

From Conceptualization to Operationalization of Mindfulness

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To study a phenomenon scientifically, it must be appropriately described and measured. How mindfulness is conceptualized and assessed has considerable importance for mindfulness science, and perhaps in part because of this, these two issues have been among the most contentious in the field. In recognition of the growing scientific and clinical interest in mindfulness, a number of textual scholars of mindfulness have in recent years made efforts to describe and explain the meaning of mindfulness within one or more Buddhist traditions (e.g., Bodhi, 2011; Dreyfus, 2011; Dunne, 2011; Gethin, 2011, Chapter 2, this volume). This chapter addresses the other key contentious feature of mindfulness science noted above, the *operationalization* of mindfulness. Herein we offer a critical analysis of mindfulness operationalizations, which predominantly take the form of subjective, or self-report methods. Mindfulness scales are used extensively in both basic and applied psychological research, and a number of questions about their use have arisen in recent years. We address several major questions in this chapter that centrally bear on the capacity of these measures to assess mindfulness validly.

Yet how a construct is operationalized, from the items and dimensions used to represent it, to the structure of the scale, is crucially dependent on how it is conceptualized. Therefore we begin with a brief discussion of classical scholarly and scientific conceptualizations of mindfulness, with particular attention to points of agreement and disagreement between mindfulness scholars and researchers. We then review published self-report measures of mindfulness, and some of the debates currently surrounding them. We follow by briefly discussing efforts to develop behavioral measures of mindfulness and close with

recommendations for further theoretical and empirical development in the assessment of mindfulness.

### Conceptualizing Mindfulness

*Classical Buddhist scholarly understandings.* Scholarship on mindfulness offers an important interpretative lens through which to understand mindfulness as presented in Buddhist source texts. Buddhist scholarship is, at its best, built upon a deep familiarity with such texts, the challenges stemming from their translations, and the difficulties inherent in changing word usage over the centuries (see Chapter 2, this volume). From the outset of this discussion, it is important to convey that there is no one meaning of mindfulness to be found in Buddhism, and no single authoritative account that trumps all others (Anālayo, 2013; Dreyfus, 2011); each definition of mindfulness is rooted in a particular scholastic and practice tradition and must be understood from within that context. Thus, we can speak of classical mindfulness, non-dual mindfulness, Zen mindfulness, and so on (Anālayo, 2013). As Dreyfus (2011) notes, “Buddhism is a plural tradition that has evolved over centuries to include a large variety of views about mindfulness” (p. 42).

Limitations of space and certainly, expertise, do not permit a discussion of all of these various understandings of mindfulness. For the present purposes we offer a brief look at several representative contemporary scholarly accounts of mindfulness as understood from classical Buddhist source texts (see Table 1, upper portion). By “classical” texts – also termed “canonical” – we refer to the Pali Canon, the oldest surviving, complete collection of Buddhist texts, which offer rich descriptions of mindfulness that informed subsequent interpretations and are still widely used today.

While by no means exhaustive, the scholarly accounts presented in Table 1 highlight conceptions of mindfulness as close, clear-minded attention to, or awareness of, what is perceived in the present. Noteworthy, however, are several key features of these canonical descriptions of mindfulness that are not easily conveyed in brief quotations. First, the scholarly accounts differ in referring to attention in some texts, and awareness in others. Differing usage of the terms ‘attention’ and ‘awareness’ may stem from the fact that outside of cognitive science, the terms are sometimes used interchangeably (e.g., Merikle & Joordens, 1997). Some scholars have used both to describe mindfulness (e.g., Bodhi, 2006a; 2011), and in fact, both terms may be applicable, for two reasons. First, there is a close interrelation between attention and awareness in daily life (e.g., Lamme, 2003); second, and more specifically, an integration of attention and meta-awareness helps to distinguish mindfulness from related states. For example, attention may be concentrated, but only when coupled with meta-awareness – an apprehension of the current state of the mind that serves to monitor that focused attentiveness – does it become mindful (Dreyfus, 2011).

A second key feature of the canonical accounts bears on the role of thought in the meaning and expression of mindfulness. The mindfulness research literature frequently highlights the non-conceptual nature of mindfulness, wherein a de-fusion or disidentification from discursive thought is typically considered key (e.g., Bishop et al., 2004). Yet canonical interpretations of mindfulness see an important role for thought. For example, Bodhi (2011) argues that as awareness becomes more lucid, comprehension of the nature and qualities of the phenomena observed also develops (e.g., an understanding of how anger arises in the mind). In this way, mindful awareness and comprehension of what is encountered are intertwined processes in practice, the combination of which leads to insight, or understanding of the mind

and behavior. Bodhi (2011) notes that clarity of awareness runs through all expressions of mindfulness, but can take on “varying layers of conceptual content ranging from ‘heavy’ to ‘light’ to ‘zero’” (p. 31). Dreyfus (2011) proposes that only the basic expression of mindfulness (which he termed “mindfulness proper”) concerns a sustained attention to perceptual objects, and it serves as a basis for the development of insight that a conjoining with comprehension provides. It is in this “wise mindfulness” that the potential of mindfulness to lessen suffering is realized.

A third central, and related, aspect of canonical mindfulness concerns the role of evaluation. This represents another point of difference from scientific and clinical conceptions of mindfulness wherein there is, as already noted, a dis-identification from thought, evaluative and otherwise. Evaluation here concerns discrimination, a reflective consideration of what is healthy and unhealthy, wise or unwise action, for example, that comes with the conjoining of sustained attentiveness and comprehension. Bodhi (2011, p. 26) makes this clear: “...the practitioner of mindfulness must at times evaluate mental qualities and intended deeds, make judgments about them, and engage in purposeful action.” In this way, canonical mindfulness is value-laden, bringing together capacities of attention and discerning thought to regulate mental states and behavior.

Thus mindfulness as understood in canonical commentaries is not antithetical to active cognitive operations. In a state of sustained, receptive attentiveness, evaluations and judgments, memories, and other cognitive operations can be closely attended to, and actively engaged, by a mind that is aware of what is happening moment to moment. As we will see, it is in the place of thought, and evaluative thought in particular, that represents a major difference between canonical and a number of science-based conceptualizations of mindfulness, a difference that is important to understanding the differing operationalizations of mindfulness.

*Scientific understandings.* Examples of definitions of mindfulness in the scientific literature span a wide range, several of which are presented in Table 1 (lower portion). An early definition of mindfulness that continues to influence how clinicians and researchers understand the construct is that of Kabat-Zinn, who describes mindfulness as intentional, non-judgmental attention (1994). Similarly, Bishop et al. (2004) proposed a two factor definition of mindfulness consisting of a self-regulation of attention to maintain focus on present experience, and a purposive, attitudinal orientation toward the present moment that includes, among other features, curiosity and acceptance. In contrast to these approaches, Brown and Ryan (e.g., 2003) focus on the deployment of attention that also characterizes the canonical descriptions of basic mindfulness outlined earlier. Brown and Ryan (2004) agree with the other science-based definitions here that non-judgment is part of mindfulness, but they argue that it is inherent in the receptive attention deployed, rather than being a separate attitude. This perspective is concordant with that of Anālayo (2003, p. 60) in describing mindfulness as “see[ing] things just as they are, unadulterated by habitual reactions and projections.” (see also Table 1).

Of particular relevance to both the conceptualization and operationalization of mindfulness is the “non-judgmental” or “acceptance” feature emphasized in most of these scientific definitions and in mindfulness research more broadly. This feature, generally framed as an attitude, represents a departure from canonical mindfulness. Bodhi (2006a; 2011), for example, has explicitly stated that what is commonly called “acceptance” is not part of mindfulness, as it does not distinguish between wholesome and unwholesome states of mind (see also Dreyfus, 2011). Dunne (2011) suggests that the non-evaluative, non-judgmental feature highlighted in the Kabat-Zinn and other definitions bears similarity to a non-dual conception of mindfulness that arose centuries after the original, canonical conception (see also Kabat-Zinn,

2011). Yet Dreyfus (2011) points out that while non-judgmental awareness is not an adequate theoretical description of canonical mindfulness, it can be useful as practical instruction in developing mindfulness, to enable a disengagement from habitual mental discursivity and reactivity that inhibits sustained attentiveness and the formation of mature discriminative judgments. Thus non-judgmentality represents a “skillful means” to enhance mindfulness rather than the thing itself. In this regard it bears noting that while Kabat-Zinn’s framing of mindfulness as nonjudgmental attention has had considerable impact on how researchers and clinicians understand the concept, his aim in defining it in this way was in fact to serve practical instruction rather than conceptual precision (Kabat-Zinn, 2011).

We believe there is considerable opportunity for further interchange between Buddhist scholarship and Western science in seeking shared understandings of mindfulness that are sensitive to differences amongst traditions and trainee populations (see Chapter 2, this volume). Western science may also foster new insights about how to conceptualize mindfulness (e.g., Chapters 3 and 5, this volume). For example, cognitive science research indicates that attention and conscious awareness can be decoupled (Koch & Tsuchiya, 2012; Watanabe et al., 2011), such that attention gates conscious awareness. This work suggests the possibility that both attention and awareness are needed for mindfulness to arise, and that attention is a necessary precondition for awareness. Interestingly, this is consistent with classical Buddhist theory, wherein attention toward one’s present moment experience fosters conscious awareness of phenomenal experience. Such research may help to reveal how mindfulness operates on a moment-to-moment basis, and how best to teach it.

#### Operationalizations of Mindfulness

Reflecting its varied conceptualizations, there have been numerous efforts to

operationalize mindfulness, and to date all have been informed by classical and/or science-based conceptions. Most measures of trait and state mindfulness take the form of self-report-based scales, although there is recent interest in behavioral measurement. Arguably, the use of mindfulness measures has contributed to our understanding of the construct and has shown how mindfulness itself – apart from the multi-component training programs designed to enhance it – is related to numerous outcomes at the neurobiological, subjective, and behavioral levels in a variety of normative and clinical populations.

Before discussing research findings employing the various mindfulness scales, it is important to briefly note the controversial issues surrounding their use. Questions concerning mindfulness scale use include the following: Do self-report-based instruments actually measure mindfulness? Can the same scales be used for both mindfulness-naïve and trained populations? Does the interpretation of scale items depend on first-person experience with mindfulness? Is it appropriate to trust the self-endorsement of mindfulness, or are responses inherently biased? Do we need self-report-based or other measures of mindfulness or is it sufficient to build a science based on measured outcomes of mindfulness training? There is insufficient space to address these questions in detail here, but recently published articles debate these and other mindfulness measurement issues (Brown, Ryan, Loverich, Biegel, & West, 2011; Goodman, Quaglia, & Brown, in press; Grossman, 2011). In the remainder of this chapter, we consider three central questions about the assessment of mindfulness: Do self-report scales measure mindfulness? Are these measures valid predictors of theoretically meaningful outcomes? How can mindfulness assessment be improved?

There are currently eight published self-report measures of trait or dispositional mindfulness for adults and two such scales for adolescents and children. Two additional scales

measure state mindfulness in adults. State mindfulness concerns the quality of mindful presence at a given moment, or within a narrow window of time (e.g., the past 5 minutes). Measures of trait or dispositional mindfulness typically concern the general, cross-situational frequency of mindful states over time. Individual differences in trait mindfulness are thought to stem from two sources. First, many scholars and researchers agree that training in mindfulness techniques can lead to higher levels of dispositional mindfulness. Second, individuals may vary naturally in this trait, perhaps due to genetic predisposition, socialization, attention-intensive training, or other factors. Most measures of trait mindfulness were developed with this *innateist* (Dunne, 2011; see also Dreyfus, 2011) view in mind. Two trait scales were developed for use among mindfulness trainees (the *Frieburg Mindfulness Inventory* [FMI; Walach, Buchheld, Büttenmüller, Kleinknecht, & Schmidt, 2006]; and the *Toronto Mindfulness Scale* [TMS; Lau, Bishop, & Segal, 2006]), thereby implicitly or explicitly taking a *constructivist* or training-dependent (Dunne, 2011) position on the development of the disposition. Yet several scales (e.g., *Five Facet Mindfulness Questionnaire* [FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006]); *Mindful Attention Awareness Scale* [MAAS; Brown & Ryan, 2003]) have demonstrated reliability and validity in both general (non-trainee) and mindfulness trainee populations, as well as sensitivity to scale score changes coinciding with mindfulness training. Table 2 presents these scales, their primary conceptual origins, factor structures and other psychometric properties, the populations in which each has been validated, evidence for the reliability and construct validity of each scale, and the types of outcomes to which each scale has been applied.

#### *Do self-report scales measure mindfulness?*

Whether the extant scales actually measure mindfulness is a question prompted by recognition of the complex, subtle nature of mindfulness, the diversity of operationalizations of

the construct, and the apparent similarity of some scales (and subscales) to other forms of attention. We address each issue in turn.

*Complexity of the construct.* Mindfulness is a quality of mind that can both spontaneously occur, and also be developed or enhanced through practices such as meditation. Thus expressions of mindfulness could be expected to show more subtleties among those with more training in mindfulness, just as our understanding of what it means to play a musical instrument, or perform any number of other skills, is subject to change according to level of experience.

Unquestionably the current mindfulness scales primarily tap rudimentary expressions of mindfulness, and this is by design, as all were developed with mindfulness naïve or novice trainee respondents in mind. Yet just as the basic, brief training offered by current mindfulness interventions has shown remarkable effects on brain function, subjective experience, and behavior, so too have scaled measures of mindfulness predicted a range of subjective and objective outcomes consistent with mindfulness theory, as evidence to be discussed later will suggest. Nonetheless, to date nuanced measurement of mindfulness has been neglected in efforts to establish the construct validity of the existing measures.

*Scale diversity.* How should one best think about so many operationalizations of mindfulness? It has been argued that the diversity of scales, particularly the differing factor structures, reflects poor consensus about what mindfulness is, and without such consensus, these scales cannot be said to adequately assess the phenomenon (Grossman, 2011). We suggest, alternatively, that there are valid reasons for a diversity of measures, and researchers can make effective use of this diversity to address different research objectives. Mindfulness scale differences, particularly the differing factor structures, likely stem from at least two sources, namely: a) the explicit or implicit conceptual position driving the definition and

operationalization, and b) the intended uses of the scale.

Regarding the former, most extant scales were derived with one or more of three sources in mind: Buddhist scholarship, Buddhist popular writings, and clinical approaches (see Table 2). We regard a clinical source for definition and operationalization as one that applies mindfulness to clinical issues, but it is important to note that some clinical approaches (e.g., Kabat-Zinn, 1990; Linehan, 1993) have drawn upon Buddhist and other contemplative sources. Calling a theoretical source “clinical” is in recognition that clinical applications, because they are oriented toward the goals of fostering adjustment and well-being, can involve particular, even unique, ways of conceptualizing mindfulness (see also Chiesa & Malinowski, 2011; Dreyfus, 2011). As examples of each source, the *Kentucky Inventory of Mindfulness Skills* (KIMS; Baer, Smith, & Allen, 2004) and its structurally similar descendant, the FFMQ, were developed from the Dialectical Behavior Therapy model of “mindfulness skills” (Linehan, 1993), cultivated through a variety of short exercises originally designed for individuals with Borderline Personality Disorder. These exercises particularly focus on the elements of observing, describing, acting with awareness, non-judgment of inner experience, and non-reactivity to emotional events, all of which are important tools in self-regulation specifically targeted within DBT, and thus their utility as outcomes measures. The *Philadelphia Mindfulness Scale* (PHLMS; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008) was derived from Kabat-Zinn’s model of mindfulness as nonjudgmental attention, which links this measurement approach with an emphasis on stress reduction, while the FMI and MAAS were developed primarily on the basis of canonical, and specifically Theravadin Buddhist, scholarship and popular writings, as well as clinical writings on mindfulness and its practice.

Despite the wide variance in sources and aims, all of the scales shown in Table 2 either

focus on quality of attention and awareness as the central feature (e.g., MAAS) or include it among a set of factors (e.g., FFMQ Act with Awareness). Beyond this factor, the scales differ widely in their inclusion of other factors (e.g., acceptance, nonjudgment). Thus, diversity of operationalizations primarily reflects conceptual divergences concerning what processes, aside from attention and awareness, are part of mindfulness and thus must be included in its measurement. These conceptual differences have manifold implications for the ways in which mindfulness, its development, its antecedents, and its consequences are understood. For example, aside from the conceptual issue raised by the canonical perspective on mindfulness noted earlier, the acceptance or non-judgment factor included in several scales is also considered a form of emotion regulation (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010) and a coping strategy (Carver, Scheier, & Weintraub, 1989), making operational overlap between these constructs a key concern. Also, measures of mindfulness skills may be conflated with those outcomes of practicing mindfulness that reflect the development of introspective skill (e.g., the ability to describe internal events).

Differences between scales may also be attributed to their intended uses, particularly regarding the focal population. Some scales, such as the MAAS, which has state and trait versions, were developed for use in the general population to assess naturally occurring variations in mindfulness both between individuals and within persons as a function of current context or training. In contrast, the FMI and the state TMS were developed to measure mindfulness within mindfulness meditation training contexts. Similarly, the FFMQ was validated as a four-factor version for the general population and a five-factor version for practitioners (that includes the *Observe* factor), though the latter version is commonly used in both populations (but from a psychometric validation perspective, inappropriately so). Differences between scales

according to target population are reasonable given that mindfulness may be understood differently by those with or without experience in it. Knowing the populations for which each scale has been designed and validated (see Table 2) will better inform choices about which scale(s) to use for any given research situation.

In sum, understanding that different scales stem from differences in their conceptual starting points, intended applications, and target populations can inform choices about which to use in research. As we have reviewed, conceptions of mindfulness vary both between and within Buddhist and Western psychological traditions. Whereas all share a common focus on quality of attention to, or awareness of ongoing experience, they diverge in whether attitudinal and other features are part of the construct. Many of the measures were designed for particular populations and with particular aims in mind, such as assessing the lived day-to-day experience of mindfulness, or measuring mindfulness practice skills. In the face of the differences in conception and intended use, researchers would do well to carefully consider scale choices and specify the guiding theory and intended use when describing the chosen measure in their research reports. Further, empirical research is needed to show whether some mindfulness scale factors are better understood as representing other constructs, such as emotion regulation (e.g., Coffey, Hartman, & Fredrickson, 2010). Such research would not only clarify the nature of the selected measure but also foster clearer interpretation of research findings.

*Dissociability from other attention constructs.* A second key issue in whether the extant self-report scales measure mindfulness concerns their discriminability from measures of other attention-related constructs. For example, attentional control measures, commonly understood as tapping the capacity to deliberately select and focus on a particular object over others have, like mindfulness, been associated with adaptive outcomes, such as lower attentional bias to

threatening information among trait anxiety populations (Derryberry & Reed, 2002).

Attentional control and mindfulness appear to be overlapping constructs. Both capacities involve an increased stability, or continuity of attention toward a focal object, and both may be trainable. Evidence also supports their relation (e.g., Brown, Goodman, & Inzlicht, 2013; Mrazek, Smallwood, & Schooler, 2012). Despite this similarity, there is theoretical divergence between the two constructs. In particular, mindfulness is distinct in its interrelation with meta-awareness and its receptivity to ongoing phenomena (see Goodman et al., in press for further discussion). If measures of mindfulness are dissociable from those of attentional control, the former should also predict theoretically relevant outcomes over and above the latter. Emerging evidence supports such incremental validity. For example, Brown et al. (2013) found that both the MAAS and FFMQ Act with Awareness measures, but not a measure of attentional control, predicted reduced amplitudes of the late positive potential (LPP) – an electrocortical indicator of emotional reactivity – in response to unpleasant, high arousal images. Quaglia, Goodman, and Brown (2013) also found that whereas the MAAS predicted electrocortical markers of attention to socioemotional stimuli (the N100, N170, Go and No-Go N200), attentional control did not.

Grossman (2011) has argued that some mindfulness measures are merely capturing “experienced lapses of attention” (p. 1038). This charge has relied, to a considerable degree, on face validity - the superficial appearance, or face value - of scale items as reflections of a construct. Because it relies on subjective judgment, face validity is typically not a scientific criterion for judging the value of a measure (e.g., Gravetter & Forzano, 2009). Scale items may bear no obvious relation to the construct of interest (Walsh & Betz, 2001), and as with some mindfulness scales (e.g., FFMQ, KIMS, MAAS), indirect assessment is sometimes necessary when self-knowledge or social desirability is a concern (Gravetter & Forzano, 2009; Walsh &

Betz, 2001). Further, the construct validity evidence reviewed here shows that measures of mindfulness and a key form of attention (attentional control) are dissociable and only the former have predicted outcomes consistent with mindfulness theory. In sum, the meaning of a construct lies not in item content per se but in the entire body of theoretical and empirical relations with other constructs. Said differently, the meaning of the measure *is* its construct validity.

Yet during this still early stage of research on dispositional mindfulness, self-report measures of the construct should continue to be subjected to rigorous empirical scrutiny. Studies that use self-report measures of mindfulness should incorporate additional measures of attention that share variance with mindfulness to assess their relations and incremental validity. Aside from addressing validity concerns, such research will enhance our understanding of how mindfulness fits into the nomological network of other, established indexes of attention (e.g., Posner & Rothbart, 2007).

*Are self-report measures valid predictors of theoretically meaningful outcomes?*

Whether mindfulness scales predict theoretically expected outcomes is a key issue concerning both their construct validity and their research and clinical value. As indicated in the rightmost columns of Table 2, research has examined whether trait and, to a lesser extent, state mindfulness are associated with, or predict a variety of outcomes, ranging from those in cognitive, affective, and mental/physical health domains. Whether individual differences in mindfulness show relations to such important outcomes can inform about the value of more frequent mindful states. We have previously reviewed much of this literature (see Brown, et al., 2007; Goodman et al., in press), but in brief, several self-report measures of mindfulness are related to a broad range of objective behavioral and neurophysiological outcomes in theoretically expected directions. For example, in the cognitive domain, scores on the CAMS-R and MAAS

were negatively correlated with target omissions on the Continuous Performance Test II, indicating fewer attention lapses during this focused task among more mindful individuals (Schmertz, Anderson, & Robins, 2009). Similarly, Mrazek, et al. (2012) found that higher MAAS scores negatively related to the number of errors on the Sustained Attention to Response Task (SART), a task that is also used to index mind wandering. Finally, Moore & Malinowski (2009) found that global KIMS scores were positively correlated with sustained attention on the d2-Concentration and Endurance Test.

In the affective domain, multiple fMRI studies have demonstrated that mindfulness scale scores predict meaningful differences in neural activation soon after encountering emotionally salient stimuli. Amygdala activation appears to index emotional appraisal (Oschner & Gross, 2005; Damasio, 1994; Davidson, 2000), and MAAS scores have predicted greater activity in prefrontal cortical regions and decreased activity in the amygdala during emotion regulation tasks (Creswell et al., 2007; Modinos et al., 2010; cf. Frewen et al., 2010). Interestingly, Way et al. (2010) found that MAAS scores predicted lower bilateral amygdala activation at rest, suggesting lower susceptibility to threat-based appraisals. Consistent with these findings, Taren, Creswell, and Gianaros (2013) found a relation between MAAS-assessed trait mindfulness and decreased gray matter amygdala volume in a large sample of community adults, providing evidence of a neurobiological pathway that may help explain how mindful attention alters stress and emotional responding. Mindfulness scale scores show a similar pattern of effects with ecological indicators of emotion regulation. Brown (2011) found that MAAS scores predicted less emotional lability on a day-to-day basis using experience sampling, part of a family of ecological momentary assessment (EMA) methods that track participants' real-world subjective experience and behavior. Another EMA study found that the *non-reactivity* subscale of the

FFMQ predicted more subtle differentiation between types of positive and negative emotion, reflected in smaller correlations between ratings of similar emotions, as well as less emotional lability of both positive and negative emotion (Hill & Updegraff, 2012). Mindfulness scale associations have also been found in studies of adaptive behavior regulation in such domains as gambling (Lakey et al., 2007), drinking (Garland, 2011), and smoking (Black et al., 2011).

In the health domain, mindfulness scales have been associated with biological markers of stress and physical health. MAAS-measured mindfulness has been found in two studies to be associated with reduced psychological and biological (cortisol) stress reactivity to acute physical and social stressors (Arch & Craske, 2010; Brown, Weinstein, & Creswell, 2012). Mindfulness scales have also been associated with reduced physical symptoms and physician visits (Brown & Ryan, 2003).

This brief overview of some key findings, along with findings organized by domain in Table 2, indicate that several mindfulness measures, particularly the MAAS and KIMS/FFMQ Act with Awareness scales, are related to, or predict cognitive, emotional, behavior regulatory, and physical health-relevant physiological outcomes in ways consistent with theoretical conceptions of mindfulness. The findings are also broadly consistent with those revealed by studies of mindfulness training (Goodman et al., in press), suggesting that the scale measures are tapping psychological phenomena fostered through such training.

#### *How can mindfulness assessment be improved?*

Despite the variety of scale operationalizations, several extant self-report scales have shown strong construct validity, including the ability to predict outcomes consistent both with mindfulness theory and with research based on experimental inductions of mindfulness and mindfulness training (see also Chapter 12, this volume). Further validation in both lay and

trainee populations may extend the utility of these scales. Yet, the question remains whether participants can accurately report their levels of mindfulness. Although we described a number of theoretically consistent outcomes predicted by self-report scales, more objective measures of mindfulness may provide more precision. Initial steps have been taken to develop behavioral, 2<sup>nd</sup> person, and ecological/ambulatory measures of mindfulness, as we outline next.

*Behavioral measures of mindfulness.* The inherently subjective nature of mindfulness makes it unlikely that the construct could, even in principle, be reduced to behavioral assessment alone, but such measures could provide corroboration of mindful states or traits at a level of analysis not subject to the response biases that can creep into self-reports of behavior. Furthest along this line of investigation are behavioral measures of mind wandering, which have been conceptualized as occurrences of task-unrelated thoughts (Smallwood & Schooler, 2006). Mind wandering has been considered antithetical to mindfulness in some accounts (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Davidson, 2010), and as already noted, recent research shows a convergence of mind wandering measures/tasks and self-reported mindfulness (Burg & Michalak, 2011; Mrazek et al., 2012). But definitions of mindfulness (see, for example, Table 1) suggest that it is more than an absence of mind-wandering; so assessing mindfulness behaviorally will require more than measures of mind-wandering.

Naturally-occurring, observable behaviors may also inform about level of state mindfulness. For example, though not yet tested for predictive validity, a measure of introspective accuracy of tactile sensitivity may help to index mindfulness. Fox, Zakarauskas, Dixon, Ellamil, Thompson, & Christoff (2012) showed that expert meditators' subjective reports of tactile sensitivity during a body scan better matched objective measures than did the reports of novice meditators. These behavioral measures provide a promising avenue for further research.

*Second-person structured interviews.* Mindfulness teachers and other experts on the subjective and objective markers of mindfulness may also provide assessments of individuals' level of mindfulness through targeted probing of subjective experience and observation of behavior. Qualitative interview techniques may be used to assess the training-related development of mindfulness (Garland & Gaylord, 2009), as well as to explore mechanisms of change in mindfulness interventions (Mackenzie, Carlson, Munoz, & Speca, 2007; Williams, McManus, Muse, & Williams, 2011). Investigators have recently begun to develop expert interview schedules to assess mindfulness in trainees (e.g., Stelter, 2010). Potential risks of this interview approach include self-presentation and other response biases, but the approach has a long history and holds promise for assessing trait and state mindfulness, as well as the developmental processes that may unfold through mindfulness training.

*Ecological momentary assessment.* EMA seeks to capture experience and behavior as it happens in day-to-day life, typically through the use of records made on mobile electronic devices (e.g., cell phones). The recording of cognitive processes during mindfulness practice sessions and during normative daily activities may provide a useful index of mindful states (Garland & Gaylord, 2009) which, when examined over time, could inform about dispositions toward mindfulness (e.g., Brown & Ryan, 2003). Unlike single-occasion self-report measures, EMA does not require significant retrospection that may be tainted by memory biases, and it permits the study of how mindful states are related to behaviors of interest occurring in real-world contexts (Hill & Updegraff, 2012; Levesque & Brown, 2007). EMA recording is time, labor, and potentially cost intensive, however, suggesting that its current utility as a measure of mindfulness will be to supplement more efficient means.

## Conclusions

Research on the conceptualization and operationalization of mindfulness has been provocative, generating debates concerning the meaning, assessment, development, and training of this quality. In this chapter we have attempted to show that in the midst of these valuable debates, efforts to define and measure basic forms of mindfulness as a trait and state have contributed to a developing theory and to a growing, multi-faceted body of empirical findings on mindfulness. Such investigation of subjective states has also opened topics to inquiry not easily permissible by other means, and is increasingly being done in conjunction with neurophysiological and behavioral methods to better inform about the underpinnings, processes, and outcomes of mindfulness.

Much work is needed to better understand the nature and expression of mindfulness, as suggested in our review. Research should further examine the close relations between mindfulness and well-researched cognitive functions, including neurally mediated systems of attention (Posner & Petersen, 1990), and working memory. Work is also clearly needed on mindfulness assessment. In the present review of mindfulness scales, few have been shown to predict objective outcomes. At this time it is unclear whether the majority of scales lack predictive validity for such outcomes or simply have yet to be used in such research. More broadly, rigorous assessment research undertaken in intimate dialogue with scholarly conceptualization efforts will do much to enhance research using self-report, behavioral, or other means of tapping traits and states of mindfulness. These iterations between theory, measurement, and observation will help to expand and better integrate our scientific knowledge of mindfulness; more broadly such research can also contribute to applying that science to its most beneficial ends.

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Table 1. *Selected definitions of basic mindfulness in contemporary scholarship on classical Buddhism and in the scientific literature*

Source	Definition
<i>Canonical Buddhist scholarly sources</i>	
Anālayo (2003, p. 60)	“...an alert but receptive equanimous observation.”
Bodhi (2011, p. 21)	“...watchfulness, the lucid awareness of each event that presents itself on the successive occasions of experience.”
Dreyfus (2011, p. 47)	“The mind’s ability to keep the object in the ken [focus] of attention without losing it.”
Gethin (Chapter 2, this volume, p. 29)	“A kind of lucid holding of attention on an object, where the mind is both aware of the object and, in some sense, aware that it is aware of the object.”
<i>Scientific sources</i>	
Kabat-Zinn (1994, p. 4)	“Paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally.”
Bishop et al. (2004, p. 232)	“[A] kind of nonlaborative, nonjudgmental, present-centered awareness in which each thought, feeling, or sensation that arises in the attentional field is acknowledged and accepted as it is.”
Brown & Ryan (2004, p. 245)	“Open or receptive attention to and awareness of ongoing events and experience.”