice factors (i.e., practice frequency and practice dosage).

The present study assessed the following three hypotheses:

$H_{1:}$ The Practice Quality-Mindfulness (PQ-M) measure will load onto two factors of "Attention" and "Receptivity" (see Appendix).

$H_{2:}$ MBSR participants will significantly improve in practice quality over the course of the intervention.

$H_{3:}$ The PQ-M measure will be predictive of outcomes of satisfaction with life and psychological symptom reduction.

METHODS

Participants

To gather a naturalistic sample of MBSR participants, the PQ-M was integrated as a standard measure into the MBSR program at a large Midwest university's Integrative Medicine Program. Two different sized naturalistic samples (n = 99 and n = 19) were used for this study. During the orientation session (prior to session one) MBSR class participants who were over the age of 18 and fluent in English were invited to become involved in the full study (which we will call "sample two" that included n=19 participants completing pre-post testing and multiple administrations of the PQ-M). Those MBSR class participants not interested in involvement in the full study ("sample one"; n=99) completed only two PQ-M measures (one at week 1 and the other at week 8) for the purposes of factor analyzing the PQ-M measure, along with a basic demographic and consent form. No participants were actively recruited for this study prior to the orientation session--they were all enrolled in the MBSR program prior to being solicited for study involvement. The two samples were not paid and volunteered. The study was approved by the local IRB.

For study one (n=99), we only had access to gender and racial status information, as minimizing participant burden was a priority. Eighty-percent of the sample in study one were female and 2% were of racial minority status. The smaller sized sub-sample in sample two (n = 19) were volunteers for the full study which involved completing (a) a pre- and post-test battery of measures and (b) daily measures of mindfulness practice. This smaller sub-sample provided multiple measures over time which were used to examine the

predictive validity of the PQ-M measure. Out of a total of 19 participants in sample two (2 participants were dropped from analyses due to missing data other than baseline measures but did not differ on baseline characteristics from sample two) , 78% were female (*n* = 15), 100% were of White racial status, 84% were employed full-time (*n*=16), 79% were married/partnered, 84% were employed full-time (*n*=16), and 42% had prior meditation experience (*n*=8). Table 1a displays the descriptive statistics for the other demographics of the sample for sample two. The small number of participants in sample two is a limitation to the analyses conducted on this sample, as will be discussed further in the discussion section.

Both samples (*n* = 99 and *n* = 19) presented with varying health and psychological statuses (e.g., chronic pain, anxiety, stress). Typical presenting problems for participants enrolling in the MBSR program include general psychological distress, medical illness, and desire for personal growth.

Treatment: Mindfulness Meditation

Four instructors facilitated the MBSR intervention in five separate groups. All instructors held a Master's degree (*n* = 3) or PhD (*n* = 1) in a health-related field, were of White racial status, had previously attended a 7-day MBSR professional training, and had several years of mindfulness practice experience (range 8 - 33 years). Most MBSR instructors are required to attend the 7-day professional training and to have several years of personal mindfulness practice. In this respect, the instructor sample is similar to other instructors in the field and in the MBSR literature, which may result in greater generalizability of the findings.

MBSR classes focus on mindfulness meditation practices which involve paying attention in the present moment, with a quality of openness and willingness to experience

whatever is in one's field of awareness. These practices include various forms of meditation, such as breath meditation, body scan (moving the attention throughout the body noticing physical sensations), and mindful movement or gentle yoga. In theory, MBSR trains participants to recognize automatic habitual patterns of behavior, emotional reactivity, and loss of attention. Participants met in groups of up to 25 participants, for 2.5-hour sessions, one day per week for 8-weeks, including one all day class. The total duration of class sessions was approximately 30 hours per participant. In addition to in-class practice time, participants were asked to formally practice 6 days per week at home. Participants were also asked to record the duration of the practice sessions, the type of mindfulness they practiced (e.g., breath meditation, mindful yoga), and their practice quality for a given formal practice session using the PQ-M.

Instruments

A questionnaire packet was developed which included various self-report measures. They fell into several categories coinciding with their purpose for the study. Researchers administered the following self-report instruments prior to the first MBSR session and at the conclusion of the MBSR class (along with seven packets of seven PQ-M sheets to complete after each home practice session corresponding to the seven weeks between pre and post class):

Depression Anxiety Stress Scales (DASS; Lovibond, S. H. & Lovibond, 1995). The DASS-21 is a 21-item self-report questionnaire designed to measure the severity of a range of psychological symptoms common to depression, anxiety, and stress. Participants completing the DASS are asked to indicate the presence of symptoms over the previous week. Each item is scored from 0 ("Did not apply to me at all over the last week") to 3 ("Applied to me very much or most of the time over the past week"). The DASS has been studied extensively in medical (e.g., Ownsworth, Little, Turner, Hawkes, & Shum, 2008)

and non-medical clinical populations (Brown, Chorpita, Korotitsch, & Barlow, 1997) as well as in non-clinical samples (Henry & Crawford, 2005). The DASS has demonstrated adequate internal consistency (αs = 0.91 depression subscale, 0.84 anxiety subscale, 0.90 stress subscale; Anthony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005).

Satisfaction with Life (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). The SWLS is a 5-item instrument designed to measure global life satisfaction. The measure shows good convergent validity with other scales and with other types of assessments of subjective well-being. The SWLS has been studied extensively and has obtained adequate internal consistency (α = 0.85; Pavot, Diener, Colvin, & Sandvik, 1991). The SWLS is a complement to scales that focus on psychological symptoms because it assesses subjective views of the respondent's life by using the person's own criteria (Pavot & Diener, 1993).

Mindful Attention and Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS measures present-moment awareness and consists of 15 items rated on a 6-point Likert scale (1 = *almost always*; 6 = *almost never*), with higher scores indicating greater present-moment awareness (Brown & Ryan, 2003). The scale shows strong psychometric properties (Cronbach's αs = .80 to .87) and has been validated with college, community, and cancer patient samples (Brown & Ryan, 2003). Research has shown that the MAAS is related to, and predictive of, a variety of self-regulation and well-being constructs (Brown & Ryan, 2003; MacKillop & Anderson, 2007).

Social Desirability (MCSD; Reynolds, 1982). The short form of the Marlow-Crowne Social Desirability scale was used to assess the degree to which an individual's responses are based on social desirability rather than on actual experience. This is an important potential confound to consider, especially when using a single assessment method (such as self-report) that is susceptible to correlated response set bias (i.e. an

individual responds positively to all questionnaires and artifactually inflates associations between measures; Heppner, Wampold, & Kivlighan, 2008). The Kuder-Richardson internal consistency coefficient (equivalent to Cronbach's α, but for scales, such as the MCSD, that involve dichotomous choices) was acceptable for the 13-item short form used (r = .76) and correlated significantly with both the longer Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960) at r = .93 as well as with another measure of social desirability (Edwards Social Desirability Scale; Edwards, 1957) at r = .41 (Reynolds, 1982).

Practice Quality -Mindfulness (PQ-M). This measure was used to assess participants' mindfulness practice quality, which is defined as a *balanced perseverance/resolve in (a) receptive (b) present-moment attention, during the act of formally practicing mindfulness meditation*. The finalized seven-item measure was administered to a sample of n = 99 MBSR participants for this current study. The measure takes about 1-2 minutes to complete and each participant completed the measure after each mindfulness practice session.

Mindfulness Practice Frequency. Participants maintained a practice log indicating the frequency and duration of their formal home practice sessions. Practice frequency was defined as number of formal (i.e., while doing nothing else) home mindfulness practices per week. For each day participants practiced a minimum of 10-minutes (in a single sitting), they received a score of 1 for practice frequency, with a maximum total score of seven per week (corresponding to the number of days in a week). This measure was included with the rationale that practice frequency may be more relevant than practice dosage. For example, perhaps someone who practices 10-minutes/day, six days a week for a total of 60-minutes of practice per week will cultivate greater mindfulness than someone who practices once every two weeks for 120-minutes. The idea being that regular

consistent practice is more conducive to developing mindfulness skills than inconsistent and sporadic practice.

Cronbach's α scores were in an acceptable range for all outcome variables, ranging from 0.79 (DASS-Depression) to 0.93 (SWLS).

Analysis of Data

Data were entered into the statistical software program R (R Development Core Team, 2010) and five R packages were used for the analyses. These packages were 'psych' (Revelle, 2010) for factor analysis and data manipulation; 'car' (Fox & Weisberg, 2010) for regression diagnostics, 'lme4' (Bates & Maechler, 2010) for multi-level modeling; 'plyr' (Wickham, 2010) for data manipulation; and 'ggplot2' (Wickham, 2009) for graphics.

RESULTS

Descriptive statistics. The predictor variables in this study were practice related: (a) practice frequency, (b) weekly practice dosage, and (c) practice quality. Data from these predictors were collected daily (n = 126) and aggregated by week into seven weekly repeated measures for the n = 19 participants (Table 1b) to provide more stable estimates in the presence of missing data. All participants completed each practice measure weekly and regular reminders were provided to prevent missing data. When a participant missed a class, instructors encouraged them to bring the home practice materials to the next class session. However, missed sessions was uncommon, as only 10% of the sample missed two or less MBSR class sessions. The descriptive statistics for the outcome variables are shown in Table 1c.

Factor Analysis. A factor analysis was conducted using the larger n = 99 of all MBSR class participants during the study period. Some studies suggest there should be at least 10 participants for each item in the instrument being used (Bryant and Yarnold, 1995,

Everitt, 1975). This study met minimum sample size requirements to appropriately conduct an exploratory factor analysis (minimum $n = 70$). The results of the exploratory, oblique rotated factor analysis (EFA) are presented in Table 2. Items 1-3 and 5-7 loaded exclusively on the Attention and Receptivity factors, respectively, at both administrations. Internal consistency for each of the scales was examined using Cronbach's α. The α scores were moderate to large: 0.66 for Attention (4 items) and 0.72 for Receptivity (3 items) at week 1 and 0.87 for Attention (3 items) and 0.83 for Receptivity (4 items) at week 7. In contrast, item 4 loaded somewhat weakly on the Attention factor at week 1 and moderately on the Receptivity factor at week 7. Removing item 4 resulted in an increase in α scores from 0.66 to 0.72 for Attention at week 1 and from 0.83 to 0.87 for Receptivity at week 7. Due to inconsistency in factor loading, item 4 was removed and Attention and Receptivity scores were computed as the mean of scores on the remaining three items for each subscale (the receptivity subscale was reverse scored prior to computing means). Each factor accounted for 26% of the total variance (for a combined variance of 52%) at week 1 and 36% for each factor at week 7 (72% cumulative variance). Descriptive statistics for the subscales are presented in Table 3. Examination of the histograms suggested that the distributions looked approximately normal (available from first author upon request).

Construct Validity. To legitimize the inferences made from the operationalization of the PQ-M to measure the actual quality of mindfulness practice, construct validity was assessed in multiple ways:

(a) *Predictive validity* assessed the PQ-M measure's ability to predict outcomes of psychological health and well-being. Assessment for predictive validity involved the subsample of MBSR participants ($n = 19$) using ordinary least squares regression models. Change scores (post - pre test scores) on the overall DASS scale (aggregate of DASS-Anxiety, DASS-Depression, and DASS- Stress) and SWLS was computed. Paired t-tests

indicated that pre-post change on DASS and SWLS were statistically significant (ps<.05). Predictive validity for the PQ-M was supported for overall psychological improvement. Specifically, change in practice quality (slope values derived from MLM), above that of average practice quality (entered simultaneously in multiple regression), was significantly associated with changes in overall DASS ($B = 2.22$, $p = 0.026$) under a OLS regression at post-test, when controlling for social desirability and baseline mindfulness. This relationship was marginally significant when also controlling for both practice frequency and practice dosage ($B = 2.075$, $p < 0.062$; see Tables 4a & 4b for details of both OLS regression analyses). Practice quality was not associated with changes in SWLS (see Tables 4a & 4b for details on these analyses).

(b) Convergent validity was examined by assessing the degree to which the PQ-M measure was similar to the construct of mindfulness. We examined the correlation between aggregated week 1's PQ-M scores and pre-test mindfulness measures (MAAS) along with week 7's PQ-M and post-test mindfulness measures. The PQ-M and MAAS measures correlated $r = .53$ ($p < .01$) at pre-test and $r = .33$ ($p < .01$) at post-test.

Longitudinal Multilevel Modeling. Longitudinal multilevel modeling (MLM) was used to assess change in practice quality over time (for the longitudinal plot of participant change over time see Figure 1). Two-level models were fit for all analyses, with time at level one and participant at level two (see first author's dissertation for details on the procedure). Nesting the data in a three-level model (by MBSR group or instructor) was considered but deemed inappropriate due to only five groups and four instructors available at this higher level. Maas and Hox (2005) conducted a simulation study and determined that a small number of nested groups leads to biased estimates of the second-levels standard errors.

The output from these models indicated there was significant growth in practice quality over time. A likelihood ratio test comparison of the empty model to the unconditional growth model produced a significant χ^2 statistic of 45.37 ($p < 0.001$). The intercept value for the unconditional growth model was 79.23 ($SE = 2.77$; $p < 0.001$), indicating that average (grand mean centered) practice quality was 79.23, plus or minus about 6. The slope for the unconditional longitudinal model was 2.02 ($SE = 0.42$; $p < 0.001$), indicated that, on average, participants improved in practice quality by 2.02 points each week, plus or minus about 1.

The intercept and slope variances for the unconditional longitudinal model were 148.34 and 2.09 respectively with significant χ^2 statistics of 501.86 and 46.6 respectively ($p < .01$), indicating the model could be improved by adding predictors at level 2. Therefore, the overall dataset was assessed for level 2 predictors of practice quality. To do so, a series of conditional longitudinal (growth) models were conducted, which involved (a) entering predictors at level two (individual level), (b) assessing for model fit, and (c) comparing to the previously run model. The level 1 equation remains the same as the unconditional longitudinal model (i.e., equation 3 above) while the level 2 equations adds a predictor or predictors to the previous equations 4 and 5 (above). The level 2 equations are as follows:

$$B_{0i} = \gamma_{00} + \gamma_{01}(predictor) + u_{0i} \quad (1)$$

$$B_{1i} = \gamma_{10} + \gamma_{11}(predictor) + u_{1i} \quad (2)$$

In equation 1, γ_{01} is the gamma coefficient to predict level 2 variations in intercept from the person-level predictor variable at baseline. In equation 2, γ_{11} is the gamma coefficient to predict level 2 variations in slope (growth or change over time) from the person-level predictor variable at baseline. The person-level predictors of practice quality added to the

conditional MLMs included: (1) baseline mindfulness, (2) baseline symptom severity (i.e., anxiety and stress), and (3) baseline satisfaction with life. Only baseline mindfulness was associated with change in practice quality over time (see Table 5). Specifically, γ_{11} = -1.06 (t = -2.45; p = 0.03), indicating that participants with higher baseline mindfulness experienced a slower rate of growth in mindfulness practice quality. Conversely, participants reporting lower baseline mindfulness showed greater changes in practice quality over time. These results may be due to theoretical and/or properties of instrument measurement, which will be expanded upon in the discussion section.

In sum, under random effects MLMs, overall change in mindfulness practice quality was statistically significant and in the expected (positive) direction. This indicated there was indeed a positive growth trend over time. Further, baseline mindfulness influenced changes in practice quality over the course of the intervention, such that those with lower baseline mindfulness had greater improvements in practice quality over time.

DISCUSSION

This exploratory study examined the impact of a newly created measure, Practice Quality-Mindfulness (PQ-M), on several outcomes (psychological health and well-being) during an 8-week MBSR course. Mindfulness practice quality was defined as a *balanced perseverance/resolve in (a) receptive (b) present-moment attention, during the act of formally practicing mindfulness meditation*. Initially, a 7-item measure was developed and tested on MBSR participants. As hypothesized, the factor analysis suggested a two-factor structure: Attention (factor 1) and Receptivity (factor 2). Specifically, items 1-3 loaded exclusively on the Attention factor and 5-7 loaded on the Receptivity factors, at both administrations. However, item 4 loaded inconsistently from week 1 to week 7 and was removed from all subsequent analyses. Exploratory factor analysis indicated that internal consistency was strong for the full scale (6 items) and moderate to strong at each

administration point (week 1 and week 7) for the subscales. Therefore, what appears to be underlying mindfulness practice quality is *how* a participant attends to present-moment experience, along with their degree of receptivity (or openness, willingness) to "fully experience" whatever arises in the moment (e.g., sensations of pain or pleasure, difficult thoughts or unpleasant memories).

Validity. The PQ-M measure was significantly related with the MAAS measure, supporting *convergent validity*. The analyses indicated that these constructs are moderately to strongly related to one another but also seem to be measuring their own unique constructs. This finding is particularly important for further development of the PQ-M, as very low correlations would indicate there is no commonality between constructs and extremely high correlations or collinearity would indicate the measure is no different from the dispositional mindfulness construct. If there were no commonality between constructs, one could not be assured the PQ-M was measuring anything related to mindfulness, which it purports to be doing. After all, it is a measure of mindfulness practice quality that, at least theoretically, should be related to mindfulness. Similarly, if the measure were collinear with mindfulness (i.e., only measuring mindfulness), there would be no need to further develop the measure, given several extant validated measures of mindfulness. *Predictive validity* for the PQ-M was supported in this study. Change in practice quality (using MLM intercept values) was associated overall psychological change. This finding was in the expected direction where greater practice quality was associated with more favorable outcome.

Clinical implications. This study contributes to the mindfulness intervention literature by validating a measure of mindfulness practice quality and testing practice related factors (including practice quality) that are associated with outcomes of health and well-being. This is the first study we are aware of to assess quality of mindfulness

practice. Preliminary findings indicated the PQ-M to be a valid and reliable measure. Specifically, change in practice quality over the course of the MBSR intervention was associated with post-intervention outcome. Results from this study indicated that the PQ-M is minimally burdensome on participant's time (1-2 minute completion time) and has potential as a tracking tool for assessing changes in mindfulness practice quality. In particular, results are in accord with findings in the field of learning theory (Ericsson et al., 1993) and suggest higher practice quality during the MBSR intervention may lead to greater reductions in psychological symptoms by the end of the intervention.

These results may be of use to mindfulness practitioners and teachers of mindfulness interventions. For example, the measure has potential to be used during the mindfulness intervention to track participants' practice quality, and perhaps identify those at risk for poorer outcomes. As an add-on to well introduced feedback systems (e.g. Lambert & Shimokawa, 2011), mindfulness instructors can use this ongoing feedback to begin integrating corrective directions for remediation during the intervention. That is, MBSR instructors could administer the measure after in-session mindfulness practices to enable them to identify participants who are reporting lower practice quality and provide additional instruction. Further, completing the PQ-M is one way in which participants can track their own practice habits, allowing a clear reminder as to the specific qualities of attention and receptivity emphasized in MBSR. These self-monitoring activities may both bolster participants' commitment to practice and provide direction for improving practice quality over time. This topic warrants further exploration in future studies.

*Study limitations***.** There are a number of limitations in this study that are important to note. One of the primary limitations is the small sample size (n = 19) used for the multilevel modeling and ordinary least squares regressions. This small sample size limits power to detect significant effects, inflates Type II error, and may have obscured patterns

of relationships that were not seen in the current analyses. Another limitation involves the use of naturalistic sampling where, lacking randomization to treatment, observed treatment effects may be due to motivation or systematic bias related to participant self-selection. Naturalistic sampling also limits generalizability, due again to the self-selected nature of the sample. In addition, the sample was in a normal range of clinical symptomology, which may not generalize to a more severe clinical population (e.g., personality disorders). However, this study may generalize to a typical MBSR population, as this sample is representative of other samples that have been studied (e.g., Cordon, Brown, and Gibson, 2009). Furthermore, all of the participants in the present study were White; therefore, generalizing the findings to other populations, such as other racial–ethnic population, is not possible. Although pretreatment symptoms were controlled in all analyses, uncontrolled factors cannot be ruled out as possible explanations for change. Some of these factors include early symptom change (Feeley, DeRubeis, & Gelfand, 1999), therapeutic alliance (Horvath, Del Re, Flückiger, and Symonds, 2011), change expectations (Wampold, 2001; Greenburg, Constantino, & Bruce, 2006), or behavioral activation (e.g. Jacobson, Martell, & Dimidjian, 2001). Future research should also consider including other potential predictors and causal mediators (e.g., group cohesion and other common factors) between mindfulness interventions and outcome.

Overall, this is the first known study to examine a range of mindfulness practice factors and results suggest there are numerous opportunities for future research. First, future research can further examine the stability of the factor structure of the PQ-M, perhaps with the addition of a third factor related to the degree of sleepiness or “haziness” during practice. The one PQ-M item tapping into this quality loaded weakly on its respective factors at week one and week seven. Alertness is theorized to be an important element of practice (e.g., if a practitioner is sleeping throughout practice, how much

mindfulness can actually be developed?) and should be developed further in future studies. In addition, future studies should include larger sample sizes with the inclusion of more groups to allow for decomposition of effects at multiple levels (through 3-level MLM). The 3-level MLM will enable researchers to model group (e.g., group cohesion and norms), individual, and time effects. Studies of this nature have potential to contribute significantly to the mindfulness literature and to assist mindfulness teachers in understanding what factors are most important for participant outcome. Other potential research directions include conducting more nuanced time-varying analyses, such as an examination of the influence of psychological symptoms (collected weekly) on practice quality (and vice versa) over the course of the mindfulness training. In conclusion, this study has found preliminary support for mindfulness practice quality being associated with participant outcome. Mindfulness practice is presumed to be important for cultivating mindfulness and a variety of adaptive, healthy, and flexible qualities to more readily handle life difficulties. Although the recommended dosage levels of practice are varied in the literature, this study has found that how one practices (i.e., practice quality) seems to be most important for cultivating these qualities.

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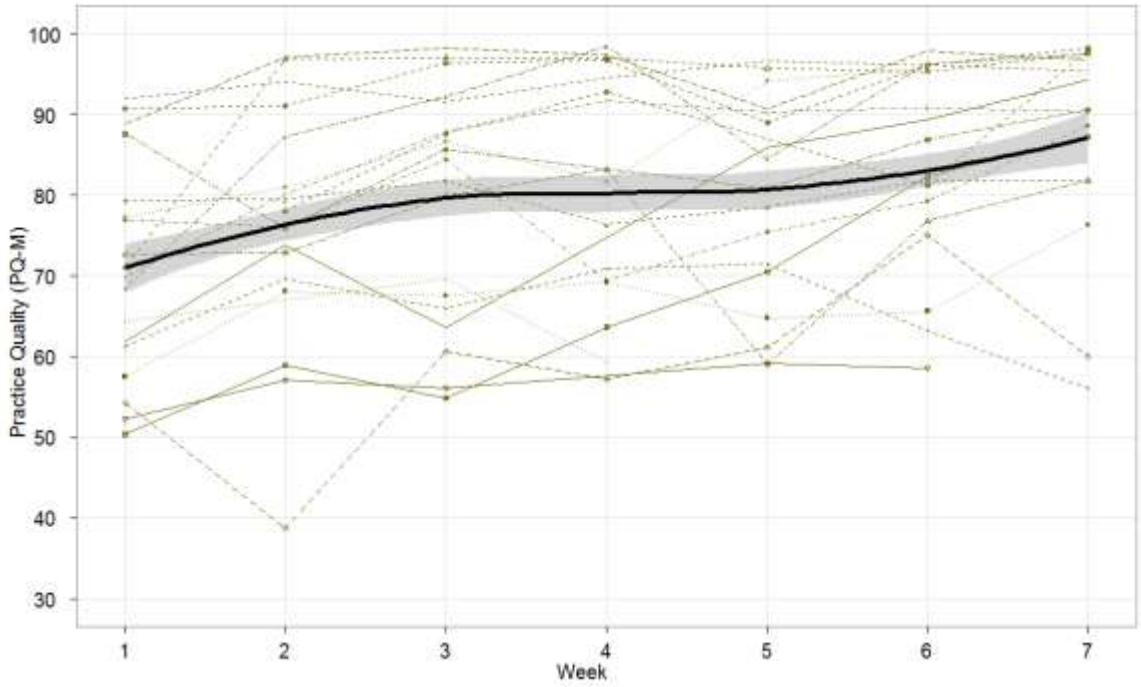
Figure 1. Individual Slopes of Practice Quality Over Time



Note. Each participant's changes in practice quality over time is plotted over time, along with a non-linear smooth line (in black) representing the overall growth trajectory of practice quality. The light grey shading around the overall line represents its standard error. This plot indicates there is a general increase in practice quality over the course of the MBSR intervention, along with between-person variation in starting values and growth trends over time.

Table 1a: ***Sample characteristics and baseline measures***

Variable	*n*	*M* (*SD*)	α
Age	19	49.64 (10.57)	
DASS-Stress	19	13.27 (7.32)	0.81
DASS-Anx.	19	3.82 (4.23)	0.72
DASS-Depr.	19	8.55 (6.96)	0.86
DASS (Full)	19	7.82 (4.44)	0.86
SWLS	19	22.00 (7.34)	0.91
MCSD	19	2.14 (1.13)	0.69
MAAS	19	3.43 (0.80)	0.9

Table 1b: ***Predictor variables over all seven time points***

Variable	*n*	*M* (*SD*)	α
Wk Consist	126	4.99 (1.31)	
Wk Avg (Min)	126	40.08 (8.47)	
PQ-M (Full)	126	77.32 (15.52)	0.91
PQ-M (Persev)	126	74.69 (18.27)	0.95
PQ-M (Recep)	126	79.30 (16.22)	0.86

Table 1c: ***Post-test outcome measures***

Variable	*n*	*M* (*SD*)	α
DASS-Stress	19	9.73 (7.28)	0.84
DASS-Anx.	19	3.36 (4.55)	0.84
DASS-Depr.	19	3.91 (4.25)	0.79
DASS (Full)	19	4.63 (3.81)	0.89
SWLS	19	25.14 (7.41)	0.93

Note: DASS = Depression Anxiety and Stress Scales; DASS-Stress = DASS stress subscale; DASS-Anx = DASS anxiety subscale; DASS-Depr = DASS depression subscale; DASS (full) = DASS total score; SWLS = Satisfaction With Life Scale; MCSD = Marlowe-Crowne Social Desirability Scale; MAAS = Mindful Attention and Awareness Scale; PQ-M = Practice Quality – Mindfulness; PQ-M Full = PQ=M score using all six items; PQ-M (Persev) = PQ-M perseverance subscale; PQ-M (Recep) = PQ-M receptivity subscale; Wk Consist = Number of formal mindfulness practice sessions per week; Wk Average (Min) = Number of minutes of formal mindfulness practice per week.

Table 2: Factor loadings for seven item PQ-M

Item	Factor Loadings			
	Perseverance		Receptivity	
	week 1	*week 7*	*week 1*	*week 7*
1. During practice, I attempted to return to my present-moment experience, whether unpleasant, pleasant, or neutral.	0.82	0.98		
2. During practice I attempted to return to each experience, no matter how difficult, with a sense that "It's OK to experience this"	0.71	0.81		
3. During practice I attempted to feel each experience as bare sensations in the body (tension in throat, movement in belly, etc),	0.57	0.7		
4. During practice I was "zoning out" or falling asleep.	-0.35			0.5
5. During practice, I was struggling against having certain experiences (e.g., unpleasant thoughts, emotions, and/or bodily sensations).			0.51	0.86
6. During practice. I was actively avoiding or "pushing away" certain experiences.			0.93	0.81
7. During practice, I was actively trying to fix or change certain experiences, in order to get to a "better place".			0.61	0.84

Table 3: Descriptive statistics for the PQ-M factors (n = 99 for week 1 and n = 78 for week 7)

	No. of items	*M* (*SD*) wk 1	*M* (*SD*) wk7	Skew wk 1	Skew wk 7	Kurtosis wk 1	Kurtosis wk 7
Attention	3	68.73 (17.22)	73.95 (20.46)	-0.27	-1.2	0.2	4.07
Receptivity	3	73.95 (19.74)	82.11 (17.36)	-0.64	-0.97	0.43	2.97
Practice Quality (full)	6	71.34 (14.84)	78.03 (16.56)	-0.19	-0.84	-0.24	2.83

Note. The correlations between Attention and Receptivity subscales were $r = .29$ and $r = .50$ for Week 1 and Week 7, respectively.

Table 4a: ***Change in outcome measures predicted by baseline characteristics and PQ-M***

	beta	SE	t value	P
Change in DASS				
(Intercept)	-17.56	7.00	-2.51	0.03
MCSD	-0.27	0.21	-1.27	0.22
MAAS (baseline)	3.78	1.19	3.16	<0.01
Average PQ-M	0.02	0.076	0.21	0.84
Change PQ-M	2.22	0.89	2.49	0.03
Change in SWLS				
(Intercept)	17.73	11.30	1.57	0.14
MCSD	0.14	0.34	0.42	0.68
MAAS (baseline)	-2.99	1.93	-1.55	0.14
Average PQ-M	-0.05	0.12	-0.37	0.72
Change PQ-M	-1.53	1.44	-1.06	0.31

Table 4b: ***Change in outcome measures predicted by baseline characteristics, PQ-M, and practice variables***

	beta	SE	t value	P
Change in DASS				
(Intercept)	-25.44	9.92	-2.56	0.03
MCSD	-0.25	0.23	-1.09	0.30
MAAS (baseline)	3.41	1.41	2.41	0.03
Average PQ-M	0.003	0.08	0.04	0.97
Change PQ-M	2.07	1.01	2.06	0.06
Practice Duration	-0.001	0.005	-0.31	0.76
Practice Consistency	2.25	2.42	0.93	0.37
Change in SWLS				
(Intercept)	14.73	17.05	0.86	0.40
MCSD	0.17	0.39	0.44	0.67
MAAS (baseline)	-3.29	2.43	-1.35	0.20
Average PQ-M	-0.04	0.14	-0.28	0.78
Change PQ-M	-1.70	1.73	-0.98	0.35
Practice Duration	-0.002	0.01	-0.22	0.83
Practice Consistency	1.08	4.16	0.26	0.80

Table 5: ***Overall effects from T1 (week 1) to T7 (week 7)***

	Baseline (session 1) T1				Time (T1 - T7)		Slope (T1 - T7)		Fit Indices
Model	γ_{00} intcpt (SE)	*t*-value	γ_{01} predictor (SE)	*t*-value	γ_{10} slope (SE)	*t*-value	γ_{11} predictor (SE)	*t*-value	Deviance
Empty	79.06 (2.81)	28.11							902.5
Uncond. Longitudinal	79.23 (2.77)	28.60			2.02 (.42)	4.80			857.1
Cond. Longitudinal									
Baseline mindfulness	63.68 (11.24)	5.66	4.49 (3.16)	1.42	5.65 (1.53)	3.70	-1.06 (.43)	-2.46	850
Baseline anxiety	83.07 (3.46)	24.03	-1.13 (.68)	-1.66	2.22 (.55)	4.01	-.06 (.11)	-0.53	854
Baseline stress	86.08 (5.60)	15.37	-.57 (.41)	-1.39	2.32 (.88)	2.65	-.03 (.07)	-0.40	855
Baseline satisfaction with life	73.05 (10.20)	7.16	.27 (.42)	0.64	.55 (1.52)	0.36	.06 (.06)	1.01	855.6

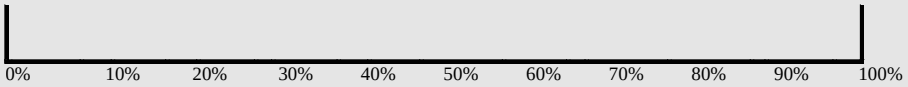
Note: n = 19. Parameters listed here derived from several distinct models: (1) Empty refers to unconditional intercept model $y_{ij} = B_{0i} + e_{ij}$; $B_{0i} = \gamma_{00} + u_{0i}$ (2) The unconditional longitudinal model; $y_{ij} = B_{0i} + B_{1i}(time) + e_{ij}$; $B_{0i} = \gamma_{00} + u_{0i}$; $B_{1i} = \gamma_{10} + u_{1i}$ (3) Conditional longitudinal models (using baseline mindfulness, anxiety, stress and life satisfaction) $y_{ij} = B_{0i} + B_{1i}(time) + e_{ij}$; $B_{0i} = \gamma_{00} + \gamma_{01}(predictor) + u_{0i}$; $B_{1i} = \gamma_{10} + \gamma_{11}(predictor) + u_{1i}$

Appendix

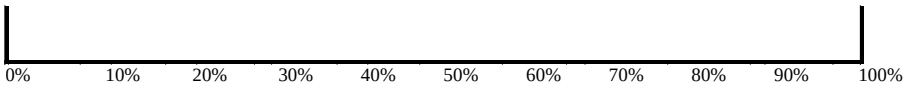
Revised six item Practice Quality-Mindfulness (PQ-M)

With respect to today's session, please place a vertical mark on the line below each question to indicate the approximate percentage of time that your experience reflected each statement below.

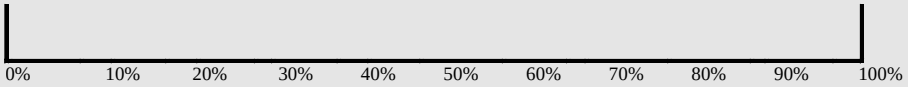
1. During practice, I attempted to return to my present-moment experience, whether unpleasant, pleasant, or neutral.



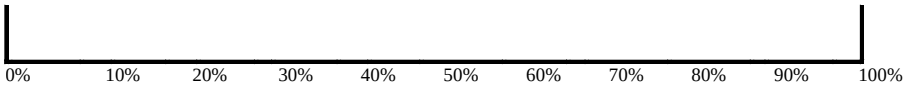
2. During practice, I attempted to return to each experience, no matter how unpleasant, with a sense that "It's OK to experience this".



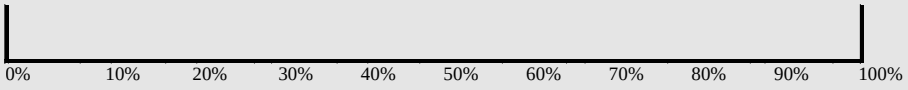
3. During practice, I attempted to feel each experience as bare sensations in the body (tension in throat, movement in belly, etc).



4. During practice, I was struggling against having certain experiences (e.g., unpleasant thoughts, emotions, and/or bodily sensations).



5. During practice, I was actively avoiding or "pushing away" certain experiences.



6. During practice, I was actively trying to fix or change certain experiences, in order to get to a "better place".