

## CHAPTER 3

# Developing Attention and Decreasing Affective Bias

## Toward a Cross-Cultural Cognitive Science of Mindfulness

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Wisdom and consciousness, friend—these states are conjoined, not disjoined. . . .  
For what one wisely understands, one is conscious of, and what one is conscious  
of, that one wisely understands.

—MAJJHIMA NIKĀYA 43<sup>1</sup>

The study of consciousness was banished from respectable science with the rise of behaviorism in the early 20th century. Beginning in the 1980s, however, researchers in cognitive science began to return to the topic (e.g., Baars, 1988; Chalmers, 1996; Crick & Koch, 1990; Dennett, 1991). In recent decades, there has been an explosion of research on the neurophysiological processes underlying conscious experience (Tononi & Koch, 2008), as well as the ways in which attention (Mole, Smithies, & Wu, 2011) and emotion (Barrett, Mesquita, Ochsner, & Gross, 2007) shape conscious experience. We think that this research climate is beneficial for understanding the nature and benefits of mindfulness meditation because advances in the cognitive science of consciousness provide an important but as yet underused resource for deepening our understanding of how contemplative attention-training practices function in traditional Buddhist and modern clinical contexts.

Mindfulness meditation is traditionally said to be part of a process of “awakening” (*bodhi*). In keeping with this idea, many teachers characterize mindfulness as involving one’s becoming more conscious of subtle bodily stimuli and emotional

reactions. For example, Bhante Gunaratana (2002, p. 108) stresses the importance of developing mindfulness such that mental habits of fear and grasping run their course “in the arena of conscious attention.” As he puts it, “we can make the unconscious conscious, slowly, one piece at a time” (p. 9). Similarly, Jon Kabat-Zinn (2005) notes that simple experiences of seeing or tasting or walking become vivid and transformative when one becomes mindful of them: “Sentience is closer than close. . . . Cultivated and strengthened, sentience lights up our lives and it lights up the world, and grants us degrees of freedom we could scarcely imagine even though our imagination itself stems from it” (pp. 319–320). The reason that resting on the level of bare sentience is said to be transformative is that often we are caught up in distortive interpretation and analysis: “Thinking and memory come in a bit later, but very quickly, on the heels of an initial moment of pure sense contact. Thinking and memory can easily color our original experience in ways that distort or detract from the bare experience itself” (p. 199).

Meditation teachers, and practitioners of meditation more generally, draw from their first-person experience in explaining how the forms of attention training they practice may result in health and other benefits. Yet our earlier comments on the relationship between attention training and consciousness are more poetic than precise. Specifically, they do not aim at the kind of theoretical sophistication and controlled, third-person perspective needed for a scientific understanding of how attention training may result in psychological and behavioral changes. Similarly, the statement quoted at the outset of this chapter that “consciousness and wisdom are conjoined” might seem—like many descriptions of the relationship between attention, consciousness, wisdom, and ethical action found in traditional texts—to aim more at practical inspiration than at theoretical precision. Although other textual descriptions from traditional Buddhist psychological theory do offer systematic and fine-grained accounts of the interrelations among attention, consciousness, and emotional reactivity (see Anālayo, 2003), these accounts have only recently begun to be tapped by the scientific community (e.g., Grabovac, Lau, & Willett, 2011). One reason for this state of affairs may be that it is unclear how such traditional accounts could be empirically operationalized using constructs from cognitive science. This uncertainty about how to proceed scientifically may be especially true in the case of traditional claims about the development of wisdom, such as the suggestion that developing mindfulness results in “seeing and knowing things as they are.” Hence, our aim in this chapter is to show how cognitive science may be able to illuminate mindfulness by detailing some of the ways that attention, affect, and consciousness interrelate. In this way, we hope to contribute to a more rigorous scientific and philosophical understanding of precisely how consciousness and wisdom relate to each other in the cultivation of mindfulness.

To study the effects of therapeutic interventions, such as mindfulness training, on the brain and the rest of the body, scientists need to employ conceptual constructs of the phenomena under investigation that guide where and how they will look. Thus, in studying the health benefits and physiological mechanisms of mindfulness meditation, scientists have had to ask what precisely mindfulness is (Davidson, 2010). In describing “what mindfulness is, what it isn’t, and its role in healthcare and

medicine” Kabat-Zinn (1996) suggests that two Buddhist canonical texts in which the practice “is elaborated most thoroughly” (pp. 161–162) are the *Anapanasati-sutta* and the *Mahāsatiipaṭṭhāna-sutta*. Each text consists of a discourse attributed to the Buddha and recorded among the canonical texts of the Theravāda Buddhist tradition. Scholars call the body of dialogues and discourses to which these texts belong to the Pāli *Nikāyas*. In order to focus our discussion in this chapter on one example of an approach integrating textual and scientific perspectives, among the many different conceptions of mindfulness, we draw inspiration mainly from the accounts found in the Pāli *Nikāyas*, without thereby meaning to privilege the particular notion of mindfulness found there over different notions of mindfulness found in other Buddhist traditions, or in later texts of the Theravāda Buddhist tradition. Likewise, for the sake of simplicity, we make reference especially to Pāli textual sources and terminology.

It has been noted sometimes in the scientific literature that “mindfulness” is a translation of the Pāli term *sati*. The broad usage of the term *sati* in the Pāli *Nikāyas* is perhaps best captured by the colloquial English notion of “minding.” The Pāli texts employ *sati* in reference to everything from “minding” one’s livestock (MN.I.117) to “minding” one’s meditation object in practices such as loving-kindness (Sn 26), in addition to using *sati* specifically in the context of mindfulness meditation, or, more literally, in the establishment of *sati* (*sati-upaṭṭhāna*).<sup>2</sup> It is important to note at the outset, however, that even focusing just on accounts of the specific form of meditation termed *sati-upaṭṭhāna*, the prescriptions for practice and descriptions of its effects found in the Pāli *Nikāyas* are subject to multiple possible readings. The account of relations between consciousness and wisdom that we develop here is one of a number of possible readings, and the value we see in this account lies not in its claim to historical authenticity, but instead in its suggestion of new and fruitful avenues for scientific research by drawing on suggestions consistent with both the broad thrust of the Buddha’s teachings in the Pāli *Nikāyas* and with recent empirical results.

### Toward a Cross-Cultural Cognitive Science of Mindfulness

Scientific investigations of practices derived from Buddhist traditions have focused to date primarily on how various forms of attention training alter cognitive and affective processes (see Lutz, Slagter, Dunne, & Davidson, 2008, for a review). Yet Buddhist teachings include many other methods for training practitioners’ habits of mind. The strong emphasis on moral conduct, for example, can be seen as a means for protecting oneself from unwholesome states, such as greed, hatred, and delusion. Modern clinical presentations, out of practical necessity, have often separated practices of ethical restraint from practices of meditation. Traditionally, however, behavioral restraint is taken to be both foundational for and an essential outcome of meditative development.

The term *meditation* generally refers to a category of practices involving attention-training techniques aimed directly at cultivating particular positive mental states. Many Buddhist techniques of reflection, such as reflection on the inevitability of death (*marāṇasati*), act as a complement to ethical training. Other practices range

from cultivating states such as loving-kindness, or literally friendliness (*mettā*), to practices aimed simply at cultivating a settled and unified state of mind (*samādhi*) through concentration on a sensory or mental object. In these forms of meditation, practitioners counteract mind-wandering by repeatedly bringing the mind back to the object of meditation.

The use of such methods of attention training for developing strong concentration appears to have been widespread at the time of the Buddha. Buddhist texts relate that the Buddha, before his enlightenment, studied techniques for concentrating the mind under teachers such as Āḷāra Kālāma and Uddaka Rāmaputta (M.36). These early Buddhist texts also emphasize that the method of mind training that the Buddha went on to discover for himself was novel, with results that differed importantly from those that were being taught by his contemporaries.

Over the course of Buddhist history, there have been substantive debates within and between various Buddhist traditions about what precisely the unique and revolutionary aspect of the Buddha's teaching was or is. Within the Theravāda Buddhist tradition of South and Southeast Asia, it is commonly held that the establishment of mindfulness (*satipaṭṭhāna*) is essential for realizing the liberating insights described in the canonical texts of this tradition. Nevertheless, it should not be assumed that there is a single, unequivocal concept of mindfulness to be found in this or any Buddhist tradition. For example, in the recent literature, there has been an emerging debate over what role, if any, cognitive factors such as memory, evaluation, and intellectual analysis play in mindfulness meditation (see the collection of articles in the June 2011 issue of *Contemporary Buddhism*). In some cases, this debate may reflect differences in emphasis and understanding between the early Buddhist texts and later commentarial developments within the Theravāda (Anālayo, 2013). In other cases, these debates may reflect differences in emphasis and understanding between modern presentations of mindfulness in clinical contexts and the various Buddhist traditions from which these modern presentations are partly derived.

Perhaps the most influential clinical presentation of mindfulness is the 8-week mindfulness-based stress reduction (MBSR) program pioneered by Jon Kabat-Zinn at the University of Massachusetts Medical School in the 1980s. This program has been replicated and adapted widely, and is now offered in the secular context of hospitals and clinics around the world. It has also been the subject of a growing body of empirical research. Studies comparing participants in the MBSR program to control groups have shown that mindfulness practice correlates with significant reductions in suffering associated with various illnesses, and with structural and functional changes in the brain (for a relatively recent review, see, e.g., Hölzel et al., 2011).

In addition to being influenced by the Theravāda Buddhist sources noted earlier, Kabat-Zinn's presentation was also influenced by Korean Zen Buddhist teachings, as well as by other Asian spiritual traditions, such as Yoga (Kabat-Zinn, 2011). As Kabat-Zinn noted in a recent article, he used the term *mindfulness* "as a placeholder for the entire dharma," that is, as an umbrella term meant to point in a secular, accessible way toward the many varied techniques employed in a diverse array of Buddhist traditions (2011, p. 290). Perhaps in part for this reason, attempts in the scientific literature to formulate what mindfulness is often have proceeded

without serious engagement from theoretical formulations of mindfulness practice contained in Buddhist textual traditions. In the absence of references to such traditional canonical sources, many researchers have focused on one particular phrase Kabat-Zinn used in his introductory guide for practitioners to describe mindfulness, namely, the phrase “paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally” (1994, p. 4). Thus, Bishop and colleagues (2004), in proposing an operational definition of mindfulness for clinical psychology, summarize the literature by noting that “mindfulness has been described as a kind of nonelaborative, nonjudgmental, present-centered awareness in which each thought, feeling, or sensation that arises in the attentional field is acknowledged and accepted as it is” (p. 232).

In this modern conception of mindfulness as present-centered, mindfulness does not itself involve memory or evaluation. In contrast to this modern notion, Dreyfus (2011) argues that *sati* comprises “retentive focus,” the ability of the mind to hold its object and not float away from it. This conception seems close to the cognitive science construct of working memory. Like Dreyfus, we believe that the technical vocabularies used in cognitive science can provide a greater degree of precision for characterizing mindfulness than can the operational definition of mindfulness in clinical psychology (notwithstanding the usefulness that definition may have for therapeutic purposes). Indeed, the vocabulary of cognitive science can help to capture for modern practitioners of mindfulness the care and precision with which the Buddhist terms are used in their native philosophical context. For this reason, careful understanding of the traditional Buddhist textual sources in the context of recent scientific research can benefit both scientific understanding of psychological changes involved in mindfulness practice and the Buddhist project of understanding what these texts can mean for us today. Making this point in an earlier article, we suggested that integrating third-person empirical observation of the brain and behavior with ancient and modern accounts based on first-person meditative exploration may prove mutually beneficial to both the scientific project of understanding the mind and the Buddhist project of transforming it (Davis & Thompson, 2013). In particular, we proposed that building bridges between traditional Buddhist models of the mind and contemporary cognitive science may lead toward a more precise understanding of the respective roles of attention, consciousness, and memory in mindfulness meditation. In this chapter, we take that project one step forward, drawing on scientific and philosophical work on consciousness and attention in order to move toward a rigorous, precise, and empirically testable account of the relationship between consciousness and wisdom as suggested by traditional accounts of mindfulness.

### **Phenomenal Consciousness and Cognitive Awareness.**

An important step toward a cross-cultural cognitive science of mindfulness is to clarify some of the different senses of the term *consciousness* in contemporary cognitive science so that they can be related to various Buddhist concepts (for further discussion see Davis & Thompson, 2013; Thompson, 2014). One general or comprehensive

way to indicate what is meant by *consciousness* is to say that consciousness “consists of inner, qualitative, subjective states and processes of sentience and awareness” (Searle, 2000, p. 559). When we try to refine our understanding of terms such as *inner*, *qualitative*, *subjective*, *sentience*, and *awareness*, however, we need to make at least two important conceptual distinctions.

First, we can distinguish between what philosophers of mind call creature consciousness and state consciousness (Bayne, 2007). Whereas *creature consciousness* pertains to the whole subject of experience, the person or animal, *state consciousness* pertains to a particular mental state. A creature is conscious if, and only if, there is something it is like to be that creature (for that creature) (Nagel, 1974). Notice that creature consciousness, so defined, does not mean being awake because consciousness—that is, inner, qualitative, subjective states and processes of sentience and awareness—occurs during other states besides wakefulness, such as dreaming. Moreover, patients in a vegetative state apparently lack or have highly diminished qualitative awareness of themselves and their environment while nonetheless being awake (they undergo a sleep–wake cycle). Thus, when we say that someone is awake but unresponsive or awake and alert, or asleep and dreaming, it is consciousness in the sense of creature consciousness with which we are concerned. In contrast, when we talk about a person being conscious of a given stimulus versus not being conscious of the stimulus, it is state consciousness with which we are concerned. Thus, in the case of state consciousness, we are concerned with the content and qualitative character of the particular mental states of the subject.

If we now ask what exactly it means to say that the person is conscious of the stimulus or that the content of a given mental state is conscious, we find ourselves needing to make another conceptual distinction (see Block, 1995, 2007). On the one hand, we can say that the person is conscious of the stimulus if the person subjectively experiences the stimulus as being a certain way, that is, as having a certain qualitative appearance. In this sense of *conscious*, a given mental state or bodily state is conscious if, and only if, there is something it is like for the subject to be in that state. Philosophers call this concept of consciousness “phenomenal consciousness” (*phenomenal* here means how things seem or appear in experience). On the other hand, we can also say that the person is conscious of the stimulus if the person can report or describe it, or reason about it, or use it to guide how he or she acts or behaves. Philosophers call this concept “access consciousness” (*access* here means available for use in thought and action). In summary, *consciousness* can mean awareness in the sense of subjective experience (*phenomenal consciousness*) or awareness in the sense of cognitive access (*access consciousness* or *cognitive awareness*).

One reason philosophers draw this distinction is to make the point that to explain consciousness in the sense of cognitive awareness is not necessarily to explain consciousness in the sense of subjective experience. As David Chalmers (1995, p. 206) writes:

Even when we have explained the performance of all the cognitive and behavioral functions in the vicinity of experience—perceptual discrimination, categorization, internal access, verbal report—there may still remain a further unanswered



question: *Why is the performance of these functions accompanied by experience?*

A simple explanation of the functions leaves this question open.

Another reason for making the distinction between phenomenal consciousness and cognitive awareness is to allow for the possibility that one could subliminally or implicitly experience something without being able to report or describe the experience, at least not fully or explicitly. In other words, one could have an experience with a subjectively felt character—for example, a bodily feeling elicited by a memory or a perceived situation—without being able to report and describe that experience or feeling, at least not fully or easily. Moreover, some cognitive scientists and philosophers argue that in certain experimental situations one can experience an image or a stimulus array but without being able to form the kind of memory needed for a verbal report of exactly what it was (see Block, 2008). Although the interpretation of such results is controversial (Block, 2011; Cohen & Dennett, 2011; Kouider, de Gardelle, Sackur, & Depoux, 2010), it seems reasonable to suppose that it is possible for one's subjective experience (phenomenal consciousness) at a given time and in certain conditions to outstrip the cognitive capacities or resources one has for accessing the experience at that time and in those conditions.

In our earlier article (Davis & Thompson, 2013), we drew a tentative parallel between this cognitive science distinction between phenomenal consciousness and cognitive access and another distinction found in the Buddhist texts in which mindfulness practice is described. One central model of the mind found in the Pāli *Nikāyas* distinguishes between *viññāṇa*, which is often glossed as “consciousness,” and *saññā*, which is defined as involving identification and reportability of what one has experienced. These Pali texts thus define *saññā* in terms remarkably similar to the cognitive science notion of cognitive awareness. The *Nibbedhika Sutta* (AN.III.413), for example, defines *saññā* as that which results in spoken communication (*vohara*): “As one identifies (*sañjānāti*) it, so one says ‘I saw thus.’” In the *Khajjaniya Sutta* (SN.III.87), *saññā* is defined as cognizing (*sañjānāti*) that there is blue, that there is red, yellow, or white. Although *saññā* is often glossed as “perception,” this interpretation is inadequate. As Pali scholar Peter Harvey (1995, p. 141) explains, “the word ‘*saññā*’ and its verbal form ‘*sañ-jānāti*’ clearly refer to some kind of knowledge or knowing which is done in an associative, connective, linking (*sa-*) way.”

Modern meditation teachers often employ this traditional distinction between *viññāṇa* and *saññā* implicitly in their presentations of mindfulness. We noted above Kabat-Zinn's suggestion that “thinking and memory come in a bit later, but very quickly, on the heels of an initial moment of pure sense contact” (2005, p. 199). The practitioner-scholar Bhante Gunaratana (2002) offers a similar but more detailed interpretation of Buddhist theory on this point:

Mindfulness registers experiences, but it does not compare them. It does not label them or categorize them. It just observes everything as if it was occurring for the first time. It is not analysis which is based on reflection and memory. It is, rather, the direct and immediate experiencing of whatever is happening, without the medium of thought. It comes before thought in the perceptual process. (p. 168)

Although it is difficult to draw out a precise definition of consciousness from the Pāli *Nikāyas*, given these modern presentations, it is tempting to relate *viññāṇa* to the concept of phenomenal consciousness. According to this interpretation, *viññāṇa*, defined as a moment of visual, auditory, tactile, olfactory, gustatory, or mental experience, would be analogous to phenomenal consciousness, whereas *saññā*, defined as a recognitional ability, would be analogous to cognitive awareness.

Whether phenomenal consciousness and cognitive awareness are separable or whether one depends constitutively on the other is an issue of considerable debate in current cognitive science (see Block, 2011; Cohen & Dennett, 2011). We cannot enter these debates here (for further discussion, see Davis & Thompson, 2013). It is important to note, however, that whereas some philosophers have argued that phenomenal consciousness cannot be characterized in functional terms (Block, 2007, 2008; Chalmers, 1996), our account of the difference between *viññāṇa* and *saññā* does not depend on this claim. On the contrary, given the relation we are suggesting between consciousness and wisdom, our account requires that consciousness have predictable downstream effects on psychological functioning. At a minimum, the way we propose to interpret the textual distinction between *viññāṇa* and *saññā* requires that the function and effects of phenomenal consciousness, or *viññāṇa*, be importantly different from the function of cognitive awareness, or *saññā*, and the effects it has on recall, report, and deliberation.

In spelling out this requirement, we think it is helpful to draw on neuroscientists Parvizi and Damasio's (2001) proposal that there is a basal or core level of consciousness, dependent on the thalamus and brainstem, that occurs independently of selective attentional processes in higher cortical areas. This core or ground-floor level of consciousness depends on a basic kind of alerting function distinct from the higher-level mechanisms of selective attention that come into play in determining what one is conscious of. In our reading of this view, the fact that there is felt experience—the fact that there is something it is like for the subject—depends on the basic alerting function. In contrast, the particular contents of consciousness—what it is like for the subject—depends also on how this consciousness is directed to particular objects and properties through selective attention. Put another way, the particular contents of phenomenal state consciousness can be seen as modifications or modulations of a basal level of creature consciousness dependent on the alerting function (see also Searle, 2000).

Given this viewpoint, we propose that *viññāṇa* corresponds more closely to the basal level of consciousness, whereas *saññā* corresponds more closely to the cognitive awareness of particular phenomenal contents via working memory and selective attention (Davis & Thompson, 2013). This interpretation suggests ways that the two kinds of mental phenomena could be functionally interrelated. On the one hand, one role of phenomenal consciousness may be to make experiential content accessible for encoding in working memory, and hence for the purposes of identification, recall, deliberation, and report (Prinz, 2005, 2012; see also Block 2011, p. 567). On the other hand, one central commentarial text in the Theravāda Buddhist tradition, the *Aṭṭhasālinī*, suggests that mindfulness (*sati*) has as its immediate cause (*padaṭṭhānā*) firm identification (*thirasaññā*). *Saññā* here seems to play the role



of directing attention toward an object and maintaining it there.<sup>3</sup> Our account suggests one way to understand this proposed function of *saññā*, namely, that by holding in working memory a conceptual representation—say, of the abdomen or of the breath—attentional processes thereby allow more interoceptive and somatosensory stimuli from the body, as it moves with the breath, to be consciously experienced. To explore this idea more fully we need to consider the relation between attention and consciousness, seen especially in the light of mindfulness practice.

### Attention and Consciousness

Cognitive neuroscientists distinguish between two types of attention that not only rely on distinct neural systems but also share a common neural network (Corbetta & Shulman, 2002). If we ask you to switch your attention from the words on this page to the sensations in your right hand, and you comply, you are employing so-called top-down, endogenous orienting. Scientists distinguish this voluntary form of attention from so-called bottom-up, stimulus-driven attention, which is activated when a strong or salient stimulus, such as a loud siren or a flash of light, grabs your attention. Top-down attention depends on generating and maintaining a “control set” that specifies in advance what you are to select; thus, when you switched your attention to the sensations in your right hand, you did so by forming an attentional control set on the basis of our instructions. The maintenance of an attentional control set depends crucially on *working memory*, the ability to retain task-relevant information on a short-term basis.

Working memory has been shown to play an important role in visual selective attention (de Fockert, Rees, Frith, & Lavie, 2001) and seems to play a similar role in directing bodily awareness. In a paradigm developed by Ruth Schubert and colleagues, subjects are instructed to attend either to the left or right hand, while tactile stimulation is applied to left and right index fingers with the mechanical pins of a Braille stimulator (Schubert, Blankenburg, Lemm, Villringer, & Curio, 2006; Schubert, Haufe, Blankenburg, Villringer, & Curio, 2009; Schubert, Ritter, Wüstenberg, Preuschhof, Curio, Sommer, et al., 2008). In a series of studies integrating behavioral tasks with multiple neuroimaging methods, Schubert and colleagues found evidence that selective, top-down spatial attention, for instance, to the left hand, functions to increase subjects’ ability to detect and report on weak stimuli by directly amplifying early sensory responses to stimuli in this area of the body and inhibiting responses to other areas. More recent studies have shown what are called “mind-only” effects of bodily attention. Jones and colleagues (2010) reported evidence that directing subjects with a visual word cue to attend either to the hand or to the foot exerts effects on the primary somatosensory cortex (S1) even in the absence of tactile stimulation to these areas. Moreover, the degree of attentional modulation of S1 was predictive of detection of tactile stimuli, when they were applied. In further studies, Kerr and colleagues (2011) found that these effects of bodily attention were enhanced in groups undergoing MBSR training compared to a control group. Even in the absence of any tactile stimulus, meditators showed faster response to visually presented directions either to

attend to the hand or foot and a greater differentiation between neural responses to these attentional cues. This finding is consistent with results showing that, following a course in the MBSR program, participants show increased performance on tasks measuring such top-down orienting (Jha, Krompinger, & Baine, 2007), as well as enhanced activity in brain areas specific to interoceptive attention (Farb, Segal, & Anderson, 2013a, 2013b).

Desimone and Duncan's (1995) well-known "biased-competition" model of attention makes sense of such results by suggesting that representations in early sensory areas compete with one another for access to downstream resources, such as those involved in the ability to have conscious access to the sensory response and to report on it, while top-down modulation by attentional control sets serves to bias these competitions in favor of certain sensory responses. In a more recent proposal, Rolls (2008, p. 442) drew on the biased-competition model to suggest that attention is an emergent process, in which feedback and feedforward effects between working memory areas and sensory processing areas settle into an optimal configuration for energy minimization. In this light we may hypothesize that when meditators apply instructions to attend to the sensations of the breath in mindfulness practice, working memory plays a role in specifying how attention is to be directed. Indeed, many forms of mindfulness meditation begin in this way, by employing working memory in directing selective attention – for instance, to the sensations of breathing.

In the most central and detailed account in the Pāli *Nikāyas* of how mindfulness is to be established (D.22, M.10), meditators are instructed to pay attention to every aspect of daily life. In going, the ardent meditator knows clearly, "I am going"; in breathing in or out long or short, he or she knows "I am breathing in short," and so on. Likewise, one knows clearly when there is a pleasant feeling or a painful one; when there is anger in the mind, one knows clearly "there is anger in the mind," and reciprocally when the mind is without anger. Likewise, one knows when concentration or equanimity is not present, and one knows when these are strong. One influential form of mindfulness practice descended from the Mahasi Sayadaw of Burma, and popularized by American teachers such as Joseph Goldstein and Sharon Salzberg, employs a closely related practice of mental noting. At introductory stages of practice, meditators are instructed to use mental labels to note everything from the movement of the breath to perceptual processes such as seeing and hearing, and even mental states such as boredom, interest, restlessness, or joy. Such minimal conceptual labels might seem insufficient for developing the penetrative understanding, *paññā*, that mindfulness is said to bring. In light of the cognitive science of attention reviewed earlier, however, we can understand meditators' use of labels, such as "I am going," not as a phenomenological analysis of experience, or as a metaphysical analysis of the nature of reality, but rather as holding in working memory a mental representation that functions to direct top-down attention in ways that can have transformative effects.

A number of recent studies have shown increased awareness associated with mindfulness practice. Most prominently, following a 3-month mindfulness meditation retreat, participants showed a decrease in what is referred to as the "attentional blink." In this experimental paradigm, subjects have to identify two visual targets

presented within 200 to 500 milliseconds of each other in a rapid sequence of other distracting visual stimuli. Subjects often notice the first target but fail to notice the second one, as if their attention had blinked. The standard explanation is that detecting the first target uses up the available attentional resources, so the second target is missed and not reported. A recent study indicated that the ability to detect the second target was greatly improved after a 3-month intensive Theravāda mindfulness meditation retreat, and that this improvement correlated with electrocortical measures showing more efficient neural responses to the first target (Slagter et al., 2007). Importantly, in this study, the participants were instructed not to meditate during the task, so the improved performance indicates that mindfulness meditation had lasting effects on attention outside the context of meditation practice. The authors of this study suggest that mindfulness meditation may lead to less elaborative cognitive processing of the first visual target—less “mental stickiness” to it—and that this reduction facilitates the ability to identify and report the second rapidly occurring target.

The philosopher Jesse Prinz (2005, 2011, 2012), marshaling recent empirical research, has proposed that attention, in particular the occipitoparietal activity associated with endogenous orienting to a particular stimulus, is required for phenomenal consciousness of that stimulus. Yet evidence from recent investigations of meditation, in conjunction with other empirical and theoretical considerations, may require a refinement of such views. For example, in the attentional blink study, long-term mindfulness meditators seem better able to detect the second target precisely because they do not fixate on the first one. Moreover, in recent pilot testing in a group of Zen meditators, subjects did better on the attentional blink task at times when they reported having stopped caring about the task (C. Kerr, personal communication, August, 11, 2014). This finding is consistent with the “biased competition” model of attention noted earlier, in which the function of endogenous orienting is precisely to inhibit stimulus representations outside the focus of attention, in addition to amplifying those representations in the selected set. Our suggestion is that by reducing top-down orienting, and instead cultivating a general and receptive awareness, individuals can become conscious of more subtle and fleeting stimuli than they would be able to otherwise. In other words, mindfulness practice may involve enhancing the processes involved in sustaining the basal alert consciousness instead of acting simply on selective attention (as more concentrative type meditation practices are likely to do).

We can relate this idea to another influential cognitive psychology model of attention—the attention network theory of Posner and colleagues (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Fan, McCandliss, Fossella, Flombaum, & Posner, 2005; Petersen & Posner, 2012; Posner & Petersen, 1990).<sup>3</sup> This model delineates three interreacting attentional networks—alerting, orienting, and executive control. Using the terms of Corbetta and Shulman’s (2002) model of top-down versus bottom-up attention (mentioned earlier), we can understand the executive control network as top-down influence on selective attention, the orienting function as the hub of top-down and bottom-up convergence, and the alerting network as a potential bottom-up influence. The alerting function can be further subdivided. On the one hand is *phasic alertness*, a task-specific sensitivity to a particular class of stimuli, such as when a radar operator watches vigilantly for indications of incoming aircraft. There

is emerging evidence that cultivating this phasic type of alertness can also raise what is called *intrinsic* or *tonic alertness*, the general level of arousal and sensitivity to stimuli across a range of sense modalities that is characteristic of being minimally conscious (Robertson, Mattingley, Rorden, & Driver, 1998). This finding suggests that developing focused attention, for instance, on the breath or mental states, may help to cultivate a more general alertness to a range of stimuli across perceptual modalities, thereby increasing the scope of the basal phenomenal consciousness.

## Two Factors in Mindfulness Meditation

Considering the different types of attention that cognitive science distinguishes can help us to better understand Buddhist textual accounts of the nature of mindfulness practice and how to go about practicing mindfulness ourselves. *Satipaṭṭhāna* has an intimate relation with attention in the early Buddhist dialogues, yet the notion of attention (Pali: *manasikāra*) found in these texts is not clearly specified. One suggestion that is consistent with later Buddhist Abhidharma theory is to understand *manasikāra* as a kind of endogenous orienting to a particular stimulus, such that one is conscious of only one object at a time. Yet, to the degree that Abhidharma theory also posits that *manasikāra* is necessary for each moment of conscious experience, understanding *manasikāra* as a form of endogenous orienting becomes incompatible with the results of mindfulness practice. First, to the degree that mindfulness involves an open and receptive awareness of unanticipated and rapidly changing stimuli at all the senses, endogenous orienting processes as understood in cognitive science seem too slow and too narrowly focused to perform this function. Second, as noted earlier, endogenous orienting may actually get in the way of being conscious of stimuli that are outside the narrow area of selected focus. Hence, we have proposed that from the perspective of a cross-cultural cognitive science of mindfulness, the relation between *manasikāra* and *satipaṭṭhāna* be taken to indicate that by cultivating a heightened alertness, one consciously experiences more of the internal and external stimuli reaching one's sense organs (Davis & Thompson, 2013). This proposal is consistent with results finding increased alertness in mindfulness interventions (Britton, Lindahl, Cahn, Davis, & Goldman, 2014; Jha et al., 2007). It is also consistent with Parvizi and Damasio's view (2001), noted earlier, that there is a basic, core level of consciousness, dependent on the thalamus and brainstem, that occurs independently of selective attentional processes in higher cortical areas.

Moreover, the development of alertness may counteract biases of attention by broadening the awareness of incoming stimuli to include aspects that attention would otherwise have been biased away from and, in particular, by making our habitual reactions themselves more conscious (cf. Anālayo, 2003, p. 229). One early Buddhist dialogue suggested that the stages of affective appraisal (Pāli: *vedanā*) and cognitive appraisal (*saññā*) serve as the basis of thought (*vitakka*) and conceptual proliferation (*paṇāsa*) (MN 18 and its parallels, in Anālayo, 2011, p. 136). According to this model, initial distortions of attention and memory affect later conceptualizations of the experience. Likewise, in the recent psychological literature, biases of attention

and memory have been suggested as affecting the trajectory of psychological reactions to emotionally salient stimuli (Todd, Cunningham, Anderson, & Thompson, 2012). Drawing on such suggestions, Brewer, Elwafi, and Davis (2013) suggest that mindfulness, besides leading to increased awareness of one's own emotional reactions, may lead to more accurate awareness, in particular by attenuating affective biases that underlie distortions of attention and memory (Elliott, Zahn, Deakin, & Anderson, 2010).

A variety of experimental results support this idea. Recent findings showing that mindfulness training is associated with decreases in negative biases in word-recall tasks (Roberts-Wolfe, Sacchet, Hastings, Roth, & Britton, 2012) support the hypothesis that mindfulness attenuates memory biases. Another finding that a group receiving mindfulness training exhibited a decrease in the attentional blink for emotional face stimuli (Van Dam, 2012) supports the suggestion that mindfulness decreases attentional biases (for discussion of the paradigm, see Van Dam, Earleywine, & Altarriba, 2012). In addition, whereas a control group showed small decreases or modest increases in subjective distress as a result of the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), the mindfulness group showed large decreases in subjective distress. Further analysis suggested that mindfulness decreased psychological symptoms, in part by improving awareness of emotional imagery, as well as by generating emotional stability in response to psychosocial stress. Using this same psychosocial stress test, Britton, Shahar, Szepsenwol, and Jacobs (2011) found that the perseveration of emotional response was reduced in a group receiving mindfulness training, but not the intensity of the response. Wait-list control subjects showed an increase in anticipatory anxiety, indicating a stress sensitization effect, while the prestressor levels of the subjects receiving Mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002) did not change. Moreover, the MBCT group showed decreased emotional reactivity during the poststressor phase. Specifically, the time course (duration) of the affective response, but not the amplitude, was decreased following MBCT. One explanation for these results is that affective biases increase the tendency of attention to return again and again to mental images that spark negative affect, and that mindfulness decreases proliferation by attenuating affective biases of attention and memory.

In summary, we propose that the establishment of mindfulness, *satipaṭṭhāna*, be understood as involving two critical and mutually supportive factors—increased alertness on the one hand, and the attenuation of affective biases of attention and memory on the other. Increased alertness results in increased consciousness of internal and external stimuli that would otherwise not be consciously experienced. Yet without a concomitant reduction in emotional fixation due to affective biases of attention and memory, generalized increases in alertness can lead to pathological symptoms, as in an panic attack when one fixates on an unpleasant stimulus. Conversely, by attenuating affective biases, mindfulness practitioners may become conscious of a broader range of stimuli and also reduce emotional proliferation following pleasant or unpleasant experience. Reciprocally, the extension of one's conscious experience to include a broader range of current stimuli may counteract affective biases by reducing fixation on one stimulus or one recurrent memory.

### **Full and Accurate Awareness**

Both by increasing alertness and by attenuating affective biases, establishing mindfulness may lead to increases in emotional awareness in a variety of forms. Decreased attentional blink, especially in conjunction with more general emotional awareness, might predict increased awareness in interpersonal interactions. For example, increased awareness of visual, nonverbal responses such as “microfacial expressions” can facilitate detection of suppressed or repressed responses (Todd et al., 2012). Such expressions are normally detectable only with slow-motion video or by observers trained to detect such microfacial expressions (Ekman & Friesen, 1969). Yet even without explicit training, decreases in attentional blink predict increased awareness of others’ emotional expressions. In this way, the two mutually supportive factors of increased alertness and decreased affective bias may result in better awareness of others’ emotions.

Equally important, recent evidence suggests that mindfulness training may result in increased awareness of one’s own emotional state by virtue of increased conscious experience of interoceptive changes involved in one’s physiological reactions. In a recent study, mindfulness meditators showed significantly more coherence between physiological changes and their subjective awareness of emotional responses than did either professional dancers (ballet and modern dance) or control subjects with no meditation or dance experience (Sze, Gyurak, Yuan, & Levenson, 2010). Mindfulness meditators were more aware of their visceral responses and thereby more aware of their emotions. In another study, Silverstein, Brown, Roth, and Britton (2011) reported evidence of increased interoceptive awareness in female undergraduates engaged in mindfulness training. They suggested that women who were distracted by emotionally driven self-evaluative thoughts were much slower in registering their bodily reactions, as measured by reaction time in rating physiological response to sexual stimuli, whereas mindfulness meditation training increased awareness of bodily reactions by decreasing self-evaluative thoughts.

Such instances in which awareness increases access to information about one’s own and others’ emotional situation provide examples of how mindfulness might lead to fuller, more accurate cognitive understanding by virtue of cultivating a broad and receptive field of conscious experience. On the one hand, if expressions of one’s own or others’ emotional reactions are not consciously experienced, then they cannot be encoded in working memory so as to be available for recall, consideration, or report. Thus, by increasing phenomenal consciousness of subtle internal and external stimuli, one makes one’s cognitive awareness more complete. On the other hand, to the degree that attention and memory are affectively biased, one is less likely to consciously experience subtle emotional stimuli that do not fit one’s biases. Thus, by decreasing affective biases and increasing alertness, cognitive understanding is enhanced.

This perspective suggests an intimate relation between perceptual and cognitive changes involved in mindfulness. In the Pāli *Nikāyas*, latent craving and aversion are said to result in perceptual distortions (*saññā-vipallāsa*), which when elaborated lead to distortions of both thought (*citta-vipallāsa*) and view (*diṭṭhi-vipallāsa*) when



such thought patterns become habitual (see the translator's introduction to Olendzki, 2010). Given the contemporary focus on the present-centered, nonevaluative aspects of mindfulness, it is worth emphasizing that evaluative conceptual understandings informed by mindfulness practice may often be crucial in making decisions that are skillful, in the sense of not setting one up for suffering. Cognitive aspects of mindfulness training may therefore play an important role in generating the beneficial outcomes of mindfulness. As Kabat-Zinn (2011, p. 291) notes, "non-judgmental does not mean . . . that there is some ideal state in which judgments no longer arise." Indeed, early Buddhist definitions of mindfulness (Anālayo, 2013) suggest that mindfulness transforms evaluative and ethical judgments but does not eradicate them.

For example, according to one early Buddhist dialogue, the attraction of sensual pleasures is based on a distorted cognition, and such cognitive distortions can only be corrected through wise attention. The simile given here is that of a leper who takes delight in cauterizing his wounds over fire, but when healed, accurately takes this burning to be painful (MN 75 and its parallels, in Anālayo, 2011, p. 410). To the degree that sensual pleasures do not in fact provide lasting satisfaction, as the Pāli *Nikāyas* suggest, having expectations of gaining satisfaction in this way and making decisions based on these expectations will inevitably set one up for frustration and sorrow. Thus, a future-focused understanding that no object of experience will bring lasting satisfaction may have important effects on decision making about how to live and act.

On this account, the cognitive effects of establishing mindfulness rest on a lack of affective biases and an increased ability to face hard truths. Some have suggested that the salutary effects of mindfulness may be due to increases in positive reappraisal of life situations (Garland, Gaylord, & Fredrickson, 2011; Garland, Gaylord, & Park, 2009). Garland and colleagues (2011, p. 60) give the example of mindfulness allowing clients' reappraisal of a serious heart condition as "an opportunity to change their lifestyle and health behaviors rather than as a catastrophe portending imminent doom." But the Pāli *Nikāyas* do not support a conception of mindfulness as biasing subjects' conscious experience or cognitive considerations specifically toward positive aspects of a situation. Rather, we have suggested that *satipaṭṭhāna* functions to decrease affective biases of attention and memory toward pleasant as well as unpleasant stimuli. In accord with this suggestion, Ortner, Kilner, and Zelazo (2007) found that both mindfulness training and relaxation training groups decreased arousal to negative images, but that only mindfulness training decreased arousal to positive images.

### **Conclusion: "Seeing and Knowing Things as They Are"**

Together, increases in alertness and attenuation of affective biases suggest how mindfulness may achieve the traditional goal of "seeing and knowing things as they are" (*yathābhūtañānadassana*). One function of mindfulness is to counteract not knowing. Under normal attentional circumstances, we miss much of what is going on. By increasing phenomenal consciousness of subtle changes in our bodies, minds, and in our environments, we may make this information available to be encoded in working

memory and thus to be identified, deliberated on, and expressed to others. A second function of mindfulness is to counteract knowing wrongly. Through attenuating affective biases, we can gradually replace emotionally distorted perceptions, thoughts, and views with undistorted cognitions. These two functions of mindfulness are mutually reinforcing.

Psychological states induced by nonconscious primes or by expectations, fears, and hopes can cause individuals to misidentify perceptual stimuli in two ways. First, biases of attention may cause certain objects or features to be preferentially selected or deselected for conscious experience. Second, biases of memory may cause certain experiences to be preferentially selected or deselected for uptake into belief-forming processes. Siegel (2012) proposes that such selection effects can make the resulting beliefs less worthy of being called knowledge because these selection effects cause individuals to improperly ignore information that should not be ignored given their purposes, or to improperly bypass experience that bears rationally on the beliefs they form. In Siegel's terms, selection effects "epistemically downgrade" resulting beliefs. We have surveyed recent research suggesting that Buddhist-derived practices of cultivating mindfulness can counteract biases of both attention and memory. If so, cultivating mindfulness can epistemically upgrade certain beliefs, making them more worthy of being called knowledge.

In this chapter, we have sketched an account of two mutually reinforcing factors involved in mindfulness meditation: first, an increased phenomenal consciousness of subtle, fleeting stimuli; and second, decreases in affective biases of attention and memory. By acting on perceptual and cognitive levels, the sharpening of attention and the decrease in affective biases can function to dispel incomplete and biased interpretations. On this account, affective biases function to fixate attention such that we are not conscious in a broad and open manner; reciprocally, being receptive in an alert and open way results in a broad field of conscious experience that includes stimuli that would normally escape awareness. These include fleeting and subtle sensory clues about external conditions, as well as stimuli from interoceptive changes involved in one's emotional reactions that often influence behavior without being consciously experienced. Accordingly, we can understand the cultivation of mindfulness as resulting in fuller and more accurate awareness of external and internal conditions, and of our own and others' psychological states. To the degree that such effects of attention training result in a more accurate and more precise understanding of what leads to suffering in ourselves and in others, this chapter offers an account of how mindfulness training-based increases in the breadth and subtlety of conscious experience could result in better practical understanding of how one ought best to live. Thus, this approach offers one precise and empirically grounded way in which we can understand the claim made in the *Majjhima* text quoted at the outset, that consciousness and wisdom are conjoined.

## NOTES

1. Sutta references are to collection (e.g., *Majjhima Nikāya* (MN), *Suttanipāta* [Sn]), and then either to sutta number (in the case of DN, MN, and Iti), samyutta and sutta number

(SN), nipāta and sutta number (AN), verse number (Dhp), vagga and sutta number (Ud, Sn).

2. The term *satipaṭṭhāna* has commonly been rendered as a (plural) noun, the (four) “foundations of mindfulness.” But the primary sense of the term is verbal and refers to the active practice of establishing mindfulness, as noted recently by prominent translators such as Bhikkhu Bodhi (2011, p. 25) and Thanissaro Bhikkhu (2011). For a critique of the more standard gloss of *satipaṭṭhāna* as “foundations of mindfulness” and the commentarial derivation of the term from *paṭṭhāna* on which this gloss is based, see Anālayo (2003, pp. 29–30).
3. We would like to thank Nicholas Van Dam for helpful discussion on this point.

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