A common factors perspective on mindfulness-based interventions

Simon B. Goldberg[1,2†]

[1]Department of Counseling Psychology, University of Wisconsin, Madison, WI, USA

[2]Center for Healthy Minds, University of Wisconsin, Madison, WI, USA

[†]email: sbgoldberg@wisc.edu

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Abstract

Mindfulness-based interventions (MBIs) have entered mainstream Western culture in the past four decades. There are now dozens of MBIs with varying degrees of empirical support and a variety of mindfulness-specific psychological mechanisms have been proposed to account for the beneficial effects of MBIs. Although it has long been acknowledged that non-specific or common factors might contribute to MBI efficacy, relatively little empirical work has directly investigated these aspects. In this Perspective, I suggest that situating MBIs within the broader psychotherapy research literature and emphasizing the commonalities rather than differences between MBIs and other treatments might help guide future MBI research. To that end, I summarize the evidence for MBI efficacy and several MBI-specific psychological mechanisms, contextualize MBI findings within the broader psychotherapy literature from a common factors perspective, and propose suggestions for future research based on innovations and challenges occurring within psychotherapy research.

[H1] Introduction

Mindfulness has become very popular in Western cultures. Mindfulness meditation instructions are published by major news outlets, promoted by health care providers, taught in schools, and integrated into workplace culture[1]. Smartphone apps that include training in mindfulness are the most widely use mental health apps[2]. Many factors are contributing to this surge in popular attention to mindfulness (including media misrepresentation[3]). Importantly, there is some scientific justification for this interest amongst the general public: mindfulness and interventions aimed at cultivating mindfulness through training have been examined in thousands of empirical studies[4], and there is overwhelming evidence that mindfulness-based interventions (MBIs) might be helpful for psychological and to a lesser extent physical health in clinical[5,6] and non-clinical populations[7,8].

There is some definitional fuzziness regarding the term mindfulness in the scientific literature[3]. Mindfulness is a translation of the Pali word *sati* which refers primarily to receptive awareness[9]. Thus, unlike the typical mode of moment-to-moment experience (for example, engaging in task-unrelated thoughts that are often negative in valence[10,11]), mindful attention is characterized by a focus on present moment experience with an attitude of non-judgment[12,13,14]. Mindfulness meditation is subsumed under the Pali word *bhavana* or cultivation, although not all forms of meditation (*bhavana*) emphasize mindfulness (for example, concentration practices[15]). Thus, mindfulness can be considered a psychological capacity (*sati*) that is cultivated through meditation practices (*bhavana*). Mindfulness can be viewed both as a dispositional trait (a general tendency to attend to the present moment with receptivity)[16] and a momentary state (attending to this specific present moment with receptivity)[17]. Although derived from a spiritual

and soteriological context, secular mindfulness in Western cultures primarily emphasizes its potential therapeutic benefits for mental and physical health[18].

MBIs are interventions that involve the repeated practice of mindfulness meditation[19]. This includes relatively short-term mindfulness trainings delivered in 8-week, group-based formats and MBIs delivered in individual therapy[20]. Many MBIs have been developed and tested with a specific clinical condition in mind. For example, mindfulness-based stress reduction, was designed to target treatment-resistant chronic pain[21], mindfulness-based cognitive therapy targets depression[22], mindfulness-based relapse prevention targets substance use[23], and mindfulness-oriented recovery enhancement targets pain and opioid misuse[24]. Traditional psychotherapies that emphasize the attitudinal stance of present-moment, nonjudgmental attention but not formal meditation practice (such as Acceptance and Commitment Therapy and Dialectical Behavior Therapy[25,26]) or single mindfulness inductions[27] (single mindfulness meditation practices that are designed to produce state-like effects) are not considered MBIs. Mindfulness training refers to the broader range of dosages of mindfulness meditation, from a single session of mindfulness meditation practice to decades of intensive retreat practice.

In parallel with research seeking to evaluate the effects of MBIs on psychological and physical health, theoretical and empirical studies have sought to clarify how MBIs work. Proposed candidate mechanisms include alterations in attention[28–30] and emotion regulation[28–30] and changes in cognitive processes[28–31] (for example, positive reappraisal)[32]. MBI effectiveness might also be driven by non-specific aspects of MBIs, such as expectations of benefit and the influence of group and instructor support[21]. Yet, non-specific factors are often viewed primarily as a confound in studies of MBI mechanisms (but see[33–35]) and used as motivation for increasing the rigor of comparison conditions to isolate the specific effects of MBIs[28,36–38].

However, non-specific aspects of MBIs might be more than a methodological liability to be controlled for. Within the broader psychotherapy literature there is a long history of studying factors common across various types of psychotherapy as therapeutic mechanisms in and of themselves[39,40]. The common factors tradition provides an alternative narrative to that emphasizing specific ingredients, highlighting a different set of candidate mechanisms which suggest different pathways for improving outcomes[41].

In this Perspective, I suggest that viewing MBIs through a common factors lens can inform efforts to increase the effectiveness and public health impact of mindfulness. To provide context for understanding mechanisms within MBIs, I first define the basic tenets of and evidence for the specific ingredients and common factors perspectives on mechanisms of change in psychotherapy. Next, I summarize the efficacy evidence for MBIs, and evidence for MBI-specific and common factors mechanisms. It is difficult to definitively prove that a particular intervention component or mechanism of change is causal in psychotherapy[42,43]. Thus, here I aim to emphasize evidence supporting a common factors understanding of MBIs, rather than to resolve the debate regarding the relative contribution of specific ingredients and common factors. Finally, I show how contextualizing MBIs within psychotherapy research suggests specific avenues for future research.

The study of MBI-specific mechanisms and common factors are active areas of research and therefore debate (as is true for psychotherapy generally[41,42]). Thus, others might disagree with some of the ideas forwarded here. In addition, the mindfulness literature is vast. Thus, many theoretical and empirical contributions, such as the extensive MBI neurobiological literature (for a review, see[1,28,30]), are not covered here. In line with the American Psychological Association's evidence-based practice guidelines[44], when possible I have privileged evidence derived from

meta-analyses and systematic reviews, followed by individual randomized controlled trials (RCTs) and non-experimental designs.

[H1] Specific ingredients vs. common factors

The literature on specific ingredients and common factors in psychotherapy is extensive (see[41,42] for reviews). Proponents of specific forms of psychotherapy often emphasize theory-specified ingredients and mechanisms as central[40,45–47]. For example, proponents of cognitive behavioral therapy (CBT) might emphasize cognitive restructuring techniques as key intervention components and changes in maladaptive cognitive processes such as negative automatic thoughts as a key mechanism of change[48]. Similarly, proponents of MBIs might emphasize adherence to meditation practice as a key intervention component and changes in mindful attention as a key mechanism of change[49,50]. However, for almost a century psychotherapy researchers have observed that diverse forms of treatment produce similar benefits[39]. This pattern has been interpreted as indirect support for the possibility that interventions work due to factors shared across treatments, that is, common factors[39].

A variety of common factors have been proposed to explain how psychotherapy works. According to one commonly applied model, four intervention features are present across various systems of healing (for example, shamanism and medicine), including psychotherapy: provision of a treatment rationale, relationship between healer and sufferer, healing ritual, and healing setting[51]. Common factors have also been categorized into support (for example, therapeutic alliance and therapist warmth), learning (for example, provision of feedback and changing expectations of personal effectiveness), and action (for example, taking risks and being encouraged to face fears), and might occur in that order (support leads to learning which leads to

action)[42]. The therapeutic alliance (the affective bond between therapist and patient, and agreement on the tasks and goals of therapy) is the most widely studied common factor.[46,52]

Evidence that psychotherapies work (absolute efficacy[53]) and tend to work about equally well (lack of relative efficacy[41]) are cornerstones of the common factors argument. Both findings support the notion that psychotherapy in general is helpful and that the particular type of psychotherapy is less important. RCTs directly comparing two or more forms of psychotherapy (such as comparisons between CBT and psychodynamic psychotherapy[54]) provide the strongest evidence for similar outcomes. Meta-analyses have concluded that differences between psychotherapies, when present, tend to be small (standardized mean differences ≤ 0.20[42,54]). Advocates of common factors have suggested that researcher allegiance (researchers' belief that a given treatment or theory of change is superior to other treatments or theories of change[55]) could explain small differences between treatments[40]. Indeed, there is a small-to-moderate association between researcher allegiance and RCT outcomes ($r = .26$)[56]. By contrast, advocates of specific ingredients have argued that similar outcomes could be obtained through different intervention-specific mechanisms[57], such as changes in rumination and changes in acceptance[48]. Researchers on both sides of the common factors vs. specific ingredient debate have raised methodological questions regarding the meta-analyses that have been conducted, questioning the inclusion of certain trials, the use of particular outcome measure types, and the ways in which treatment conditions are categorized[42,58,59].

One elegant design for more directly evaluating the effect of specific ingredients is the component trial. These RCTs compare two versions of a given psychotherapy, with a purportedly active ingredient either removed (dismantling trial) or added (additive trial)[60]. In the context of MBIs, a component trial might involve testing monitoring of experience without

acceptance (dismantled mindful attention[14,61]). Similar to meta-analyses examining relative efficacy, meta-analyses of component trials have failed to find differences between psychotherapy treatments with and without purportedly active ingredients or have detected small advantages of including an additional component (standardized mean differences = -0.20 to 0.28)[60,62,63]. Similar to the relative efficacy literature, some have argued that methodological limitations of the literature (such as limited statistical power and high risk of researcher bias) make it difficult to draw firm conclusions from component trials[42].

Another method used to evaluate the importance of specific ingredients is examining the association between outcomes and therapists' (or in the case of MBIs, mindfulness instructors') adherence to a particular treatment manual and competence in delivering intervention-specific components[64]. Showing that higher adherence and competence delivering a particular treatment are associated with superior outcomes suggests the specific treatment ingredients are important. Results from meta-analyses of adherence-outcome and competence-outcome associations are mixed, with non-significant associations in adult samples (*r*s = .02 and .07, for adherence-outcome and competence-outcome, respectively[64]) and a small but significant effect for adherence-outcome (r = .10) but not competence-outcome (r = .02) in youth samples[65]. This suggests that adhering to a particular treatment manual or delivering treatment-specific components more competently does not make psychotherapy more effective, thereby arguing against the role of specific ingredients. Potential explanations offered for this lack of association include unreliability in adherence and competence measures and range restriction (owing to selecting highly adherent and/or competent therapists to deliver treatments in research studies)[64]. These methodological limitations make it difficult to draw firm conclusions for either specific

ingredients or common factors from the largely null association between adherence and competence.

Thus far, the evidence reviewed has emphasized small effects or lack of association between specific ingredients and treatment outcomes. However, proponents of both specific ingredients and common factors also point to large, primarily correlational literatures demonstrating linkages between these aspects of treatment and outcome[42]. On the specific ingredients side, the largest body of evidence links various aspects of CBT with treatment outcome (for a review, see[42]). A review of 30 meta-analyses of CBT processes concluded that the strongest support for linkages between CBT processes and outcome exists for cognitive (for example, changes in trauma-related cognitions) and behavioral treatment processes (for example, exposure and response prevention), along with therapeutic alliance (a common factor) and homework assignments[47]. On the common factors side, widely studied factors shown to correlate with outcomes include therapeutic alliance[52], goal consensus and collaboration between therapist and patient[66], and therapist empathy[67].

A final piece of correlational evidence offered by proponents of common factors involves therapist and group effects, that is, variance in outcomes explained by nesting participants within a particular therapist (in the case of individual psychotherapy[68]) or treatment group (in the case of group psychotherapy[69]). In theory, if the specific ingredients of a particular treatment are what is most important, therapists and group membership should not be associated with outcomes (unless this membership is associated with treatment specific ingredients, as in the case of treatment adherence and competence). However, meta-analytic evidence demonstrates that nesting within therapists and group accounts for variance in patients' outcomes (intraclass correlation coefficients = .05 and .06, for therapist[68] and group[69], respectively). Variance in

therapists' ability to form an effective therapeutic alliance[70] and variance in group cohesion[69,71] have been offered as common factors that might underlie these effects.

Thus, decades of research and thousands of empirical studies have examined both specific ingredients and common factors. Yet, it remains difficult to definitively identify causal mechanisms within psychotherapy, largely because many requirements must be met to determine causality[43]. These requirements include a strong association (between treatment and mechanism and between mechanism and outcome), specificity (lack of strong associations with other variables), consistency (evidence for strong association and specificity across studies), experimental manipulation (experiments directly manipulating the proposed mechanism impact the outcome), timeline (changes in mechanisms temporally precede changes in outcomes), gradient (stronger doses are associated with larger changes in outcomes), and plausibility or coherence (a cogent theoretical explanation of how the mechanism operates)[43]. Although many specific ingredients and common factors meet some of these requirements (for example, strong association[41,47] and consistency[52]), research designs in psychotherapy rarely allow testing of other requirements (for example, experimental manipulation, timeline, and gradient). Based on these requirements, insufficient evidence is available to claim that any given specific ingredient or common factor is a causal mechanism in psychotherapy (see[42], [43] for reviews).

[H1] MBI efficacy and causal mechanisms

Given no specific ingredient or common factor has emerged as definitively causal within psychotherapy generally, it is reasonable to conclude that definitive evidence for causal mechanisms in MBIs also does not yet exist. From this vantage point, what follows is a discussion of the efficacy evidence for MBIs and for candidate specific ingredients and common

factors that might play a role in MBI efficacy. This discussion is not intended to resolve the debate regarding how MBIs work, but rather to highlight common factors that have been less frequently studied within MBI research that might prove useful to explore.

[H3] Evidence for MBI efficacy

Several consistent findings emerge across the hundreds of RCTs testing MBIs and the dozens of meta-analyses aggregating these effects (Table 1). Relative to no treatment controls, MBIs tend to produce small-to-large reductions (standardized mean difference = 0.21-0.89) in common psychological symptoms (depression[6,7], anxiety[6,7], and stress[72]) and improvements in measures of well-being[7,73] in both clinical and non-clinical populations that are persistent albeit attenuated at follow-up (for example, six months following the end of the intervention)[5–7]. There is some heterogeneity across settings and populations. For example, smaller treatment effects have been observed in children[74], racial/ethnic minority samples[75], and for substance use[76]. MBIs might reduce psychosomatic outcomes like pain and sleep relative to no treatment, although evidence is less robust particularly for sleep than that for psychological symptoms, with fewer studies available and confidence intervals that include zero[5].

MBIs modestly outperform non-specific control conditions (conditions that control for time and instructor attention but that lack components intended to be therapeutic[54]) on psychiatric symptoms in clinical samples[6,77] and show effects of similar magnitude for depression and anxiety symptoms in non-clinical samples (although confidence intervals around effect size estimates are wider due largely to fewer available studies[7]). There is some evidence that MBIs slightly outperform specific active controls (other interventions intended to be therapeutic, such as physical exercise or relaxation training [54]) on psychiatric symptoms[6] but not

physical health conditions[5]. However, this slight superiority of MBIs might be driven by researcher allegiance (studies conducted by researchers who developed the MBI might be more prone to find positive results)[78]. MBIs generally perform similarly to specific active controls in non-clinical populations[7]. When compared directly, MBIs produce outcomes very similar to frontline, evidence-based treatments (for example, CBT and antidepressants)[6,79].

[H3] Evidence for MBI-specific mechanisms

A variety of MBI-specific psychological mechanisms have been proposed (see Table 2). These mechanisms include mindfulness[1,50], alterations in attention and emotion regulation[28–30,80,81], self-awareness and body awareness[28–30,81], acceptance[14,31,82,83], decentering (the ability to "step out" from within one's experience and reflect on that experience[84])[29,32,80,85,86], reappraisal[29,32,80,81,87] and exposure[29,31,80,85,86].

The evidence pertaining to these candidate psychological mechanisms (Table 2) is largely based on one criteria for determining causality[43], strong association (the presence of an effect of MBIs on a particular mechanism). However, much of the strongest evidence that MBIs produce larger effects than controls on candidate mechanisms comes from self-report measures of mindfulness and aspects of mindfulness such as decentering and acceptance with questionable construct validity[88,89]. Moreover, effects of MBIs on self-report measures might vary depending on the comparison condition (smaller effects are observed when MBIs are compared with other treatments[90]). Evidence for behavioral effects (for example, effects of MBIs on measures of attention[91,92] and interoception[93]) is less robust (that is, the effects are smaller and less consistently statistically significant). One meta-analysis[50] that examined mediational pathways

(the second part of the strong association criterion[43]) found the strongest evidence for changes in mindfulness and repetitive negative thinking as mediators of MBIs effects on mental health.

Various MBI-specific treatment ingredients (aspects of the treatment rather than psychological consequences of the treatment) have also been examined. The evidence for meditation practice dosage is the most robust. A meta-analysis of 28 studies revealed a similar small-to-moderate correlation between amount of home practice and intervention outcomes in clinical (r = .25) and non-clinical samples (r = .29)[49]. Observing a robust association across studies meets the consistency requirement for demonstrating a causal mechanism[43]. Findings from three RCTs that experimentally manipulated the dosage of repeated mindfulness training were mixed, showing evidence for larger[94] and smaller[95] effects from higher versus lower dosages, as well as no differences across dosage conditions[96]. Factors that might impact the link between practice and outcomes in MBIs are discussed in Box 1.

Efforts to isolate the effects of mindfulness meditation practice within MBIs through dismantling designs which remove purportedly active intervention components such as mindfulness meditation training have also yielded mixed findings[61,97]. Arguably the most rigorous MBI dismantling trial found no differences in depressive relapse between full mindfulness-based cognitive therapy (with meditation practice) and dismantled mindfulness-based cognitive therapy (psychoeducation without meditation practice) over 12-month follow-up[97]. It is particularly notable that this trial was conducted by one of the developers of mindfulness-based cognitive therapy whose presumed allegiance to this treatment might bias against a null finding. By contrast, another dismantling study found evidence for unique benefits of mindfulness (monitoring experience with acceptance) delivered through a smartphone app compared to an active control dismantling condition (monitoring experience without acceptance)

on some but not all psychological outcomes (for example, mindfulness reduced momentary but not retrospective loneliness[61,98]). A third study found that full mindfulness-based cognitive therapy and mindfulness-based cognitive therapy with some meditative techniques removed (focused attention or open awareness only) produced similar effects on depression symptoms[99]. Thus, results from dismantling studies are mixed and definitive evidence for the potency of meditation practice as a specific ingredient in MBIs is lacking.

In sum, although many theoretically coherent MBI mechanisms have been proposed, like the broader psychotherapy literature, there is limited research that definitively supports any particular MBI-specific mechanism as causal.

[H3] Evidence for common factors in MBIs

A small but growing number of studies have specifically investigated common factors within MBIs[33–35,100]. Furthermore, several patterns of findings within the broader MBI literature align with tenants of a common factors perspective on psychotherapy (Table 3).

First, MBIs produce moderate benefits (standardized mean difference $\approx \geq 0.50$) relative to no treatment in RCTs[6,7] and also show moderate effects (standardized mean difference $\approx \geq 0.50$) in naturalistic settings[101,102] (absolute efficacy). Differences between MBIs and other therapies are small when compared directly in RCTs (standardized mean difference $\approx \leq 0.20$, limited relative efficacy[5]). As discussed previously in the context of psychotherapy generally, the lack of relative efficacy for MBIs vis-à-vis other therapies can be interpreted as indirect support for the importance of common factors.

Second, dismantling studies have failed to find definitive evidence that mindfulness meditation is a specific ingredient in MBIs.[61,97] As described above for psychotherapy generally

a lack of evidence for specific ingredients bolsters the argument that MBIs work at least in part via common factors rather than treatment-specific ingredients. Furthermore, evidence for linkages between MBI instructor adherence and competence with outcomes has been found in some MBI studies[103,104] but not all[105]. Thus, it is not clear that MBI instructors delivering the treatment-specific components of MBIs is what drives beneficial effects.

Third, there is meta-analytic evidence that researcher allegiance is positively associated with outcomes in MBI RCTs[78]. Moreover, researcher allegiance accounts for the small differences observed between MBIs and other treatments[78]. Thus, similar to psychotherapy generally, the slight advantages reported for MBIs vis-à-vis other treatments[6] might be accounted for by researcher allegiance. When this bias is controlled for, MBIs are no more effective than other therapies.

Finally, there is evidence for group effects in mindfulness-based stress reduction[106], but not for therapist (or instructor) effects. This suggests elements of the group, a non-MBI-specific ingredient, is associated with outcomes. Therapeutic alliance, also a non-MBI-specific ingredient, has been shown to correlate with outcomes in MBIs across several studies[100,105,107], although null associations have also been reported (for example, with smoking abstinence[107]).

As with psychotherapy generally, the findings reviewed here do not provide definitive evidence supporting common factors as causal mechanisms at the exclusion of specific ingredients within MBIs. However, the correspondence between the pattern of findings discussed for MBIs and those in the broader psychotherapy literature is striking and suggests that, as with psychotherapy generally, non-specific factors are likely important within MBIs as well.

[H1] MBIs as psychotherapy

Findings reviewed thus far suggest that short-term MBIs like mindfulness-based stress reduction and mindfulness-based cognitive therapy are similarly effective to other psychotherapeutic interventions and that evidence for MBI-specific psychological and treatment mechanisms is modest. These patterns raise the question of whether short-term MBIs are more similar to other psychological interventions than different. Although the evidence for the role of common factors in MBIs is similarly inconclusive, contextualizing the patterns observed in the MBI literature within the broader psychotherapy literature might be useful for guiding efforts to study and augment common factors within MBIs. Several other theoretical reviews have drawn compelling linkages between MBIs and CBT[14,80,108]; here, I examine linkages with psychotherapy more generally. Specifically, contextualizing MBI research within psychotherapy research might help explain patterns seen in MBI RCTs by highlighting parallel findings that might replicate when sufficiently powered (such as researcher allegiance effects and alliance-outcome associations) and providing theory-informed explanations for these patterns (such as the potency of common factors[40]).

Viewing MBIs through a common factors lens also highlights the potential of treatment ingredients that have historically been less studied within mindfulness research. These include aspects of participants' interpersonal relationship with the instructor such as agreement on the tasks and goals of an intervention (therapeutic alliance[107]), a sense of receiving support from the group (group cohesion[71]), and the role of expectations that treatment will be beneficial[41]. Although some of these characteristics have been noted in relation to MBIs (for example, the role of expectancy[21]), they are often viewed primarily as confounding variables[28,36] rather than theory-based, potentially potent causal mechanisms that should be studied and harnessed. The

specific suggestions for future research below follow from the view that common factors may play an important causal role within MBIs. Thus, further research seeking to understand these factors as well as seeking to augment the impact of MBIs in treatment non-specific ways might be an important complement to traditional MBI research that has primarily emphasized MBI-specific mechanisms and the development and testing of novel MBIs[1].

[H3] Applying innovations

If MBIs are more similar than different to other forms of psychotherapy, treatment non-specific innovations occurring within psychotherapy research might be extended to MBIs. One such innovation is the practice of routine outcome monitoring (measurement-based care) which involves having patients complete measures repeatedly that therapists then use to modify the course of treatment[109]. Meta-analytic evidence suggests that routine outcome monitoring improves patient outcomes and reduces dropout in psychotherapy[109]. Many mindfulness teachers (like many psychotherapists[110]) might argue that asking participants to reflect on their progress in treatment contradicts the spirit of acceptance and non-doing that are central to MBIs[12]. Thus, it might be important to empirically evaluate participants' perception of and response to outcome monitoring within MBIs. Indeed, there are numerous brief measures of mindfulness (such as the Five Facet Mindfulness Questionnaire[16] and the Mindful Attention Awareness Scale[111]), meditation practice quality (such as the Practice Quality Mindfulness[112] or the Mindfulness Adherence Questionnaire[113]), and therapeutic alliance (such as the Working Alliance Inventory[114]) that, along with symptom measures, could serve as useful indicators of how one is progressing within an MBI.

A second innovation that can be applied to MBIs is leveraging mobile health (mHealth) technologies to extend their reach. There is strong evidence that psychological interventions can be effectively delivered through mHealth[115–117]. The prominence of mindfulness meditation within mental health apps[2] suggests that MBIs are already at the forefront of unguided mHealth interventions (those delivered without live instructor guidance). Current evidence suggests meditation apps are beneficial[118] and have some of the strongest empirical support among various mobile phone-based mental health interventions[117] Among the 27 most popular mental health apps, the two most popular (Headspace and Calm), which account for 90% of monthly active users, have meditation as their primary content[2]. Across users of all 27 apps, mindfulness content reaches 96% of monthly active users while cognitive restructuring and exposure (core elements of CBT) reach only 2% and 0.0004%, respectively.

mHealth MBIs take many forms. For example, mHealth MBIs may be primarily unguided (as in the case of many meditation apps[118]) or include some amount of instructor or coach support. This support may occur synchronously (for example via video conferencing or telephone coaching[119]) or asynchronously (for example technical and motivational support provided via text messages or emails[120]). It has not yet been established which mHealth elements are most important for producing beneficial effects nor the ideal cost-benefit tradeoff between intervention burden on consumers and providers and efficacy. Clinical trials are currently investigating the optimal type, dosage, and timing of instructor support for mHealth MBIs[121].

Precisely how common factors investigated in traditional psychotherapy translate into the mHealth context, particularly unguided mHealth, is an area of active research[122,123]. Stronger therapeutic alliance is clearly linked to beneficial outcomes in guided mHealth interventions that include human support (synchronously or asynchronously) as part of their delivery[52]. There is

also preliminary evidence that therapeutic alliance emerges within the context of unguided mHealth interventions[124,125] (including mHealth MBIs[126]) and, as in in-person psychotherapy, is associated with outcomes[124–126]. Monitoring therapeutic alliance within unguided mHealth MBIs could be used to inform treatment (for example, to trigger additional support or just-in-time adaptive interventions[127]).

A third innovation in psychotherapy and health care generally is a movement towards precision medicine[128]. Even if differences between treatments are small on average, treatment recommendations can be personalized based on patient characteristics through machine learning (that is, predictive matching)[129]. Prior work has identified some baseline patient characteristics that predict MBI treatment response. For example, greater symptom severity is associated with larger improvement following mindfulness-based cognitive therapy for individuals with current or remitted depression[79], identifying as a woman and being low on extraversion are associated with larger improvement in psychological distress following mindfulness-based cognitive therapy for distressed individuals with diabetes[130], and greater rumination and greater empathy are associated with larger improvement following an mHealth MBI[131]. Although, work predicting treatment response using machine learning is just beginning in mindfulness research, preliminary evidence suggests that sets of baseline characteristics subjected to machine learning can provide treatment recommendations, such as choosing between maintenance antidepressant and mindfulness-based cognitive therapy[132].

Multimodal and intensive sampling data streams (for example, experience sampling and passive measures gathered through smartphones and other electronic devices) used in some MBI studies[133] and mental health research broadly[134,135] might be particularly promising inputs for machine learning models, given that these models can often handle many correlated

predictors[136]. Although to our knowledge, no work to date has investigated these data streams using machine learning in the context of an MBI, passive data collected through smartphones can detect daily ratings of depression[137] and anxiety[138] as well as aspects of well-being[139]. These methods might prove valuable for passively evaluating outcomes and as inputs for recommending or modifying MBI treatments. Future smartphone-based meditation apps could customize user experiences based on input from these data streams (for example, recommending specific practices matched with patients' trait or state characteristics).

[H3] Addressing limitations

Viewing MBIs as another psychotherapy also aligns MBIs with the current limitations of psychotherapy and highlights potential solutions that might apply to MBIs. First, there is a lack of evaluation of harm and adverse effects within MBIs[140,141] and psychotherapy research broadly[142]. Efforts to more clearly characterize rates and predictors of adverse effects in MBIs (which might range from mild, transient anxiety to cognitive and perceptual changes associated with functional impairment[143]) is very important; however, most MBI research has exclusively focused on the potential benefits of MBIs[3,141]. Ultimately, comparisons between MBIs and other psychotherapies might provide the most relevant data for evaluating the safety of MBIs[101,144]. Such comparisons can clarify if MBIs are more or less safe than other psychotherapies, which can guide patients' and providers' treatment decisions.

Second, there is a lack of racial and ethnic diversity in MBI research[75,145] and psychotherapy generally[146]. Mindfulness research should draw from the rich tradition within psychotherapy research of investigating treatment and provider characteristics that might augment outcomes for racial or ethnic minority populations. For example, adapting

psychotherapies to patients' cultural worldview[147], cultural humility (that is, a lack of superiority and openness to patients' cultural perspectives)[148], and matching between patient and provider cultural identities improve treatment outcomes[149]. These factors have yet to be adequately studied in the context of MBIs[75].

Third, as discussed above, it is challenging to establish causal mechanisms in both MBI and psychotherapy research. Suggestions for establishing causal mechanisms within psychotherapy[42] might also relate to studying specific ingredients and common factors within MBIs. Specifically, MBI studies should move beyond RCTs establishing efficacy and correlational studies investigating candidate mechanisms. Instead, future studies should experimentally manipulate candidate mechanisms, explore temporal associations between candidate mechanisms and outcomes, clarify dose-response relationships between candidate mechanisms and outcomes, and evaluate multiple potential mediators simultaneously, all within the context of a sound theoretical model. Evaluating within-person processes via intensive sampling (for example, using experience sampling) might be helpful for these goals. Specifically, intensive sampling methods can provide the granularity to evaluate temporal precedence as well as effects on proximal outcomes such as momentary mood that might be more sensitive to experimental manipulations than distal outcomes such as retrospective psychological symptoms. Studies that have already included some of these features[150,151] can serve as models for future work. For example, an experience sampling study demonstrated that levels of decentering during mindfulness meditation practice mediated the effects of changes in mindfulness on emotional arousal (that is, feeling more calm than nervous), supporting decentering as a potential causal mechanism[151].

Finally, both MBI and psychotherapy research needs to more clearly identify therapist characteristics that are associated with beneficial outcomes. Although a wide range of candidate therapist characteristics have been explored (such as therapists attachment style[152] and interpersonal skills[153]), few consistent predictors of patient outcomes have been identified[154]. Performance-based tasks assessing therapists' interpersonal skills, for example where therapists are asked to respond to video vignettes of challenging patients[153], have been shown to be the most consistent predictors of treatment outcome[154,155]. Using similar measures to understand characteristics of effective MBI instructors could empirically guide instructor training efforts, rather than solely emphasizing technical adherence and competence which are not always strongly linked to outcomes[64]. The Mindfulness-Based Interventions: Teaching Assessment Criteria is a measure of mindfulness teaching skills that includes representation of common factors domains (for example, relational skills and holding the group learning environment such as setting clear ground rules and emphasizing the universality of themes which are discussed in the group [156,157]). The Mindfulness-Based Interventions: Teaching Assessment Criteria might be a useful starting point for identifying MBI-specific and non-specific instructor characteristics empirically linked to outcomes.

[H1] Conclusions

In 40 years, mindfulness meditation has gone from a practice found in Asian monasteries to a topic of mainstream interest in Western countries[3]. The numerous MBIs that have been developed generally perform on par with frontline, evidence-based treatments[6,79] and a wide variety of MBI-specific mechanisms have been proposed and to varying degrees evaluated. The aim of this Perspective was to situate MBI research within the broader context of specific

ingredients versus common factors debates in psychotherapy research. Viewing MBIs as another effective psychological intervention among many valid approaches might allow mindfulness researchers and clinicians to capitalize on findings from the broader field of psychotherapy research.

Based on compelling evidence that MBIs are generally effective, a key next step is increasing access. This will require shifting from developing novel MBIs to studying the dissemination and implementation of established MBIs[158]. Mobile technology might play a key role in increasing MBI access, but mHealth MBIs will need to overcome high and rapid disengagement seen in mHealth interventions generally[159].

Although common factors were emphasized by the creators of mindfulness-based stress reduction (for example, the influence of group support and expectation of relief[21]) and CBT (for example, the importance of therapist warmth and genuineness[160]), they have rarely been emphasized in research seeking to understand how MBIs work[50] (with notable exceptions, such as the Mindfulness-Based Interventions: Teaching Assessment Criteria measure[156]). Mindfulness researchers should measure and optimize non-specific treatment ingredients such as the therapeutic alliance, expectancy, and group cohesion. Rather than treating common factors as threats to the value of mindfulness or meditation, researchers and clinicians should embrace common factors as therapeutic in their own right. Ultimately, common factors do not occur in a vacuum, but rather rely on specific ingredients (such as a cogent treatment rationale[51]). Thus, MBIs are one of many viable ways to promote change. Of course, MBI-specific mechanisms can and should continue to be studied, just not at the exclusion of studying and optimizing common factors. Moreover, fruitful integration might be possible by considering the interplay between common factors and treatment-specific mechanisms. For example, researchers could ask whether

changes on MBI-specific mechanisms precede or are preceded by changes in therapeutic alliance, or how group and instructor factors influence MBI-specific mechanisms.

Future research should also clarify whether certain outcomes are more strongly linked to a particular common factor or specific ingredient within MBIs. It is possible that the relative importance of common factors and specific ingredients varies across outcomes or populations. Within psychotherapy generally, there is evidence that the alliance-outcome association is weaker for some outcomes (such as dropout and risk behavior) and within some populations (such as patients with substance use disorders[52]). As the common factors-related MBI research to date has primarily emphasized psychological outcomes, whether similar variation emerges for MBIs is not yet known (although one study did fail to find an association between alliance and smoking cessation[107]).

Having highlighted similarities between MBIs and psychotherapy, it is also important to acknowledge that MBIs might also differ from other therapies. First, mindfulness meditation is taught with the aspiration that it becomes a life-long practice that enables a person to reach their full potential and optimally flourish[161]. By contrast, many evidence-based psychotherapies focus on reducing unwanted distressing symptoms, often by applying short-term strategies[162]. There is some evidence for specific effects of different forms of meditation practice on both the brain and behavior with longer and more intensive practice[163–167]. The longitudinal trajectory of when such specific effects emerge and how much practice is required for their expression requires further study. Second, mindfulness meditation diverges from other psychotherapies in flexibility in the intensity at which it is delivered. Although the paradigmatic MBIs like mindfulness-based stress reduction are moderate in intensity, there likely are unique benefits of MBIs that lie at the low and high ends of the intensity continuum (see Box 2). The therapeutic potential of low-intensity

intervention (for example, interventions that occur in daily life prompted by mobile technology) and high-intensity delivery formats (for example, meditation retreats that promote impacts of long-term practice) are not yet realized and require further investigation.

Table 1. Evidence for specific MBIs drawn from meta-analyses or randomized controlled trials

MBI	Primary indications	Secondary indications	Exemplar evidence	Number of studies in meta-analysis (k) or number of participants in individual studies (n)	Effect size (standardized mean difference, unless otherwise specified)	Ref.
Mindfulness-based stress reduction (MBSR)	Management of chronic pain Stress reduction in healthy and distressed populations	Applied or adapted to reduce psychological distress in various physical health conditions	MBSR improves physical functioning and depression in chronic pain patients more than non-specific controls	k = 21	0.42 and 0.49 for physical functioning and depression	[168]
			MBSR has an equivalent effect on physical functioning and depression as CBT	k = 21	0.02 and 0.06 for physical functioning and depression	[168]
			MBSR reduces stress and psychiatric symptoms in healthy populations vs. various control groups	k = 18	0.62 to 0.80	[8]
			MBSR reduces psychiatric symptoms in patients with chronic somatic diseases vs. waitlist controls	k = 8	0.26 to 0.47	[169]
			MBSR reduces depression and may improve fatigue, anxiety, and sleep vs. usual care at post-treatment in	k = 10	0.54, 0.50, 0.29, 0.38 for depression, fatigue, anxiety, and sleep	[170]

			breast cancer patients			
			MBSR reduces depression and might improve fatigue, anxiety, and sleep vs. usual care at medium-term follow-up (up to 6 months after baseline) in breast cancer patients	k = 10	0.32, 0.31, 0.28, 0.27 for depression, fatigue, anxiety, and sleep	[170]
Mindfulness-based cognitive therapy (MBCT)	Depression relapse prevention Reduction of current depressive symptoms	Applied or adapted for other common psychiatric conditions (anxiety, post-traumatic stress disorder)	MBCT reduces risk of depressive relapse vs. other treatments	k = 5	Hazard ratio = 0.79	[79]
			MBCT reduces risk of depressive relapse vs. antidepressants at 1-year follow-up	k = 4	Hazard ratio = 0.77	[79]
			MBCT reduces current depressive symptoms more than non-specific controls (not intended to be therapeutic)	k = 13	0.71	[171]
			MBCT reduces current depressive symptoms similarly to other treatments	k = 13	0.00	[171]
Mindfulness-based relapse prevention (MBRP)	Substance use relapse prevention	n/a	MBRP and CBT (relapse prevention) reduce substance use more than treatment-as-usual at 6-	n = 286	Odds ratio = 1.28 and 1.26 at 6-month follow-up, for drug use and heavy drinking	[172]

			month follow-up			
			MBRP reduces substance use equivalently to CBT at 6-month follow up	n = 191	Odds ratio = 0.95 and 0.94 at 6-month follow-up, for drug use and heavy drinking	[172]
Mindfulness-oriented recovery enhancement (MORE)	Management of chronic pain and opioid misuse	Applied or adapted for other addictive behaviors	MORE reduces pain severity and pain interference relative to support group	n = 95	0.63 and 0.84 for pain severity and pain interference	[24]
			MORE might reduce opioid misuse risk at 3-month follow-up	ns = 95 and 115	0.22 to 0.64	[24,173]
			MORE reduces substance use craving in men with comorbid substance use and other psychiatric conditions relative to CBT	n = 180	0.40	[174]
			MORE might reduce craving in men with comorbid substance use and other psychiatric conditions relative to treatment-as-usual	n = 180	0.30	[174]

Note: Exemplar studies were selected based on being the most recent, more robust (largest), and/or most widely cited evidence for a particular effect. Directions of standardized mean difference modified so that a larger value indicates benefits of mindfulness-based intervention versus control. CBT = cognitive behavioral therapy; MBCT = mindfulness-based cognitive therapy; MBRP = mindfulness-based relapse prevention; MBSR = mindfulness-based stress reduction; MORE = mindfulness-oriented recovery enhancement.

Table 2. Proposed MBI-specific mechanisms and exemplar evidence

Mechanism	Relevant reviews	Exemplar evidence	Number of studies in meta-analysis (k) or number of participants in randomized controlled trial or observational study (n)	Effect size (standardized mean difference, unless otherwise specified)	Ref.
Mindfulness	[1,50]	MBIs showed larger increases in self-reported mindfulness vs. waitlist	k = 25	0.52	[175]
		MBIs showed larger increases in self-reported mindfulness vs. specific active controls	k = 30	0.25	[175]
		No difference between MBIs vs. comparison conditions when comparison was time matched	k = 16	0.02	[90]
		No difference between MBIs vs. CBT	k = 8	0.08	[90]
		Mindfulness mediates intervention effects of MBIs in a meta-analysis	k = 13	n/a	[50]
Attention regulation	[28–30,80,81]	MBIs showed modestly larger effects on behavioral measures of attention vs. controls	k = 18	0.18	[91]
		MBIs showed modestly larger effects on behavioral measures of executive function vs. controls	k = 17	0.18	[91]
		MBIs did not differ from controls on behavioral measures of working memory vs. controls	k = 8	0.15	[91]

		Comparison condition type did not moderate effects on behavioral measures of attention regulation	k = 27	n/a	[91]
		MBIs showed larger increases in self-reported attention dimension of mindfulness measures vs. controls	k = 79	0.44	[176]
		Comparison condition type moderates effects of MBIs on self-reported attention dimension of mindfulness measures	k = 79	0.21 and 0.56, for active and inactive controls	[176]
Emotion regulation	[28–30,81]	Insufficient studies to examine effects of MBIs on emotion regulation in a systematic review	k = 4	n/a	[177]
		Mindfulness inductions showed small effects on regulation of negative affect vs. controls	k = 15	0.28	[178]
		Insufficient studies to examine effects of mindfulness inductions on emotion regulation strategies in a systematic review	k = 7	n/a	[178]
		Brief mindfulness training (induction or ≤2 weeks of training) produced reductions in negative affect reactivity in distress paradigm vs. controls	k = 46	0.27	[27]

		Decreased repetitive negative thinking mediates effects of MBIs in a meta-analysis	k = 6	n/a	[50]
		MBIs showed larger effects on nonreactivity dimension of mindfulness measures vs. controls (note that some have considered this aspect of dispositional mindfulness measures reflective of decentering[14])	k = 27	0.50	[176]
		Comparison condition type did not moderate effects of MBIs on nonreactivity dimension of mindfulness measures, not moderated by control group type	k = 27	0.34 and 0.55, for active and inactive controls	[176]
Self-awareness / body awareness	[28–30,81]	MBIs showed modestly larger effects on awareness of bodily state (interoception) vs. controls	k = 7	0.20	[93]
		MBIs showed larger effects on observe dimension of mindfulness measures vs. controls	k = 37	0.47	[176]
		Comparison condition type did not moderate effects of MBIs on observe dimension of mindfulness measures	k = 37	0.42 and 0.49, for active and inactive controls	[176]
Acceptance	[13,14,31,83]	MBIs showed larger effects on nonjudgment dimension of mindfulness measures vs. controls	k = 36	0.44	[176]
		Comparison condition type did not moderate effects of MBIs on nonjudgment dimension of mindfulness measures	k = 36	0.35 and 0.49, for active and inactive controls	[176]

Decentering	[1,29,31,32,80,85,86]	Both MBCT and cognitive therapy increased metacognitive awareness vs. controls in RCTs	ns = 100 and 158, for RCTs testing MBCT or cognitive therapy vs. controls, respectively	0.60 and 0.47, for MBCT and cognitive therapy vs. controls	[179]
		MBCT increased meta-awareness (decentering) in describing suicidal crisis vs. treatment-as-usual in RCT	n = 27	eta-squared = 0.16	[180]
		Changes in self-reported decentering mediated reductions in anxiety in RCT of MBSR vs. attentional control	n = 38	n/a	[181]
Reappraisal	[29,32,80,81,87]	Changes in positive reappraisal mediate association between changes in mindfulness and changes in stress in an MBI in observational study	n = 339	n/a	[87]
		Increases in state mindfulness during meditation associated with use of positive reappraisal during MBI in observational study	n = 234	r = .58 between latent slopes of state mindfulness and positive reappraisal	[182]
		Changes in positive reappraisal mediate effects of MBSR vs. no treatment on well-being at 6-year follow-up in RCT	n = 288	n/a	[150]
Exposure	[29,31,80,85,86]	n/a			
Meditation practice	[1,49]	Formal practice time positively associated with outcomes in MBSR and MBCT	k = 28	r = .26	[49]
		Informal practice increases state mindfulness in RCT	n = 51	n/a	[183]
		Informal practice correlated with buffered increases in stress and successful coping in RCT	n = 60	n/a	[184]

Note: Recent and highly cited conceptual reviews were selected; the list of reviews is not exhaustive. Exemplar studies were selected based on being the most recent, more robust (largest), and/or most widely cited evidence for a particular effect. In instances where limited MBI evidence was available, data were also drawn from brief mindfulness training studies (for

example[178]). Directions of standardized mean difference modified so that a larger value indicates benefits of mindfulness-based intervention versus control. MBI = mindfulness-based intervention; MBSR = mindfulness-based stress reduction; MBCT = mindfulness-based cognitive therapy; r = correlation coefficient; RCT = randomized controlled trial. n/a = not applicable.

Table 3. Key findings in psychotherapy research and corresponding exemplar evidence for short-term MBIs

Finding	Exemplar evidence in psychotherapy research			Exemplar evidence in MBI research		
	Effect	**Effect size (standardized mean difference, unless otherwise specified)**	**Ref.**	**Effect**	**Effect size (standardized mean difference, unless otherwise specified)**	**Ref.**
Absolute efficacy: psychological interventions tend to produce moderate to large effects	Psychotherapy is superior to no treatment	0.68	[53]	MBIs outperform no treatment in non-clinical samples	0.56 and 0.53 for anxiety and depression, respectively	[7]
				MBIs outperform no treatment in clinical samples	0.55 on psychiatric symptoms	[6]
	Similar magnitude effects for depression in naturalistic settings as seen in RCTs	0.74	[185]	Similar magnitude effects seen for MBSR in naturalistic settings as seen in RCTs	0.50 and 0.60, for anxiety and depression, respectively	[101]
				Similar magnitude effects seen for MBCT in naturalistic settings as seen in RCTs	0.48 for depression	[102]
Relative efficacy: differences between bona fide psychological interventions are small to non-existent	Differences between bona fide treatments tend to be uniformly distributed around zero	n/a	[54,186]	-	-	-
	Differences between bona fide treatments when observed tend to be small	0.22 for CBT vs. other treatments on psychiatric symptoms	[187]	MBIs produce similar effects to other bona fide psychotherapies (≈ or < 0.20)	0.13 on psychiatric symptoms in psychiatric samples	[78]

					0.07, -0.17, and -0.01 for anxiety, depression, and distress in healthy samples	[7]
		0.21 and 0.14 for CBT vs. other treatments on depression and anxiety	[188]	MBIs perform on par with evidence-based treatments when compared directly	-0.004 and 0.09 on psychiatric symptoms in psychiatric samples at post-treatment and follow-up	[6]
Specific ingredients: benefits of psychological interventions are not strongly linked to the presence or absence of specific treatment ingredients	Treatment packages with and without specific ingredients produce similar benefits	0.14 and 0.01 at post-treatment on targeted symptoms for additive studies (where a component is added) and dismantling studies (where a component is removed)	[60]	MBCT with and without meditation practice produces similar benefits	Hazard ratio = 0.88 for depressive relapse over 12 months follow-up	[97]
	-	-	-	Monitoring with acceptance produces benefits over monitoring alone on ecological momentary assessment but not on retrospective loneliness	0.35 and 0.06 for ecological momentary assessment loneliness and retrospective loneliness	[61]
	-	-	-	Monitoring with acceptance produces benefits over monitoring alone on physiological stress reactivity but not on subjective stress reactivity during social stressor	0.40 and 0.41 for log cortisol area under the curve and systolic blood pressure; 0.00 on subjective stress reactivity	[98]
Therapist adherence and competence: adherence and competence are not strongly linked to treatment outcome	No association between outcome and adherence or competence in adult samples	rs = .02 and .07, for adherence and competence	[64]	MBCT therapist competence not associated with changes in psychological distress	Unstandardized regression coefficient = -0.10, p = .833	[105]

	Small association between adherence and outcome but not between competence and outcome in youth samples	rs = .10 and .03, for adherence and competence, respectively	[65]	Composite of therapist adherence and competence predicted changes in opioid misuse in MORE	Unstandardized regression coefficient = -9.96, p = .009	[104]
	-	-	-	Therapist adherence in MBRP predicted changes in mindfulness	r = .37	[103]
Researcher allegiance: effects are larger when researchers are allegiant to a treatment condition	Researcher allegiance is associated with outcomes	r = .26	[56]	No differences in outcomes between MBIs and other therapies when researcher allegiance is absent or balanced between conditions	-0.05 to 0.020 for psychiatric symptoms in psychiatric samples	[78]
Therapist and group effects: therapists and group members influence participants' outcome	Patients seen by the same therapist show greater similarities in outcomes than patients seen by different therapists	ICC = 5%	[68]	No evidence for therapist effects on changes in distress in MBSR	ICC = 0% on psychological distress	[106]
	Patients in the same group show greater similarities in outcomes than patients in different groups	ICC = 6%	[69]	Participants seen in same MBSR group show greater similarities in change in distress than participants in different groups	ICC = 7% for psychological distress	[106]
Therapeutic alliance: developing agreement on the tasks and goals of therapy and an emotional bond contributes to benefits	Alliance and outcome are correlated across outcomes, rating perspectives, and types of psychotherapy	r = .28	[52]	Higher alliance is associated with larger increases in mindfulness in MBRP	Unstandardized regression coefficient = 0.34, p = .033	[100]
	-	-	-	Higher alliance is associated with larger decreases in psychological distress in MBCT	Unstandardized regression coefficient = -0.18, p = .016	[105]

	-	-	-	Higher alliance is associated with larger decreases in negative affect and emotion dysregulation, larger increases in mindfulness, but not smoking abstinence in a mindfulness-based smoking cessation intervention	rs = -.33, -.24, .33, and -.20 for negative affect, emotion dysregulation, mindfulness, and smoking abstinence	[107]

Note: CBT = cognitive behavioral therapy; ICC = intraclass correlation coefficient; MBCT = mindfulness-based cognitive therapy; MBRP = mindfulness-based relapse prevention; MBSR = mindfulness-based stress reduction; n/a = not applicable (relevant effect size does not exist or has not been evaluated); r = correlation coefficient; RCT = randomized controlled trial. Table includes representative psychotherapy and mindfulness research and is not intended to be exhaustive (for further discussion and somewhat different interpretation of the results of dismantling designs in MBIs, see[189]). MBI findings are based on short-term MBIs (interventions similar in length and intensity to mindfulness-based stress reduction). Directions of standardized mean difference modified so that a larger value indicates benefits of mindfulness-based intervention versus control.

Box 1. Home meditation practice dosage and MBI outcomes

Several factors might attenuate or otherwise impact the practice-outcome association. First, outcomes might be influenced by unmeasured informal practice not captured by estimates of formal practice alone. Although less frequently investigated than formal practice, there is both correlational and experimental evidence that informal practice (practice occurring within the flow of everyday activity) is associated with positive outcomes[183,190]. The combination of formal and informal practice time might be a stronger predictor of outcomes than formal practice time alone.

Second, the quality of participants' formal practice might influence outcomes. Improvements in practice quality (the degree to which an individual is implementing the meditation instructions during formal practice[112]) are associated with outcomes above and beyond practice time[191,192]. Like learning other skills, certain kinds of practice (for example, deliberate practice[193]), rather than duration of practice alone, might matter.

Third, participants might not report their home practice accurately, which could attenuate practice-outcome associations by introducing measurement error. At the same time, self-reported practice might inflate rather than attenuate the practice-outcome link. For example, social desirability bias (providing socially desirable rather than accurate responses) might similarly influence estimates of home practice and outcomes (individuals might overestimate home practice and treatment benefits). It would be telling to see whether the practice-outcome association increases or decreases when practice dosage, outcomes, or both are assessed objectively.

Fourth, it might be that meditation practice is not the only or even the most potent treatment ingredient. MBIs likely include many therapeutic components. One understudied but

potentially powerful element is the mindset that is communicated within MBIs, namely that one's well-being is not fixed but rather can be modified with training[194]. Merely receiving the didactic content of an MBI might be sufficient to shift participants' mindset in beneficial ways, regardless of the amount of formal practice.

Finally, it is possible that those benefiting from formal practice might be more likely to discontinue their practice. Assuming persistence is motivated to some degree by negative reinforcement (that is, practicing helps participants feel less bad), participants who feel better might no longer perceive a need to continue their meditation practice. This phenomenon has been observed in naturalistic psychotherapy settings, where participants continue to attend sessions until they have reached a good-enough level at which point they discontinue treatment[195].

Clarifying the link between home practice and outcomes and the optimal dosage of practice in MBIs (which might differ across individuals and/or within individuals across time) are crucial scientific tasks for mindfulness researchers and ones that have direct implications for optimizing the accessibility and efficacy of MBIs. Moreover, some effects may only arise following longer-term and more intensive practice (for example following 9-months of training[196]).

Box 2. Effects of minimal and intensive practice

One unique feature of mindfulness meditation relative to traditional psychotherapies is flexibility in the intensity at which it is delivered. Mindfulness meditation can be delivered once for 10 minutes or 12-hours a day for decades. There are certainly examples of other very brief and low intensity psychological interventions (for example, single-session motivational interviewing[197]). However, mindfulness meditation appears particularly amenable to low-intensity delivery, such as through smartphone apps[118].

Long-term meditation practitioners and meditation retreats fall on the other end of the intensity continuum. Meditation retreats are distinct from MBIs in important ways. For example, meditation retreats meditation retreats often occur in religious contexts and are not designed to treat psychological symptoms. Nonetheless, meditation retreats represent an application of mindfulness that might illustrate how mindfulness techniques included in MBIs diverge from other psychotherapies. There is arguably no equivalent to the long-term meditation practitioner in CBT. This end of the intensity continuum highlights the unique origins and traditional goals of meditation (complete liberation from suffering[198]) relative to Western psychotherapies (reduced symptoms, improved functioning and quality of life[199]). MBIs' link to more intensive contemplative traditions is evident in the day of mindfulness, a 6- to 8-hour day of primarily silent meditation practice that is included as a core element of many standardized MBIs[21,22]. Incidentally, mindfulness-based stress reduction was inspired by a Buddhist meditation retreat[200].

Given the challenges of randomly assigning participants to more intensive meditation practice, less is known about the impact of longer-term practice. Existing data suggest that engaging in mindfulness and related meditation practices intensively can influence psychological[201], neural[202], behavioral[203], and physiological[204] indices. Meta-analyses of

controlled studies of meditation retreats (for example, 10-day Vipassana courses) suggest intensive practice reduces psychological distress[201]. Results from the *Shamatha Project*, one of the few randomized studies testing intensive practice (3-month retreat) indicate health-promoting and prosocial effects on objective measures of basic cognitive, affective, and interpersonal processes[203]. Importantly, intensive forms of practice might also bring elevated risk for adverse effects, such as social impairment and re-experiencing of traumatic memories[143], which must be addressed if intensive practice is to become widely accessible[140]. Lastly, studies of long-term meditation practitioners who have spent thousands of hours engaged in meditation practice, often in retreat settings, have documented a range of beneficial effects on neural measures of attention and emotion regulation[167,205,206]

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