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# The Secret Ingredient in Mindfulness Interventions? A Case for Practice Quality Over Quantity

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## Abstract

As mindfulness-based interventions become increasingly widespread, interest has grown in better understanding which features of these treatments produce beneficial effects. The present study examined the relative contribution of mindfulness practice time and practice quality in predicting psychological functioning (negative affect, emotion regulation, quality of life, mindfulness). Data were drawn from a randomized clinical trial of mindfulness training for smokers and assessed outcomes at posttreatment ($n$ = 43) and 5-month follow-up ($n$ = 38). The intervention included instruction in mindfulness techniques targeted to smoking cessation and relapse prevention and was composed of 10 group meetings over 8 weeks. Data from 8 treatment groups were used. Mindfulness practice quality was measured weekly over the course of treatment, and multilevel modeling was used to estimate trajectories of change in practice quality. The measure of practice quality was shown to be valid and reliable, with change in practice quality predicting change in psychological functioning at both posttreatment (β= .31, 95% CI =[0.04, 0.56], $p$ = .022) and follow-up (β= .45 [0.16, 0.73], $p$ = .002), even when controlling for practice time. Practice time predicted outcomes at posttreatment (β= .31 [0.05, 0.57], $p$ = .019) but not at follow-up (β= .16 [[H11002]0.14, 0.47], $p$ = .293). Neither practice time nor change in practice quality predicted smoking abstinence at 1 month or 6 months postquit. Results support the importance of practice quality as a relevant aspect of mindfulness interventions.

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Exercitatio optimus est magister.

Practice is the best master.

—Latin Proverb (Benham, 1914, p. 842)

Since the initial application of mindfulness for chronic pain over 30 years ago, mindfulness-based interventions have become increasingly common practice for addressing a range of medical and psychological concerns. Research on mindfulness has largely kept pace with this rise in popularity, with a growing body of evidence supporting dissemination of these interventions. Mindfulness has been defined as a cognitive skill that involves present-focused attention that is intentional, nonjudgmental, and accepting (Kabat-Zinn, 1994). Numerous meta-analyses and systematic reviews support the use of mindfulness for a variety of applications. Mindfulness may be beneficial as a therapeutic approach in clinical and nonclinical samples (Khoury et al., 2013), for children and adolescents (Zoogman, Goldberg, Hoyt, & Miller, 2014), for anxiety and depression (Hofmann, Sawyer, Witt, & Oh, 2010), for treatment of chronic illness (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010), and for substance abuse (Zgierska et al., 2009), among other specific applications. Further, relatively short periods of mindfulness meditation instruction (e.g., 8 weeks) have shown measurable biological effects, including alterations in brain structure and function (Davidson et al., 2003; Hölzel et al., 2011).

Despite a growing body of empirical support, important questions remain unanswered: How do mindfulness treatments work and what components of these interventions, if any, are crucial for generating therapeutic change? Several mechanisms of action have been proposed, including cognitive changes (especially changes in mindfulness itself; Nyklí010Dek & Kuijpers, 2008), improved emotion regulation or induction of specific mental states (e.g., love; Kok, Waugh, & Fredrickson, 2013), changes in attention and the relationship to the self (e.g., reperceiving; Shapiro, Carlson, Astin, & Freedman, 2006), and neurological and biological changes (e.g., epigenetic effects, changes in brain structure and function; Davidson et al., 2003; Hölzel et al., 2011; Kaliman et al., 2014). Others have highlighted possible mechanisms that are common across therapeutic modalities (i.e., common factors; Wampold, 2001), including therapeutic alliance (Bowen & Kurz, 2012; Goldberg, Davis, & Hoyt, 2013) or group effects (Imel, Baldwin, Bonus, & MacCoon, 2008).

In combination with efforts to uncover change mechanisms within the individual or group, researchers have begun exploring which aspects of the interventions themselves are responsible for reported salutary effects. One likely candidate is mindfulness practice (Vettese, Toneatto, Stea, Nguyen, & Wang, 2009). Formal practices (e.g., body scan, sitting meditation) are assigned as homework in many standard mindfulness courses, including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990) and mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002). The assignment of home

practice is based on the rationale that regular formal practice fosters the development of mindfulness as a skill.

Although most mindfulness-based treatments emphasize the value of participants engaging in regular daily practice, and it seems intuitive that regular mindfulness practice might enhance these interventions' therapeutic effect, empirical evidence is inconclusive regarding the effect of practice. One recent review (Vettese et al., 2009) revealed partial support for the benefits of daily mindfulness practice. Just over half (13 out of 24) of the available studies evaluating the relationship between practice time and outcomes reported a positive association. However, the remaining studies either failed to detect such an association ($k$ = 11) or did not report associations between practice time and outcomes ($k$ = 74). This lack of consistent association is of significant theoretical concern, given that time spent practicing mindfulness is the purported activity through which mindfulness is internalized.

One prior study (Del Re, Flűckiger, Goldberg, & Hoyt, 2013) has offered an explanation for this inconsistency proposing that mindfulness practice *quality* (rather than practice *quantity*) may be a stronger predictor of outcomes. Del Re et al. (2013) referenced psychotherapy literature to support this claim, noting that although engaging in homework appears to improve outcomes (e.g., in cognitive behavioral therapies; Kazantzis, Whittington, & Dattilio, 2010), the quality of engagement may also play a role (e.g., Paivio, Hall, Holowaty, Jellis, & Tran, 2001). Indeed, research on learning and skill acquisition (e.g., playing the violin) has emphasized the importance of effortful and deliberate practice in attaining proficiency, rather than hobbylike engagement (Ericsson, Krampe, & Tesch-Romer, 1993).

Del Re et al. (2013) reported the validation of a measure of mindfulness practice quality (Practice Quality-Mindfulness; PQ-M), defining practice quality as a "balanced perseverance / resolve in (a) receptive (b) present-moment attention, during the act of formally practicing mindfulness meditation" (p. 55). The PQ-M demonstrated acceptable internal consistency and reliability and was shown to increase over an 8-week MBSR course. Moreover, those who showed the largest improvements in practice quality over time (using slopes derived from multilevel models [MLMs]) also showed the largest decreases in negative affect. However, although statistically underpowered, neither practice time nor change in practice quality significantly predicted outcomes when entered simultaneously in regression models, leaving open the question of their relative importance. Further work in this area is warranted, ideally in a larger sample, examining additional outcomes (especially mindfulness, the key purported mechanism of change), and exploring effects at longer term follow-up.

The present study involved administering the PQ-M weekly during an 8-week mindfulness intervention for smoking cessation (mindfulness training for smokers [MTS]; Davis et al., 2014) examining outcomes at posttreatment and 5-month follow-up. We aimed to assess the validity of the PQ-M in a new sample and examine the relative contribution of practice time and change in practice quality for predicting psychological functioning. Two primary hypotheses guided this work:

- *Hypothesis 1*: PQ-M scores will demonstrate acceptable internal consistency reliability and will increase over the course of a mindfulness intervention.

- *Hypothesis 2*: Change in PQ-M scores will predict psychological functioning both at posttreatment and follow-up time points, even when controlling for practice time.

## Method

### Participants

Participants were drawn from a larger randomized controlled smoking cessation trial (Davis et al., 2014). Of that total sample ($N$ = 196), 91 were randomized into a control condition and 105 into the MTS condition (for a consort diagram, see the supplemental material). Fifty-six of those randomized to MTS initiated treatment.[1] Data from all participants who completed at least two PQ-M assessments ($n$ = 53) were used for assessing measurement validity and reliability. (At least two assessments were required for multilevel slope estimations.) Of this sample, $n$ = 43 completed posttreatment measures and $n$ = 38 completed follow-up measures. The full sample ($n$ = 53) was on average 43.4 years old ($SD$ = 12.7), 52.8% female, predominantly Caucasian (92.4%), with 66.0% possessing education beyond high school. At baseline, participants smoked on average 18.2 cigarettes per day ($SD$ = 8.8), smoked 23.8 years ($SD$ = 13.2), and had made 9.4 prior quit attempts ($SD$ = 18.7). Participants who attended the posttreatment and follow-up study visits did not differ from those who did not on any baseline variable (demographic, smoking, psychological; $p > .10$).

### Sampling Procedure

Participants were recruited through newspaper, television advertisements, and flyers in a medium-sized midwestern city, with ad placement in low socioeconomic status (SES) neighborhoods. Materials advertised a “Quit Smoking Study” that provided mindfulness training, free medication, and $90 for study completion. Participants were only included in the study if they were at least 18 years old and smoked at least five cigarettes per day. Participants were excluded if they used tobacco products other than cigarettes (e.g., chewing tobacco, snuff), consumed four or more alcoholic drinks on four or more nights per week, or were currently experiencing major depression or suicidality.

### Measures

**Baseline demographic questionnaire.—**A questionnaire was completed at baseline assessing demographic and smoking history characteristics.

**Smoking outcomes.—**Seven-day point prevalence abstinence (confirmed biochemically via CO breath test) was assessed at both 1 and 6 months postquit. A stringent CO cutoff of below 7 ppm was used (Middleton & Morice, 2000). Participants who did not attend postquit study visits were assumed to have relapsed.

[1]Participants who initiated treatment differed from those who did not in the following ways: smoked more cigarettes at baseline ($t$ = 3.08, $p$ = .003), were more likely Caucasian ($\chi^2$ = 11.39, $p$ [H11021] .001), possessed education beyond high school ($\chi^2$ = 5.46, $p$ = .019), were more likely female ($\chi^2$ = 5.02, $p$ = .025). No other differences were noted on baseline demographic, smoking, or psychological measures. Implications of these differences for treatment acceptability are discussed elsewhere (Davis et al., 2014).

**Psychological functioning.—**Four self-report measures were administered at baseline, posttreatment, and follow-up to assess relevant aspects of psychological functioning. These included mindfulness and emotion regulation, both of which have commonly been proposed as proximal outcomes of mindfulness interventions and mediators of the effects of these interventions on more generic psychological symptoms (Hölzel et al., 2011). In addition, negative affect and quality of life were included as outcomes both theoretically and empirically linked with mindfulness treatments (de Vibe, Bjørndal, Tipton, Hammerstrøm, & Kowalski, 2012; Hofmann et al., 2010).

**Mindfulness.—**The Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) assessed mindfulness across five dimensions: observing, describing, acting with awareness, nonreactivity, and nonjudging. As prior work has established an adequately fitting hierarchical structure composed of all five facets (comparative fit index [CFI] > .90, root-mean-square error of approximation < .07; Baer et al., 2006) and significant correlations between subscales, a total score was computed (as has frequently been done elsewhere; e.g., Brewer et al., 2009; Lykins & Baer, 2009) of all 39 items[2] ($\alpha$=.91 in the present sample) representing an underlying common factor of mindfulness. Higher scores indicate higher levels of mindfulness.

**Emotion regulation.—**The Difficulty in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) was used to assess emotional dysregulation. The 36-item scale assesses difficulties in perceiving, understanding and accepting emotions, refraining from impulsive behaviors, and accessing emotion regulation strategies (Gratz & Roemer, 2004). Emotion regulation is plausibly related to smoking relapse (based on an affective model of addiction; Kenford et al., 2002) and potentially impacted by mindfulness training. The scale has shown predictive validity for behavioral outcomes relevant to emotion regulation (e.g., self-harm; Gratz & Roemer, 2004). A total score was used for the DERS based on prior work demonstrating significant correlations between subscales and high internal consistency for the composite score ($\alpha$= .93; Gratz & Roemer, 2004). Higher scores indicate greater emotion regulation difficulties ($\alpha$= .93 in the present sample).

**Negative affect.—**The Depression Anxiety and Stress Scales (DASS; Lovibond & Lovibond, 1995) were used to assess negative affect and involve reports of psychological and somatic symptoms over the past week. Negative affect is a known cause of smoking relapse (Kenford et al., 2002), and mindfulness interventions have been shown to decrease negative affect (Hofmann et al., 2010). This 42-item scale has been used extensively and includes sub-scales for depression, anxiety, and stress. A total score was used on the basis of prior work demonstrating high correlations between the subscales (Lovibond & Lovibond, 1995) and high internal consistency for the composite score ($\alpha$= .93; Henry & Crawford, 2005). A total score has commonly been used elsewhere (e.g., Baer et al., 2008; Henry & Crawford, 2005; Lykins & Baer, 2009). Higher scores indicate more negative affect ($\alpha$= .93 in the present sample).

[2]Due to a clerical error, only Items 1–30 of the FFMQ's 39 items were administered to $n$ = 27 participants at the posttreatment study visit and $n$ = 6 at the follow-up study visit. As discussed elsewhere (Goldberg et al., 2013), these missing items did not appear to bias total scores computed from available items.

**Quality of life.—**The World Health Organization Quality of Life-BREF (WHOQOL Group, 1998) is a 26-item measure assessing quality of life, an outcome previously shown to be sensitive to mindfulness training (de Vibe et al., 2012). Domains include physical, psychological, social, and environment, and respondents indicate life quality in the past 4 weeks. The measure has demonstrated strong internal consistency, discriminant validity (e.g., distinguishing between sick and well respondents), and construct validity (WHOQOL Group, 1998). As prior work has established an adequately fitting hierarchical structure composed of all four domains (CFI > .90; WHOQOL Group, 1998), a total score was computed using items from all domains ($\alpha$= .89 in the present sample). Higher scores indicate higher quality of life.

**Psychological functioning composite.—**Total scores from each of the above domains were *z*-transformed (with directions reversed when appropriate, i.e., DERS and DASS) and summed to create a single score at each time point. All four psychological variables correlated significantly at baseline with each other (absolute value of *r*s = .38–.75) and with the outcome composite (absolute value of *r*s = .75–87; see the supplemental material).

**Practice time.—**A meditation calendar was provided to participants during the first class meeting for recording the number of minutes spent in formal meditation practice each day over the course of the intervention. Calendars were collected at the post-treatment study visit, and average practice time in minutes was computed for each participant.

**Practice quality.—**The seven-item PQ-M (Del Re et al., 2013) was administered at each class meeting following formal meditation practice (for a maximum of 10 assessments). The PQ-M is composed of two dimensions: perseverance (e.g., “During practice, I attempted to return to my present-moment experience, whether unpleasant, pleasant, or neutral”) and receptivity (e.g., “During practice I was actively avoiding or ‘pushing away’ certain experiences”). Participants are asked to rate the percentage of time during the previous meditation practice session that their experience reflected each statement (range = 0–100). The measure has shown adequate internal consistency reliability, predictive validity (e.g., predicting psychological health outcomes within an MBSR course), and convergent validity (e.g., correlating with measures of mindfulness). In addition, the PQ-M has been shown to increase over the course of mindfulness training. A total score was computed ($\alpha$= .81 in the present sample), with higher scores indicating a higher level of practice quality. Change in PQ-M scores (derived from MLMs as described below) was used on the basis of prior work demonstrating change in practice quality to be a stronger predictor of outcomes than mean-level scores (Del Re et al., 2013).

## Research Design

An initial study visit occurred prior to treatment, after which participants were randomized to the MTS condition or a less intensive usual care condition that provided access to the Wisconsin Tobacco Quit Line, but no mindfulness training. The present study on practice quality involved only those participants randomized to the mindfulness condition (for a consort diagram, see the supplemental material). The practice quality measure (PQ-M) was administered to participants at each of the 10 mindfulness group meetings just after the

sitting meditation practice. Posttreatment measures were completed immediately following the end of treatment and follow-up measures approximately 5 months after the end of treatment.

### Intervention

Participants received a mindfulness-based smoking cessation intervention in a group format (MTS; Davis et al., 2014). This program, based on MBSR (Kabat-Zinn, 1990), provides mindfulness training targeted to smoking cessation and relapse prevention. As described elsewhere (Davis et al., 2014; Goldberg et al., 2013), the course was composed of 10 group meetings over the span of 8 weeks: a 7-hr introductory day, four weekly 3-hr mindfulness class meetings, a 7-hr quit day retreat, and four weekly 1.5-hr mindfulness group meetings. Each meeting included at least one extended period of sitting meditation practice, 20–30 min in length. Three experienced mindfulness instructors were recruited to provide the intervention. Participants were grouped into eight waves (mean group size = 6.63, *SD* = 2.83, range = 1–10), and each wave was assigned one of the three instructors. Participants were instructed to practice 30 min of guided meditation per day at home with a provided meditation CD. In addition, participants received 4 weeks of 21-mg nicotine patches and access to the Wisconsin Tobacco Quit Line, a national telephonic smoking cessation service that provides behavioral strategies and brief phone counseling.

### Data Analysis

Data were analyzed using the R statistical software program (R Development Core Team, 2013). Using the nlme package (Pinheiro, Bates, DebRoy, Sarkar, & the R Development Core Team, 2013), longitudinal multilevel modeling (Snijders & Bosker, 2012) was used to examine changes in PQ-M scores over time. Two-level models[3] were fit with time as Level 1 and participants as Level 2(i.e., repeated measures nested within participants).

Ordinary least-squares (OLS) regression models were then constructed predicting posttreatment or follow-up scores on psychological functioning controlling for baseline scores (i.e., assessing changes in psychological functioning). Practice time and changes in practice quality (i.e., random slope estimates) were entered as predictors. Logistic regression was used to examine both practice time and change in practice quality as predictors of smoking outcomes.

## Results

### PQ-M Reliability and Validity

A total of 326 PQ-M assessments were administered to 53 participants over the course of the study. Each participant completed at least two PQ-M assessments with an average of 6.15 (*SD* = 2.20, range = 2–10). The measure showed adequate internal consistency (α= .81). Average PQ-M scores across all time points (*M* = 77.08, *SD* = 17.33) were almost identical to those reported previously (*M* = 77.32, *SD* = 15.52; Del Re et al., 2013).

[3]Nesting the data in a higher level model (e.g., individuals within instructors, within treatment groups) was also explored. In these models, intraclass correlations for either instructor, group, or both as higher levels were all zero. Further, the small numbers of higher level units (i.e., three instructors, eight groups) makes multilevel modeling less appropriate (Snijders & Bosker, 2012).

Longitudinal MLMs were used to assess change in practice quality over time (see the supplemental material). An initial unconditional growth model indicated a significant fixed effect for time (modeled as class number centered at class five [the quit day]). Scores increased on average by 0.87 each class ($SE = .23$), $t(272) = 3.70$, $p < .001$. A large portion of variation in PQ-M scores existed at the participant level (ICC = .56), suggesting that there was moderate consistency in the way participants rated their practice. A second model allowed slopes to vary within participants (i.e., random slopes), and this model was found to be a better fit (log-likelihood ratio = 19.61, $p < .001$). Random slope coefficients were extracted from this better fitting model for use in subsequent regression analyses. Slope coefficients were examined for outliers (estimates 3 *SD*s deviant from the mean); no outliers were detected.

## Practice Time and Change in Practice Quality Predicting Treatment Outcomes

Practice time (average minutes meditated per day) and change in practice quality (random MLM slopes) were entered into OLS regression models as predictors of posttreatment and follow-up psychological functioning.[4] Outcome scores were examined for outliers and no outliers were detected. All models controlled for baseline. Table 1 displays results from these analyses. Participants reported practicing an average of 20.89 min per day ($SD = 9.31$).

At posttreatment, both practice time and change in practice quality were significant predictors of psychological functioning, with standardized regression coefficients small to medium sized in magnitude (for practice time: β= .31, $p = .019$; for change in practice quality: β= .31, $p = .022$; see Table 1). When entered together, both practice time and change in practice quality remained significant predictors, with coefficients essentially unchanged (βs = .29 and .28, for practice time and change in practice quality, respectively; see Table 1).

At 5 months posttreatment follow-up, however, only change in practice quality predicted long-term psychological functioning, with a medium-sized effect (β= .45, $p = .002$; see Table 1). At this more distant time point, the effect for practice time was small and nonsignificant (β= .16, $p = .293$). The same pattern was observed when both predictors were entered simultaneously: Change in practice quality remained significant (β= .43, $p = .003$), and practice time was not (β= .12, $p = .399$; see Table 1).[5,6]

[4]Associations between practice time and change in practice quality with baseline psychological, smoking, and demographic variables were also examined. Years smoked was the only significant predictor, predicting practice time ($r = .30$, $p = .047$).

[5]An anonymous reviewer pointed out that both the FFMQ and the PQ-M are intended to assess mindfulness (trait mindfulness for FFMQ and mindfulness practice quality for the PQ-M). Therefore, a psychological functioning composite including the FFMQ may be partially confounded with change in mindfulness practice. Regression models were also conducted with a psychological functioning composite that did not include the FFMQ. Effect sizes were quite similar in these models, and significance tests were identical (see the supplemental material).

[6]An anonymous reviewer noted that practice quality may be confounded with working alliance, a known predictor of outcomes in this (and many other) psychological interventions (Goldberg et al., 2013). To examine this question, we conducted regression analyses predicting outcomes at both posttreatment and follow-up time points, including working alliance as well as practice time and change in practice quality, as predictors. These models were examined on the subsample of participants for whom these data were available ($n = 37$ at posttreatment, $n = 33$ at follow-up). Of the three predictors, only working alliance was significantly associated with posttreatment outcomes, and only change in practice quality significantly predicted follow-up outcomes. We note that working alliance and practice quality are not technically “confounds,” in that they are likely causally linked. Indeed, it is plausible that patients in these groups who experience success and progress with their mindfulness practice may feel a stronger bond with the therapist, as compared with patients who experience flat or even decreasing practice quality trajectories. On this account, the decrease in the effects of practice quality when working alliance is controlled (observed when predicting posttreatment outcomes) could be interpreted as an instance of complete mediation—practice quality improvement has its effect on outcomes because it first enhances the working alliance, which in turn improves outcomes. The fact that this pattern changed in examining follow-up outcomes, and the small *N*

Neither practice time nor change in practice quality significantly predicted smoking outcomes at 1 month or 6 months postquit, when entered as individual predictors or together (all *z*s < .40, all *p*s > .700; see the supplemental material for details of these analyses). Neither practice time nor change in practice quality predicted premature termination (*p*s > .300).

## Discussion

In the present study, we sought to address the relative contribution of practice time and change in practice quality for predicting psychological outcomes and smoking abstinence in a mindfulness intervention for smoking cessation. Several outcomes were assessed, including key proposed mediators of therapeutic effect (i.e., emotion regulation, mindfulness). The primary finding was that change in practice quality compared with practice time was a more reliable and robust predictor of psychological functioning, especially during long-term follow-up. Those participants whose mindfulness practice quality improved most over time also showed the largest improvements in their psychological functioning. Neither practice time nor change in practice quality predicted smoking outcomes.

Secondarily, the study provided additional validation for a recent self-report measure of mindfulness practice quality (PQ-M; Del Re et al., 2013). Reliability and validity of the PQ-M were supported in this sample of nicotine users, including the predicted sensitivity to the effects of mindfulness intervention (i.e., increases in practice quality over time). Predictive validity was also supported with changes in practice quality predicting improvement in psychological functioning. These results support generalizability, given the present sample was composed of smokers recruited from low-SES neighborhoods who may differ from the MBSR participants recruited through an integrative medicine clinic used in the initial validation study (Del Re et al., 2013).

Researchers in human development have increasingly recognized the importance of frequent observations in order to most accurately characterize the shape of developmental change and decrease potentially misleading reliance on beginning and end states (Adolph & Robinson, 2008). In this study, we used a *microgenetic* approach by assessing practice quality at relatively small time intervals (i.e., weekly) and using the shape of change (i.e., slopes) as a predictor.

Evidence was found in support of both practice time and change in practice quality as predictors of psychological functioning, at least in the short term. However, a different picture emerged when examining long-term outcomes: Only change in practice quality significantly predicted psychological functioning, with effects increasing 5 months posttreatment, even when accounting for practice duration. This finding corroborates Del Re et al.'s (2013) report on the usefulness of practice quality in predicting outcomes in mindfulness treatments. The fact that neither practice time nor change in practice quality

available for analysis to address this question, suggest that this pattern of findings should be interpreted with caution, and warrants further study in a larger sample.

predicted smoking outcomes is consistent with prior work failing to detect a consistent association between other process variables and substance abuse treatment outcome (e.g., alliance; Meier, Barrowclough, & Donmall, 2005).

It would be imprudent and inaccurate to interpret these results to mean that practice time simply does not matter. Mindfulness practices, such as sitting or walking meditation, are the foundational instructions of MBSR and similar interventions (e.g., MBCT). The importance placed on formal meditation practice has roots in the Buddhist history of mindfulness as well (e.g., Kapleau, 1989; Rahula, 1974). At once, the significance of the *quality* of formal practice also has roots, both in secular and Buddhist sources (Kapleau, 1989). Kabat-Zinn (1994) highlighted sincerity of practice as a key quality, stating that "five minutes of formal practice can be as profound or more so than forty-five minutes … the sincerity of your effort matters far more than elapsed time" (p. 123).

The findings from this study may have implications for mindfulness interventions. Clearly, mindfulness instructors should continue to emphasize daily practice. In addition, instructors may do well to emphasize applying the right effort and diligence during formal practice, that is, actually engaging with phenomenological experience in the ways outlined in MBSR and related treatments(i.e., with accepting, nonjudgmental, present-focused attention). Increased ability to engage in practice this way (i.e., improved practice quality) may be a promising predictor of both short- and long-term outcomes.

The findings also support the use of the PQ-M in future research. This brief (seven-item) survey might be easily administered during therapeutic sessions without substantially interrupting the flow of the session. This allows for repeated administrations during a study and modeling of change in practice quality over time.

The present study has several strengths. These include recruitment of a socioeconomically diverse sample and the use of weekly microgenetic sampling procedures and multilevel modeling in order to capture the shape of change. Using slopes as predictors also reduces the impact of construct-irrelevant variance (i.e., response biases; Hoyt, Warbasse, & Chu, 2006) on practice quality effect estimates, as within-person change estimates will be relatively independent of conventional response sets.

Several limitations are also important to highlight. Self-reported psychological outcomes (e.g., negative affect) may have been impacted by response biases (e.g., social desirability, halo effects; Hoyt et al., 2006). In addition, it may be difficult to self-assess quality of practice; indeed, being able to accurately do so presumably requires some measure of mindfulness and self-awareness, the very construct under study. Total scores were used for two psychological measures (DASS, DERS) in the absence of empirical support for a hierarchical factor structure. The sample size was limited, which may have reduced statistical power to detect small effects (e.g., effects for practice time predicting follow-up outcomes). Relatedly, sample attrition, although similar to that found in other mindfulness interventions with addiction (see Zgierska et al., 2009, for a review), further reduced power and generalizability. The small number of treatment groups and instructors limited our ability to adequately model the nesting of the data. The use of a novel mindfulness

intervention for smoking cessation and a predominantly Caucasian sample limits generalizability to other mindfulness interventions (e.g., MBSR) and other racially or ethnically diverse populations. The reuse of a sample previously examined in a process–outcome study (Goldberg et al., 2013) may have capitalized on unique and potentially idiosyncratic sample characteristics. The Hawthorne effect (Adair, 1984) may also have impacted findings. Filling out PQ-M assessments regularly required participants to rate their practice, an exercise that may have caused them to evaluate, focus, and subsequently improve their mindfulness practice. Future work may do well to examine practice time and practice quality in relation to other known counseling processes (e.g., therapeutic alliance, group cohesion).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1**

Psychological Outcome Composite Predicted by Practice Time and Change in Practice Quality

| Model | Outcome | Predictor | β [95% CI] | *t (df)* | *p* |
|---|---|---|---|---|---|
| Model 1 | Posttreatment psych func | Baseline psych fanc | 0.48 [0.21, 0.75] | 3.76 (40) | <.001*** |
| | | Minutes med | 0.31 [0.05,0.57] | 2.44 (40) | .019* |
| Model 2 | Posttreatment psych func | Baseline psych fanc | 0.50 [0.22, 0.77] | 3.88 (40) | <.001*** |
| | | PQ-M slope | 0.31 [0.04,0.56] | 2.39 (40) | .022* |
| Model 3 | Posttreatment psych fanc | Baseline psych fanc | 0.47 [0.21, 0.73] | 3.90 (39) | <.001*** |
| | | Minutes med | 0.29 [0.04, 0.53] | 2.35 (39) | .024* |
| | | PQ-M slope | 0.28 [0.03, 0.52] | 2.29 (39) | .027* |
| Model 4 | Follow-up psych fanc | Baseline psych fanc | 0.39 [0.07, 0.70] | 2.52 (35) | .017* |
| | | Minutes med | 0.16 [−0.14, 0.47] | 1.07 (35) | .293 |
| Model 5 | Follow-up psych fanc | Baseline psych fanc | 0.39 [0.11, 0.67] | 2.90 (35) | .006** |
| | | PQ-M slope | 0.45 [0.16,0.73] | 3.32 (35) | .002** |
| Model 6 | Follow-up psych fanc | Baseline psych fanc | 0.37 [0.09, 0.65] | 2.72 (34) | .010* |
| | | Minutes med | 0.12 [−0.15, 0.39] | 0.85 (34) | .399 |
| | | PQ-M slope | 0.43 [0.15,0.72] | 3.20 (34) | .003* |

*Note*. CI = confidence interval; psych func = psychological functioning outcome composite (composed of measures of mindfulness [Five Facet Mindfulness Questionnaire; Baer et al., 2006], emotion regulation [Difficulty in Emotion Regulation Scale; Gratz & Roemer, 2004], negative affect [Depression Anxiety and Stress Scales; Lovibond & Lovibond, 1995], and quality of life [World Health Organization Quality of Life-BREF; WHOQOL Group, 1998]); PQ-M = Practice Quality–Mindfulness (Del Re et al., 2013); Minutes med = minutes meditated.

* $p < .05$.

** $p < .01$.

*** $p < .001$.