


# Embodied Mindfulness

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**Abstract** In this paper, we review different definitions and operationalization of mindfulness according to both Buddhist tradition and western conceptualizations, namely mindfulness as defined in modern mindfulness-meditation programs and Langerian mindfulness. Additionally, we compare and contrast these different approaches and propose a common link between them through the theory of embodiment. Using evidence from neurobiology, we explicate the concept of embodied mindfulness and argue for its utility in the empirical study of mindfulness and its mechanisms of change. To conclude, we briefly discuss the implications of embodied mindfulness on research and clinical interventions.

**Keywords** Mindfulness · Meditation · Buddhism  
Top-down · Bottom-up · Embodiment

## Introduction

The total publication counts for mindfulness research increase each year. According to Google Scholar (2017), the term “mindfulness” was found approximately 438 times in contributions between 1970 and 1980, while the same search yielded 38,000 results between 2000 and 2010, and 74,600 between 2010 and 2016. As one can see, the interest in mindfulness as a concept continues to grow. This increase is also a reflection of the fact that the term mindfulness is currently used as an umbrella for a variety of approaches that assign different meanings to the same word.

Based on current literature, mindfulness can be distinguished by at least two broad conceptualizations: The first being a traditional Buddhist approach and the second being a contemporary western approach. Both of these conceptualizations contain varying definitions of mindfulness that vary across scholars (see Table 1 for a list). Although differences among varying conceptualizations and definitions of mindfulness have been previously highlighted (e.g., Hart et al. 2013), few efforts have attempted to compare these varying streams of thought as a means to address commonalities between them. To address this current gap, we examine the theory of embodiment as a common denominator among these varying conceptualizations of mindfulness.

In recent years, embodiment theory has become a major conceptual framework for understanding the mind (Niedenthal et al. 2005). Embodiment theory considers cognitive processes as grounded in the organism’s sensory and motor experiences, such that bodily experiences have a direct effect on the mind (Barsalou 2007). Based on embodiment theory, Thompson and Varela (2001) suggested that consciousness cuts across the brain and body rather than being the summation of brain-bound neural events. From another side, mindfulness as a concept suggests an emphasis on the

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**Table 1** Mindfulness definitions according to different conceptualizations

Conceptualization	Author(s)	Definition
Buddhist	Anālayo (2003) (p. 46–47)	Recollection of the Buddha, of the Dhamma, of the Sangha, of one's ethical conduct, of one's liberality, and of heavenly beings (devas)
	Bodhi (2011) (p. 25)	Memory and lucid awareness of present happenings
	Dalai Lama and Berzin (1997) (p. 57)	State of mind and alertness that brings its focus back to the "here-and-now" if it becomes stale
	Kang and Whittingham (2010) (p. 170)	Mindfulness is non-reactive, non-elaborative, and non-reified awareness that has meta-cognitive functions, monitoring ongoing awareness and discriminating wisely between aspects of awareness content so that awareness and behavior can be directed according to the goals of genuine happiness, virtue, and truth.
	Nyanaponika Thera (1983) (p. 32)	Mindfulness as a bare attention: "the clear and single-minded awareness of what actually happens to us and in us at the successive moments of perception"
	Rapgay and Bystrisky (2009) (p. 151)	Mindfulness is an active, engaged, and not a detached, non-reactive process.
	Stanley (2013) (p. 65)	Embodied and ethically sensitive practice of present moment recollection
	Tanay and Bernstein (2013) (p. 1287)	Mindfulness as a mental state, including awareness, perceptual sensitivity to stimuli, deliberate attention to the present moment, intimacy or closeness to one's subjective experience, and curiosity
Western mindfulness-meditation	Baer (2003) (p. 125)	Mindfulness involves intentionally bringing one's attention to the internal and external experiences occurring in the present moment.
	Bishop et al. (2004) (p. 234)	Mindfulness is a process of regulating attention in order to bring a quality of non-elaborative awareness to current experience and a quality of relating to one's experience within an orientation of curiosity, experiential openness, and acceptance.
	Brown et al. (2007) (p. 212)	A receptive attention to and awareness of present moment events and experience
	Epstein (1995) (p. 96)	Bare-attention in which moment-to-moment awareness of changing objects of attention is cultivated.
	Kabat-Zinn (1994) (p. 4)	Paying attention in a particular way: on purpose, in the present moment, and non-judgmentally.
	Kabat-Zinn (2003) (p. 145)	The awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment
	Marlatt and Kristeller (1999) (p. 68)	Bringing one's complete awareness to the present experience on a moment-to-moment basis
	Siegel (2012) (p. AI-51)	Awareness of present-moment experience, with intention and purpose, without grasping on to judgments
Langerian (sociocognitive)	Williams and Kabat-Zinn (2011) (p. 15)	Mindfulness as "awareness itself," a form of "innate capacity" that is "virtually transparent"
	Langer (1989) (p. 62)	Mindfulness as the creation of new categories, openness to new information, and awareness of more than one perspective

mind over the body and this is in fact reflected in many definitions of mindfulness and has been mentioned by some

authors (e.g., Caldwell 2014). In this paper, we aim to ground the concept of mindfulness in bodily experiences using the

theory of embodiment as a common framework. To begin, we will present three principal conceptualizations and operationalization of mindfulness. Next, we will investigate the role of the body, and the body–mind connection, on these varying definitions of mindfulness. Finally, to conclude, we will propose a concept of “embodied mindfulness” as an underlying process of change among them all.

### Buddhist Conceptualizations of Mindfulness

Even though Buddhism incorporates different schools of thought (e.g., Theravada, Mahayana, and Vajrayana), all of these traditions share the common concept of mindfulness (Shonin et al. 2014). Taking into account the inherent difficulty in attempting to summarize the large diversity of meanings subsumed under the label of mindfulness, the reader is directed to other papers specifically focused on this topic (e.g., Dunne 2011, 2015). For the purposes of this paper, we will primarily focus on the conceptualizations of mindfulness outlined within Theravada Buddhism. Within Theravada, the word mindfulness, which is a translation of the *Pali* word *sati*, is frequently associated with two different meanings.

The first meaning is “to remember” and is thus related to memory (Bodhi 2011). According to this view, the practice of mindfulness enhances memory, which in turn increases one’s ability to remember past experiences as a way to facilitate a greater awareness and sense of purpose (Anālayo 2003).

The second meaning of Theravada Buddhist mindfulness refers to the development of a lucid awareness of what is occurring within the phenomenological field (Bodhi 2011) or, in other words, to an understanding of what is occurring in the present moment (Brown et al. 2007). This second definition, which forms the main basis of modern conceptualizations of Buddhist mindfulness, can be found in many Buddhist teachings. In these teachings, Buddhist mindfulness is described as a mental factor that, along with seven other factors, constitute the “noble eightfold path,” which is rooted in ethical conduct and aimed at freeing individuals from suffering (Kang and Whittingham 2010). In accordance with this view, Buddhist mindfulness involves an observance of emotional and cognitive processes to ensure that the mind does not wander or become consumed by the future or the past (Dalai Lama and Berzin 1997). A recent definition of Buddhist mindfulness includes the notion of embodiment as an interaction between the mind, body, and external world (Stanley 2013). This definition is aligned with the thesis of this paper. A list of definitions according to the Buddhist conceptualization is available in Table 1. Note that there is substantial debate on the nature of Buddhist mindfulness and how it should be taught within different traditions (e.g., Rappagay and Bystrisky 2009). For differences in the conceptualization of mindfulness

across different Buddhist schools, see Dunne (2011, 2015), for instance.

### Buddhist Operationalization of Mindfulness

Despite variations in defining mindfulness among different schools of Buddhism, most of these traditions operationalize mindfulness through an engagement in intensive and daily meditative practice (Shonin et al. 2014). Meditation includes both concentrative (i.e., a focus on specific internal or external stimuli) and insight techniques, that is, open-monitoring (Lutz et al. 2008). In addition, all Buddhist schools emphasize the importance of maintaining meditative awareness beyond formal meditation practices. In fact, most advanced meditators should, in essence, be aiming to practice “non-meditation” in which no distinction is made between meditation and post-meditation periods (Dudjom 2005). Buddhist mindfulness therefore plays a vital role in the integration of meditative awareness into everyday life. The notion of meditative awareness generally refers to a complete awareness of processes relating to the body, feelings, mind, and external phenomena, as well as their mutual interactions (Nyanaponika Thera 1983). In all Buddhist traditions, meditative practice is also rooted in ethical discipline (also referred to as ethical awareness) and more conduct-related principles such as generosity, patience, loving-kindness, and compassion (Shonin et al. 2014).

Within Buddhism, mindfulness is generally practiced for the primary purpose of long-term spiritual development and the reduction of suffering resulting from attachment and grasping, rather than psychosomatic symptom relief (Shonin et al. 2013). According to the Buddhist view, mindfulness should be taught as part of several complementary perspectives (Shonin et al. 2014). Such perspectives include the concepts of “non-self,” “non-attachment,” “impermanence,” and “inter-connectedness.” The term non-self refers to the realization that the self has no intrinsic existence (Dalai Lama 2005). Non-attachment can be defined as the liberation from excessive craving or clinging that is favored by a vision of all objects and living beings as void of any lasting self and by the impermanent nature of all phenomena. Impermanence refers to the notion that all phenomena are transient occurrences and are subject to decay and dissolution (Sogyal Rinpoche 1998). Finally, the term inter-connectedness is used in Buddhism to refer to the inter-being nature of all phenomena (Nhat Hanh 1992).

Mindfulness, as conceptualized in Buddhism, was not tested in empirical studies, even though some western-based interventions implemented some ethical and spiritual elements of Buddhist mindfulness (e.g., in Avants et al. 2005; Rappagay and Bystrisky 2009). Specifically, intensive combinations of meditative training (e.g., concentrative, open monitoring,

loving-kindness, and compassion-focused) during Buddhist teaching retreats have been shown to have positive outcomes in terms of physical and mental health in recent randomized controlled trials (Khoury et al. 2017). However, more research implementing and validating Buddhist conceptualizations of mindfulness are needed before definite conclusions can be drawn in regards to their effectiveness.

## Western Conceptualizations of Mindfulness

Among western conceptualizations of mindfulness, two approaches are particularly prominent, especially that of Jon Kabat-Zinn and his associates and Ellen Langer and her colleagues.

### Conceptualizations of Mindfulness According to Western Mindfulness-Meditation

Drawing from Buddhist traditions, Kabat-Zinn initially defined western mindfulness-meditation as “paying attention in a particular way: on purpose, in the present moment, and non-judgmentally” (1994, p. 4). This early definition became one of the most frequently used in scientific literature to describe the phenomenon of western mindfulness-meditation. Kabat-Zinn’s definition was also reiterated by many scholars, each of whom focused on specific components or adding new ones, for example, attention, awareness, intention, attitude, acceptance, non-judgment (Baer 2003; Bishop et al. 2004; Brown and Ryan 2003; Epstein 1995, p. 96; Kabat-Zinn 2003, p. 145; Marlatt and Kristeller 1999, p. 68; Shapiro et al. 2006); for detailed definitions, refer to Table 1. Although these definitions of mindfulness differ to some extent, a common underlying mechanism is the direction of attention to present moment experience. In fact, “directing attention” is mentioned explicitly in half of all definitions of mindfulness (Table 1) including seven among the nine definitions provided by western mindfulness-meditation. Furthermore, the majority of other definitions of mindfulness imply self-regulation of attention even though not explicitly mentioned. This suggests a central role for self-regulation of attention in defining and operationalizing mindfulness.

More recently, Williams and Kabat-Zinn have referred to western mindfulness-meditation as “awareness itself,” a form of “innate capacity” that is “virtually transparent” (Williams and Kabat-Zinn 2011, p. 15). With this re-definition, the authors are attempting to reconnect their definition of western mindfulness-meditation to its original Buddhist roots in which meditation practice ultimately aims at experiencing a self-transcending “pure and lucid awareness.” The concept of “awareness” is particularly notable within the Tibetan tradition. In this tradition, awareness aims at directly perceiving the fleeting nature of the self as an ever-changing flow of

psychophysical phenomena, void of any lasting identity (Nydahl 2012). The concept of awareness is also highly emphasized in working definitions of mindfulness. In fact, in Table 1, 12 out of the 18 listed definitions explicitly refer to awareness as part of their conceptualization. The use of awareness is equally present in all the approaches (i.e., Buddhist, western mindfulness-meditation, and Langerian). Similar to attention, awareness can be directed to internal cues (e.g., bodily sensations) as in meditative practices or to external cues (e.g., current context or novelty) as in Langerian mindfulness.

### Operationalization of Mindfulness According to Western Mindfulness-Meditation

Kabat-Zinn implemented western mindfulness-meditation through the development of a secular psychosomatic intervention called *Stress-Reduction and Relaxation Program* or SRP (Kabat-Zinn 1982, 1991) with the aim to reduce stress among patients suffering from medical conditions (Kabat-Zinn 1982; Kabat-Zinn et al. 1986; Kabat-Zinn et al. 1985). Later on, SRP was renamed as *Mindfulness-Based Stress Reduction* or MBSR. The MBSR protocol includes both practices from Buddhism, such as breathing, sitting, walking, eating meditation, body scanning, and gentle stretching (i.e., yoga), and western psychological approaches, such as psychoeducation, group discussions, and individual support. Body-oriented practices (e.g., body scanning, mindful eating and walking, and yoga stretching) are quite substantive and are used throughout the eight-session program. Home exercises include intensive meditative/bodily practices (average of 45 min daily) and listening to audio instructions and working with Kabat-Zinn’s popular book, *Full Catastrophe Living* (Kabat-Zinn 1991). Most MBSR interventions include intensive mindfulness-meditation retreats at varying lengths (from three to seven hours).

MBSR programs have become very popular and many studies have been conducted using Kabat-Zinn’s original or modified protocol (Grossman et al. 2004). Other western mindfulness-meditation-based protocols also follow loosely MBSR. These include the following: *Mindfulness-Based Cognitive Therapy* (MBCT; Segal et al. 2013), which combines cognitive therapy principles with mindfulness-meditation in an attempt to prevent relapse of major depressive episodes; *Mindfulness-Based Relapse Prevention* (MBRP; Bowen et al. 2009), which targets alcohol and other substance abuse relapse prevention; and *Mindfulness-Based Eating Awareness Training* (MB-EAT; Kristeller and Hallett 1999; Kristeller et al. 2013) for binge eating and eating regulation in non-bingers. The MB-EAT program incorporates traditional western mindfulness-meditation techniques, as well as guided meditation practices to address eating-related self-regulatory deficits including emotional versus physical hunger triggers, gastric and sensory-

specific satiety, food choice, and emotional regulation pertinent to self-concept and stress management. MB-EAT is another example of the central role of body awareness in the implementation of western mindfulness-meditation protocols.

Despite considerable variation among these mindfulness-based protocols, multiple systematic reviews and meta-analyses have found positive effects in both physical and psychophysiological outcomes among clinical and non-clinical populations (Chiesa and Serretti 2010, 2011; Khoury et al. 2013a, b; Khoury et al. 2015). A recent overview of 20 systematic reviews and meta-analyses of randomized controlled trials using standardized MBSR or MBCT programs found significant improvements in symptoms of depression, anxiety, and stress compared to wait list and treatment as usual controls (Gotink et al. 2015). While the mechanisms of action of these modern meditation-based treatments are not yet fully understood, many authors point towards the key role of attention and emotional regulation in their effectiveness (e.g., Chiesa et al. 2013; Hofmann et al. 2012; Hölzel et al. 2011). A recent mediation analysis of 20 studies found strong, consistent evidence for reduced cognitive and emotional reactivity, moderate and consistent evidence for reduced rumination and worry, and preliminary but insufficient evidence for increased self-compassion and psychological flexibility (Gu et al. 2015).

### Conceptualization of Mindfulness According to Ellen Langer

Social psychologist, Ellen Langer, introduced the concept of mindfulness as a sociocognitive ability (Langer et al. 1978). She defines mindfulness in opposition to “mindlessness,” which she describes as a default style of cognitive functioning in which individuals process cues from the environment in a relatively automatic but inflexible manner, without reference to the novel aspects or contexts of these cues (Langer and Piper 1987). Her concept of mindfulness is viewed as very different from Buddhist conceptualizations. In fact, Langer (1989, 1997) defines mindfulness as being open to novelty, sensitive to context and perspective, creating new categories, challenging assumptions, predefined categories, getting involved, and taking responsibility (a definition by Langer is listed in Table 1). By default, familiar categories and previously made distinctions are uncritically relied on, leading to rigid, inflexible behavior that is rule-governed rather than rule-guided. Langer and Imber (1979) found that mindlessness persists in the face of new information, even when it is advantageous to change one’s current perception.

Contrary to mindlessness, Langer describes mindfulness as a general style or mode of functioning through which individuals actively reconstruct their environment by creating new categories or distinctions and seeking multiple perspectives (Langer 1989, 1997). According to Langer, mindfulness yields an increased sensitivity to one’s environment and its changing nature, as well

as an openness to new information. Thus, Langerian mindfulness includes an ability to integrate previous knowledge into current context and an awareness that any problem-solving process can have multiple perspectives.

The process of noticing, or creating novelty, requires acceptance and the integration of uncertainty. According to Langer (2011), when we are certain regarding our knowledge, we tend to process the information automatically (i.e., mindlessly) without questioning it or its relevance to the current context. Alternatively, by accepting and integrating uncertainty, we become more aware of novelty and distinctions, and we are thus more mindful in processing incoming information.

### Operationalization of Mindfulness According to Ellen Langer’s Approach

Langer’s concept of mindfulness includes openness to novelty, flexible thinking, and cognitive reframing (Pagnini and Philips 2015). So far, most empirical studies on Langerian mindfulness have operationalized it by exclusively using selected components from her theory, for example, noticing distinctions, multiple perspectives, or producing novelty (Alexander et al. 1989). These techniques, even though unconventional and different from one study to another, were successful in inducing a state of Langerian mindfulness. Langer (2012) suggested that mindfulness is easy to learn (e.g., through paying attention to novelty and adopting an open, curious, and flexible mindset), which makes it appealing to those unwilling to meditate. According to Langer, mindfulness can be increased by just paying attention to novelty and trying to be flexible in one’s evaluations and perceptions, while questioning previous points of view that have been taken for granted.

Controlled studies that induced Langerian mindfulness have shown positive acute effects on learning (Langer et al. 1989), creativity (Grant et al. 2004), performance (Langer et al. 2009), problem solving (Ostafin and Kassman 2012), attention, and cognitive flexibility (Levy et al. 2001). Longitudinal studies suggested long-term effects of Langerian mindfulness practice on cognitive outcomes and longevity (e.g., Alexander et al. 1989). More research is currently underway to investigate the long-term effectiveness of Langerian mindfulness practice on specific medical conditions, for example, amyotrophic lateral sclerosis (Pagnini et al. 2014).

### The Role of the Body in the Different Mindfulness Approaches

The notion of present moment awareness is regarded by all Buddhist traditions as a central component of Buddhist mindfulness practice. This heightened awareness of present moment experience requires an active and intentional direction of one’s attention, which is suggested as a central and

common component among different mindfulness approaches (e.g., Hart et al. 2013). Present moment awareness generally refers to the full awareness of processes relating to the following: (1) body, (2) feelings, (3) mind, and (4) phenomena (collectively known as the four establishments of mindfulness; Pali: Satipatthana; Nyanaponika Thera 1983). This definition places the body and the mind as equivalents in Buddhist mindfulness practices. Indeed, being aware of bodily experiences is considered a crucial step towards living a more integrated lifestyle. As an example, Nhat Hanh writes: “When body and mind are one, the wounds in our hearts, minds, and bodies begin to heal” (Nhat Hanh 2006). Furthermore, awareness of the body, or of specific bodily sensations, is a founding principal of Theravada Buddhist mindfulness (Gunaratana 2002). Moreover, all Buddhist schools imply that both physical (bodily) and mental states are constantly interacting and cannot be separated (Havery 1993). Buddhism also situates consciousness in both the mind and the body, and contends that mindfulness practices, namely mindfulness-meditation, can alter the learned (i.e., conditioned) patterns of interaction between the body, mind, and environment. Of note, as reported above, within Buddhist spiritual paths, other meditation practices have been developed as a means to alter these conditioned patterns, such as concentrative/focused attention meditation practices (Lutz et al. 2008; Wallace 1999). Nevertheless, mindfulness-meditation practices are thought to be the only means to fully acknowledge complex interactions among different sources of sensory and mental experiences, as well as the self-referential and ultimately self-transcending process of awareness (e.g., Gunaratana 2002; Nydahl 2012).

It is worth mentioning that even before the development of MBSR and the wave of mindfulness-based treatments, meditative practices in the west such as Transcendental Meditation, Zen and Yoga emphasized the role of the body and showed physiological and psychological effects of these meditation practices (Wallace 1970; Wilson et al. 1975; Woolfolk 1975). For example, before Kabat-Zinn’s work, Benson used Transcendental Meditation for the reduction of stress and for other medical and psychological applications such as for the decrease of blood pressure and for the treatment of headache and of alcohol consumption (Benson 1974, 1975; Benson et al. 1974a, b).

Following earlier developments of meditative and bodily based practices in the West, most of the western mindfulness-meditation practices (e.g., MBSR and MBCT) emphasize directing attention to the body through different exercises, for example, through body scans or gentle yoga stretching. In fact, analysis of clinical, behavioral, and neuroscientific findings strongly suggest that brain regions related to both interoceptive (e.g., insula) and exteroceptive (e.g., somatosensory cortex) body awareness are highly activated among meditators and individuals who participate in MBSR training

compared to waitlist controls or non-meditators (e.g., Chiesa et al. 2013; Hölzel et al. 2011; Lutz et al. 2008). Multiple studies have additionally shown a link between increased body awareness and regulation of negative affect (Füstös et al. 2012), subjective well-being (Brani et al. 2014), empathic responses (Singer et al. 2004), and mindfulness (Cebolla et al. 2016). Moreover, positive effects are also documented following mind–body skills training, which emphasize an awareness of the body. Mind–body skills training include formal mindfulness skills, such as mindful eating, mindful walking, mindful breathing, and body techniques, including autogenic training, diaphragmatic breathing, biofeedback, and self-expression through movement. Observed effects of these interventions include an increase in empathy and resilience among healthcare workers (Kemper and Khirallah 2015) and a reduction in stress and enhancement of self-care among medical students (Greeson et al. 2015).

Similar to Buddhist mindfulness and western meditative mindfulness, Langerian mindfulness emphasizes the role of the body. In fact, Langer’s work empirically demonstrates the central role of the body in mindfulness and the body–mind interaction when inducing Langerian mindfulness among participants. For instance, in her landmark “Counterclockwise study” conducted in 1979 (Langer 2009), Langer asked participants to embed their mind in the past (20 years ago) which led to measurable changes in their body (e.g., in terms of strength, vision, hearing, and physical appearance). Other studies have also showed similar trends (e.g., Crum and Langer 2007; Langer et al. 2010; Pagnini and Philips 2015).

### Critical Issues Related to Current Mindfulness Assessment Measures

Despite the body-related practices involved in western mindfulness-meditation and incremental data suggesting the central role and positive effects that body awareness plays in western mindfulness-meditation, measures of mindfulness have limitations in terms of including the body as a central component. In fact, many western mindfulness-meditation scales do not explicitly refer to awareness of bodily sensations, such as the Mindfulness Attention Awareness Scale (MAAS; Brown and Ryan 2003), while others only briefly refer to this type of awareness, such as the Kentucky Inventory of Mindfulness Skills (KIMS; Baer et al. 2004).

However, most recent mindfulness measures seem to overcome this limitation. In fact, a recently developed State Mindfulness Scale (SMS; Tanay and Bernstein 2013) includes a “body factor” with six items and a “mind factor” with 15 items. This is the first scale that, on the basis of Buddhist scholarship (e.g., Bodhi 1993; Tanay and Bernstein 2013), has seriously integrated the role of the body in western mindfulness-meditation, although only partially (i.e., including only items that refer to one’s awareness of bodily sensations

without reference to the body–mind connection). Another recently developed scale is the Body Mindfulness Questionnaire (BMQ; Burg et al. 2016) that comprises two dimensions: “experiencing body awareness” and “appreciating body awareness.” Similar to SMS, BMQ integrates the role of body awareness in mindfulness but without reference to the body–mind connection. Outside the scope of measuring western mindfulness-meditation, a scale that is particularly relevant is the Multidimensional Assessment of Interoceptive Awareness (MAIA; Mehling et al. 2012). The MAIA is a 32-item multidimensional measure that assesses key aspects of the mind–body interaction, namely, interoceptive awareness. The MAIA has eight scales: noticing of body sensations, not distracting from negative (e.g., painful) sensations, not worrying about uncomfortable sensations, sustaining attention to sensations, awareness of the link between sensations and emotions, regulating psychological distress via attention to sensations, active listening to the body for insight, and experiencing one’s body as safe and trustworthy.

Similarly to the western mindfulness-meditation, the Langerian Mindfulness Scale (LMS; Bodner and Langer 2001) omits a direct reference to the body although her research suggests otherwise.

## Embodiment and Mindfulness

The notion of embodiment was developed in opposition to traditional accounts of cognition, which assume that all individuals represent the world using abstract mental symbols that they manipulate to think (Michalak et al. 2012). In contrast, Lakoff and Johnson (1999) proposed that the brain takes its input from the rest of the body. Therefore, neural circuits in the brain with no connections to the body are unable to facilitate thinking, and so could not support meaningful thought. According to this perspective, the body functions as a constituent of the mind rather than a perceiver or an actor serving the mind, and thus, is directly involved in cognition.

Embodied cognition reflects the assumption that a great portion of cognition is derived from, and dependent on, bodily interactions with the world (Barsalou 2007). Thus, embodiment is a key element in explaining the performance of cognitive tasks. Crucially, however, the contribution of the body is—according to Lakoff—a functional or causal contribution (Kiverstein 2012). For example, as the body becomes skillful in some domain of activity (e.g., playing tennis), it increases its ability to fluently and appropriately respond to a host of different situations and their various particularities (e.g., playing tennis with a tough opponent, on a rainy day, or on an uneven ground). This example illustrates how the body can have a functional role in incorporating knowledge about the world, such as playing tennis. In fact, an increasing number of studies support the role of the body in perception and

cognition (Chandler and Schwarz 2009; Jostmann et al. 2009; Natanzon and Ferguson 2012). Additionally, results from a recent randomized controlled trial suggest significant effects of sitting body postures (i.e., slumped versus upright) on memory bias (i.e., recalling positive versus negative words) among clinically depressed patients, that is, with diagnosis of Major Depressive Disorder (Michalak et al. 2014). The term “embodiment” therefore expresses the idea that knowledge and experience are grounded in bodily states and specifically in the brain’s modality-specific systems (Lakoff and Johnson 1999; Niedenthal et al. 2005). Those systems include the sensory systems that underlie perception of a current situation, the motor systems that underlie action, and the introspective systems that underlie conscious experiences of emotion, motivation, and cognitive operations.

Wilson (2002) distinguished between “online” and “offline” embodiments. The term online embodiment refers to the idea that much of the cognitive activity operates directly on real world environments. Accordingly, cognitive activity is intimately tied to the relevant modality-specific processes required for one to effectively interact with the environment. Offline embodiment refers to the idea that when cognitive activity is decoupled from the real-world environment, cognitive operations continue to be supported by processing the world in modality-specific systems and bodily states. Thus, just thinking about an object produces embodied states as if the object was actually present. In fact, many behavioral and neurocognitive studies have documented offline embodiment effects (for more details, see Niedenthal et al. 2005).

Varela and his collaborators (e.g., Thompson and Varela 2001; Varela et al. 1991) proposed that consciousness is embodied, involving a two-way reciprocal relationship between the brain and the body. Furthermore, they suggest that consciousness is embedded in an environmental context. Consciousness therefore cuts across the brain–body–world divisions rather than being simply located in the head. Research supports this proposition. For example, a review by Cauller (1995) found that the primary sensory areas, which are central to conscious processing, are also zones of convergence of top–down corticocortical influences with bottom–up sensory feedback.

## Convergence of Top–Down with Bottom–Up Processes

Top–down processes are initiated via mental processing at the level of the cerebral cortex. In contrast, bottom–up processes are initiated by the stimulation of various somatosensory receptors that influence central neural processing and mental activities via ascending pathways from the periphery to the brainstem and cerebral cortex (Taylor et al. 2010). Both top–down and bottom–up processes are involved in meditation and self-regulation. In fact, Chiesa et al. (2013) found evidence for a larger use of top–down emotion regulation strategies (e.g., via cognitive reappraisal) among novice meditators.

However, this over-dependence on top–down, or conceptual (in contrast to sensory) awareness, can significantly limit one’s potential for relating to self, others, and the world (Farb et al. 2015). Moreover, the over-utilization of top–down preconceptions (i.e., memories, beliefs, and emotions) and their interference with ongoing experience including relating to others, can lead to mindlessness, that is, a rigid view of the self, others, and the world (Siegel 2007). Cultivation of top–down concept formation, without the cultivation of direct awareness, can lead to increased judgment, which is related to ignorance and suffering in Buddhism (Dunne 2011).

Bottom–up processes, such as awareness of bodily signals (called interoceptive awareness), are also crucial in regulating emotions. In fact, interoceptive awareness was shown to facilitate awareness and identification of one’s emotional state, and thus the regulation of negative affect (Füstös et al. 2012). Additionally, sustained non-evaluative attention to interoceptive sensations was suggested to disengage individuals from dysfunctional cognitive patterns (e.g., negative rumination and self-appraisal) that perpetuate negative moods (Farb et al. 2012). In the same line of thought, experienced meditators were found to mainly regulate their emotions using a bottom–up approach (e.g., directly reducing activation in emotion-generative brain regions such as the amygdala and the striatum) (Chiesa et al. 2013). Additionally, meditators were shown to have greater respiratory interoceptive accuracy compared to non-meditators (not only better interoceptive awareness) (Daubenmier et al. 2013). The repeated practice of bringing attention to an internal sensory stimulus trains the practitioner’s ability to regulate attention and distinguish between thinking about physical sensations (top–down) versus experiencing them directly (bottom–up) (Williams 2010). The neural mechanisms underlying these effects may involve increased activation of regions that modulate interoceptive awareness (e.g., somatosensory and insular cortices) and correspondingly decreased activation of regions that modulate conceptual, self-referential processing (e.g., the midline structures of the prefrontal cortex) (Daubenmier et al. 2013).

The interaction of top–down and bottom–up processes can be seen as the origin of conscious experience in the present moment. Mindful awareness, independently of the conceptualization, can be considered in this light as the intentional and progressive ability to notice, differentiate, and modulate top–down processes in such a way that does not prevent one from experiencing bottom–up present-moment sensations (Siegel 2007, 2010). As a result, past-experiences and ongoing sensations can interact with one another (integrate) and shape present moment experience (mindfulness). A central aspect of the concept of embodied mindfulness is the ongoing access to present bottom–up sensations. However, top–down processes (e.g., flow of thoughts) cannot be completely eliminated. Consequently, embodied mindfulness requires a progressive ongoing integration of both top–down and bottom–up

flows, which can explain the sense of calmness, equanimity, and peace associated with meditative practices (Siegel 2012).

Integration of top–down and bottom–up processes requires a flexible regulation of attention (directing the attention flexibly towards physical sensations/emotions and perceptual/cognitive processes) and awareness of internal/external cues (e.g., bodily sensations or novelty). Both mechanisms (i.e., attention and awareness) are central in defining mindfulness according to the different conceptualizations (as discussed above and presented in Table 1). Integration of top–down and bottom–up processes takes place in the middle prefrontal cortex, an important brain region that connects the body proper, brainstem, limbic area, cortex, and input from other people. Studies suggest that this area is related to increase of body regulation, internal and interpersonal attunements, emotional regulation, flexibility, insight, kindness, and compassion (Siegel 2012) similarly to what was found among outcomes of both traditional Buddhist and western mindfulness-*meditation approaches*.

Research suggests that meditation practice (whether based on Buddhist or western mindfulness-*meditation*) increases awareness of the complex interaction of body states with cognitive and emotional processes (e.g., Michalak et al. 2012). This interaction is shown to be bidirectional, that is, from the cognitive/emotion processes towards the body and from the body, for example, postures, style of movement towards the mind (Michalak et al. 2010). The evidence of a mind–body bidirectional interaction during meditation practice is in line with the notion of a two-way or reciprocal relationship between neural events and conscious activity that was initially proposed by Varela et al. (2001, 1991) and with other modern definitions of embodiment (e.g., Meier et al. 2012).

In the same line are results obtained in Langer’s studies. For example, inducing the mindset of being 20 years younger led to physiological measurable improvements (Langer 2009), inducing the mindset of physically exercising led to a reduction in body weight (Crum and Langer 2007), inducing the mindset of being a pilot improved vision (Langer et al. 2010), and inducing the mindset of expecting to see better ameliorated visual acuity (Pirson et al. 2010). These results can be explained by embodying a specific state of mind (e.g., being 20 years younger) which manifests measurable changes in the body (e.g., better hearing, vision, or grip strength). The induction of Langerian mindfulness led to significant changes in cognitive processes, and these changes were mirrored in the body.

From another side, the convergence of top–down and bottom–up processes as a self-regulatory mechanism was portrayed in the iterative reprocessing model (Cunningham and Zelazo 2007). This model integrates reprocessing of information, which is essential for the selection, activation (or deactivation), and maintenance of goals related to self-regulation (top–down processes) with reflection on one’s



subjective experiences (bottom–up processes). This permits one to consider all experiences consciously in light of additional aspects of the context in which they occur (i.e., puts one's experiences into perspective), similarly to Langerian conceptualization of mindfulness.

In summary, neuroscientific evidence on embodiment, consciousness, self-regulation, and outcomes from studies on mindfulness-meditation and Langerian mindfulness suggest that convergence (integration) of top–down and bottom–up processes might be a central self-regulatory mechanism in all approaches of mindfulness. Such integration between upward and downward processes is facilitated by a flexible attention regulation (i.e., being able to direct one's attention flexibly to the body, to the mind, and to the surrounding environment) and a lucid awareness of internal and external cues. Attention and/or awareness are central components in different conceptualizations of mindfulness (see Table 1).

## Conclusion

The aim of this paper was to investigate common processes among different mindfulness definitions and operationalization. We propose embodiment as a common process that can integrate mindfulness across the Buddhist traditions and western school of thoughts.

The notion of embodied mindfulness is embedded in Buddhist philosophy and grounded in neurobiology, namely in the integration of top–down and bottom–up processes. An attractive feature of this notion is that it allows a common understanding of the mechanisms of change of different western mindfulness practices, namely western mindfulness-meditation and Langerian mindfulness. It also considers consciousness as an interaction between the mind, the body, and the outside world. In fact, we think that the demonstrated effectiveness of western mindfulness interventions on physical/medical conditions and psychological disorders (e.g., fibromyalgia, chronic pain, trauma, anxiety, depression, eating disorders, obesity, sexual disorders, borderline personality disorder, and schizophrenia among others) is strongly related to improving body–mind–world connection through embodied practices. In other words, we suggest that embodied mindfulness is a primary change mechanism underlying the effectiveness of mindfulness-based psychotherapeutic interventions. Evaluating this proposal could set an agenda for mindfulness research in the coming years.

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