

Fear and Terror in Buddhist Meditation: A Cognitive Model for Meditation- Related Changes in Arousal and Affect

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Abstract: This article explores the extent to which cognitive historiography can be employed to comment on debates concerning the interpretation of meditative experiences in select Buddhist texts. In particular, this article considers references to meditation-related fear and other associated emotional, perceptual, and cognitive changes. Qualitative data from Western Buddhist meditation practitioners and meditation teachers are employed to further illustrate the range of fear-related experiences and how they are interpreted. To account for why certain references to fear in Buddhist literature could plausibly be read as representative of meditation-related experiences, this article develops cognitive models based on neuroscientific research on meditation as well as from cognitive and affective neuroscience more broadly. However, this process reveals some current limitations in the field of neuroscience of meditation as well as other methodological difficulties faced by cognitive historiography when attempting to account for religious experiences from other cultures and from distant times.

Keywords: Meditation; fear; arousal; sensitization

Introduction

The Approach of Cognitive Historiography

One of the longstanding challenges for historians of religion has been how to interpret the experiences of individual people or groups of people long

since deceased, especially those for whom the only available data are textual sources. Exceedingly few textual sources are unambiguously autobiographical in nature, and scholars have often relied on other documents and artifacts for windows into the world of experience.

The emerging discipline of cognitive historiography aims to employ cognitive theorizing in order to make better inferences about historical agents. Heintz (2011) contends that historians tend to make inferences based upon folk psychological notions and that one application of cognitive historiography is to enlist psychology and cognitive science in order to improve the inferences historians make in their research. Cognitive historiography attempts to account for “the recruitment and exploitation of [...] default evolutionary and cognitive biases” (Martin 2012, 166), as these tendencies “provide a foundation for and constraints upon all varieties of socio-cultural constructions,” including, of course, religions (Eidinow and Martin 2014, 7).

In his review of the first issue of the *Journal of Cognitive Historiography*, Dimitris Xygalatas (2014, 194) finds the prospects of this new approach both “encouraging and unsatisfactory.” He suggests that cognitive historiography will be at its most potent and effective when it demonstrates three key concepts: interdisciplinarity, collaboration, and experimentation. This paper embodies interdisciplinarity and collaboration by being a co-authored work by two religious studies scholars and a clinical psychologist/neuroscientist. In this paper, we also follow Xygalatas’s suggestion for experimentation by employing “experimental evidence from living subjects to make inferences about past people” (2014, 197). Specifically, we aim to develop a cognitive model based upon experimental data from neuroscience and qualitative research in order to account for references to fear in select Buddhist textual sources from Theravāda, Zen, and Tibetan traditions. In so doing, we contend that some of this textual material could indeed be taken as plausibly descriptive of the kinds of experiences had by past meditators, even if those descriptions remain situated in broader contexts that also reflect normative exegetical, polemical, or soteriological agendas. To this end, we aim to explain how cultural practices like meditation may affect human neurobiology while also remaining attentive to how embodied experiences are nonetheless situated in relation to cultural discourses and explanatory frameworks.

The Problem of Experience in the Study of Religious Literature

In a set of influential articles focusing largely on the interpretation of Buddhist texts, Sharf (1995; 1998) has problematized a tendency to read historical sources as providing straightforward phenomenological descriptions of religious experience. Rather, he argues that many Buddhist texts—in particular

the stages-of-the-path (Skt. *mārga*) literature that presents a sequence of states and traits as resulting from Buddhist practices—would be better read as exegetical, prescriptive, or even polemical in orientation. Sharf rightly points out that texts such as *The Path of Purification*—which will be discussed below—are “first and foremost scholastic compendiums [...] attempting to systematize and schematize the confused and often conflicting descriptions of practices and stages found scattered throughout the canon,” and furthermore that these texts are “eminently impersonal” in that “authors seem to have gone to great lengths to efface their own voices” (Sharf 1995, 238). Even if we presume that the authors of such texts were themselves meditators, there is little evidence that would allow scholars to conclude that the structure and content of such texts were in fact in reference to their own or anyone else’s meditative experiences. This paper will explore to what extent the approach of cognitive historiography can help scholars to better assess what relationship Buddhist literature concerning meditation has to meditative experiences. In other words, how well does drawing upon “experimental evidence from living subjects” allow us “to make inferences about past people” (Xygalatas 2014, 197)?

Fear in Buddhist Meditation Literature

Theravāda Buddhism

The dominant form of Buddhism in South and Southeast Asia is Theravāda Buddhism, which has a canon of authoritative texts written in the Pali language. Most scholarship on fear in Theravāda Buddhism discusses these early textual sources, in which fear is depicted either as an obstacle to be overcome in practice or as a context in which to further develop one’s contemplative training (Brekke 1999; Giustarini 2012; Anālayo 2019). In the canonical discourses that Theravāda Buddhists consider to be the words of the Buddha, contemplating suffering and impermanence is associated with joy and delight rather than fear, and there is no mention of fear as a desired (or undesired) outcome of meditation (Anālayo 2019). In the subsequent commentarial literature of Theravāda Buddhism, fear came to be framed as a distinct “stage” along the “progress of insight” (Pali *visuddhi-ñāṇa-kathā*) or the “insight knowledges” (Pali *vipassanā-ñāṇa*)—one of which is “knowledge of appearance as terror” (Pali *bhayatupaṭṭhāna-ñāṇa*), or sometimes simply “knowledge of fear” (Pali *bhaya-ñāṇa*) (Buddhaghoṣa 1991; Mahāsi Sayadaw 1994).

It is important to note that there are some discrepancies between how this stage of progress is described in ancient versus contemporary Buddhist sources. The earliest reference to a relationship between insight and terror

seems to be from the “Treatise on Knowledge” section of the *Path of Discrimination* (Pali *Paṭisambhidāmagga*), a canonical text traditionally attributed to the Buddha’s disciple Sāriputta (Ñāṇamoli 2002) that may date back as early as the second-century BCE (Ronkin 2005). There, various themes associated with the arising and passing away of phenomena are described as “understanding of appearance as terror” (Ñāṇamoli 2002, 59). *The Path of Freedom* (Pali *Vimuttimaggā*), attributed to the second-century Sri Lankan monk Upatissa, also contains a reference to “fear knowledge”: “owing to his discernment of breaking-up, fear arises: fear of the cause of aggregation; fear of the arising of aggregation” (Upatissa 1961, 299). In the fifth century, Buddhaghōṣa likely drew heavily from both the *Paṭisambhidāmagga* and the *Vimuttimaggā* in his more expansive commentary, *The Path of Purification* (Pali *Visuddhimaggā*). In this text, Buddhaghōṣa adopts the *Paṭisambhidāmagga* schema of having “knowledge of appearance as terror” and “knowledge of danger” follow “knowledge of dissolution,” although in the *Paṭisambhidāmagga* terror and danger are presented as a single topic. Buddhaghōṣa also clearly draws upon the *Vimuttimaggā* in his presentation of the content of “knowledge of appearance as terror,” as well as by having that insight knowledge followed by “knowledge of desire for release” and “knowledge of reflection”—insights that are not mentioned in the *Paṭisambhidāmagga*. Crucially, after describing the break-up of formations, or phenomena, and employing various similes for the resulting “knowledge of appearance as terror,” Buddhaghōṣa adds the following:

But does the knowledge of appearance as terror itself fear or does it not fear? It does not fear. For it is simply the mere judgment that past formations have ceased, present ones are ceasing, and future ones will cease. (Buddhaghōṣa 1991, 669)

Here, Buddhaghōṣa seems to be suggesting that the knowledge of appearance as terror is a fundamentally cognitive insight into impermanence that does not have an affective character. That the original significance of key concepts like fear (Pali *bhaya*) and danger (Pali *ādīnava*) might have been more a conceptual lens for analysis is borne out by their inclusion in a list of forty ways of contemplating the aggregates, according to the *Paṭisambhidāmagga*, the *Visuddhimaggā*, and elsewhere in early Buddhist literature (Vajirañāṇa Mahāthera 1962, 388–389).

Modern commentaries from the tradition of Mahāsi Sayadaw (1904–1982) in Burma have tended to view Buddhaghōṣa’s schema of insight knowledges as a set of discrete stages through which a meditator progresses in sequence as a result of practicing insight (*vipassanā*) meditation—an approach to practice that emphasizes the observation of physiological

and mental processes in terms of the characteristics of impermanence (*aniccā*), not-self (*anattā*), and unsatisfactoriness (*dukkha*). In contrast to Buddhaghosa's emphasis on judgment, commentators such as Mahāsi Sayadaw (1994) and Matara Sri Ñāṇārāma (1993), among others, present these stages in more psychological language and highlight their affective character. For example, in *The Progress of Insight*, Mahāsi Sayadaw first describes how the “knowledge of the awareness of fearfulness” is an insight into the impermanence of phenomena. But at the end of this section, he adds “at this time, [the meditator's] mind itself is gripped by fear and seems helpless” (Mahāsi Sayadaw 1994, 24). Achan Sobin Namto emphasizes the affective dimension even further, suggesting that at this stage “when the mind experiences this special kind of fear, the meditator is afraid of everything in the world, no matter how harmless its appearance” (Namto 1989, 207).

Zen Buddhism

Similar themes concerning the arising of fear in response to teachings of impermanence, selflessness, or emptiness can also be found in the Mahāyāna traditions of Zen and Tibetan Buddhism. However, in contrast to the Theravāda commentarial tradition, fear is not presented as a topic for contemplation or a discrete stage through which one passes along the stages of insight. In addition, both Zen and Tibetan Buddhist sources depict how non-referential fear—or fear in the absence of a specific object or content—can arise as part of a broader cluster of physiological, perceptual and affective side effects of meditation.

The Perfection of Wisdom (Skt. *Prajñāpāramitā*) literature central to the Zen tradition includes references to how hearing the teachings on emptiness can lead to fear in Buddhists accustomed to other views. A commentary on the *Diamond Sūtra* (Skt. *Vajracchedikā Prajñāpāramitā Sūtra*) attributed to the eminent seventh-century Zen patriarch Huineng describes how other Buddhists will be “alarmed and frightened” when they hear the Mahāyāna teachings, whereas “only those bodhisattvas with deep roots can hear this truth and accept it without becoming distressed” (Red Pine 2001, 234).

Zen traditions also identify non-referential fear as one of a number of possible effects of meditation. One context in which this is discussed is in the literature on “meditation sickness” (Chn. *chan bing*; Jpn. *zenbyō*). In *Idle Talk on a Night Boat* (Jpn. *Yasenkan*) as well as in his letters, the eighteenth-century Japanese Zen master Hakuin Ekaku (1686–1789) attributes a range of physiological, perceptual, and affective changes to his practice of “silent illumination” meditation. These include “a ‘fire’ mounting in the upper body followed by parched lungs, cold feet, fear, depression,

ringing in the ears, constant perspiration and hallucinations” (Ahn 2007, 1; Hakuin 2009). Zen Buddhists also appraise certain unexpected experiences, often perceptual distortions and hallucinations, as *makyō*, a Japanese term that has been translated loosely as “disturbing conditions” (Sōgen 2001) and more literally as “realm of illusion” (Sharf 1995). These transient phenomena are typically considered a potentially normal consequence of the development of meditative prowess. Contemporary American Zen teacher Philip Kapleau explains that *makyō* can also include both “nameless fears, the vague anxiety that comes up to haunt one as concentration deepens,” as well as fears that “rear up when one’s practice has turned a corner and ego begins to feel menaced” (Kapleau 1989, 98).

Tibetan Buddhism

In Tibetan traditions, fear is also acknowledged as a potential consequence of insight into the selflessness of persons or phenomena. As in some Zen sources described above, fear can arise from simply hearing discourses on the teachings of emptiness. Pabongka Rinpoche (1991, 695) recounts a story of disciples of Tsongkhapa (1357–1419) becoming afraid upon hearing his teachings on emptiness.

Like the Zen concept of *makyō*, in Tibetan traditions, a range of physiological, affective, cognitive, and perceptual changes, both pleasant and unpleasant, are viewed as normal transient “meditation experiences” (Tib. *nyams*). Gyatso (1999) makes the case that discussions of experience have been comparatively more common in Tibetan traditions historically and that, in contrast to what Sharf (1995) contends, they are not exclusively a product of the modern period. Pleasant *nyams*—in particular a commonly mentioned triad of bliss, clarity, and non-conceptuality (Tib. *bde gsal mi rtog pa*)—are discussed in various places in Tibetan Buddhist literature (Gyatso 1999). Sources such as *The Vajra Essence* by Dudjom Lingpa (1835–1904) provide a more comprehensive taxonomy that includes both pleasant and unpleasant *nyams*.

Lingpa (2015, 23–25) enumerates a number of *nyams* associated with stabilizing the mind through meditation. These including perceptual sensitivities such as seeing “all phenomena as brilliantly colored particles,” and “the sensation that external sounds [...] are piercing your heart like thorns.” He also identifies physiological *nyams* including “intolerable pain throughout your body” and “insomnia at night, or fitful sleep.” Many emotional states are mentioned, ranging from an “ecstatic, blissful sense [of] mental stillness” to “unbearable misery.” Also mentioned in his enumeration of *nyams* are “an inexplicable sense of paranoia” and “fear and terror” concerning a variety of topics including friends, social interactions, and weapons, which occur

“because your mind is filled with a constant stream of anxieties,” such that “everything around you [is] leading to all kinds of hopes and fears.” Lingpa explains that the specific *nyams* that will arise for a meditation practitioner cannot be predicted and that various *nyams* could be “signs of progress.” The crucial thing is that the meditator recognizes them as “expressions of the mind” and allows them to disappear “into the space of awareness, by just letting [them] be” (Lingpa 2015, 25).

Reports of Meditation-Related Fear in the *Varieties of Contemplative Experience* Project

As a means of assessing the degree to which discussions of fear from this selection of Buddhist literature can be read as a plausible experiential outcome of the practice of meditation, this paper includes data from two types of living subjects: 1) qualitative reports from the *Varieties of Contemplative Experience* (VCE) project (this section); and 2) experimental data from the neuroscientific study of both meditators and non-meditators (the following section). Across these sections, we aim to develop a model that accounts for the presence of fear and related experiences reported in the study, and that might also help us to understand the references to fear in Buddhist literature outlined above.

The VCE is a mixed-methods study of more than 60 Buddhist meditation practitioners and more than 30 meditation teachers across Theravāda, Zen and Tibetan lineages. The interview protocol queried unexpected, challenging, difficult and distressing experiences associated with meditation, interpretations of the causes and significance of such experiences, and what was helpful or unhelpful in responding to them (Lindahl et al. 2017).⁴ Data-driven qualitative coding from the VCE project found that “fear, anxiety, panic and paranoia” was the most commonly reported meditation-related challenge among practitioners, with 82% making reference to one of these experiences at least once (Lindahl et al. 2017, 16). The most common type of fear-related experience was fear as a response to other meditation-related changes. However, some practitioners reported a non-referential fear or anxiety that arose independent of other challenges. Also included were fears about meditation, fears about the duration or loss of control of other meditation-related challenges, and fears exacerbated by meditation that arose only in certain situations. An important issue for meditation practitioners and teachers alike was determining when fear was an indication of an expected stage of contemplative development and when it was an indication of a problem warranting some form of intervention (Lindahl et al. 2020). With the objective of further illuminating some of

the textual sources outlined above, the emphasis here will be limited to fear associated with insights and non-referential fear states, both of which could be considered a normal if not normative part of contemplative development.

Fear in Response to Insights into Impermanence and Selflessness

Some practitioners reported fear in response to changes in their sense of self or sense of reality. One Theravāda practitioner spoke of his experiences on retreat in Asia, during which he would have momentary intense experiences of terror in response to discerning the impermanence of phenomena:

The take-away for me in that instant was that, essentially, everything is falling away, and all of the bets you have been making your whole life about clinging to this or holding on to that, parking your boat here—had no substance. And at that moment I experienced almost paralytic terror. [...] There was a variation another time where I was walking and somehow there was a crack in the wall, and I looked into the crack in the wall, somehow with some hypersensitivity, and it triggered a sense of terror, of impermanence of things—but, again, it was very brief.

A Theravāda practitioner who undertook various retreats in the United States described fear and terror arising from a sense of the “world falling apart” and there being “no center.” For her, part of the fear was a worry about how to function in the world, a sentiment echoed by other practitioners in the same tradition. In describing her “momentary experience of non-self,” one Theravāda practitioner thought that her fear was on account of wondering “who’s going to carry on here?”

One teacher who had practiced in multiple traditions explained how in the context of *vipassanā* practice in the tradition of Mahāsi Sayadaw, “there are kinds of insight where everything is changing so fast that it appears that there couldn’t be a self” and that these have “the potential for terror.” So too, he thought that in Mahāyāna traditions in which the doctrine of emptiness of persons and phenomena is taught in terms of “everything is insubstantial—there’s no solidity anywhere,” these teachings can also be “contexts where people can get really scared.” Indeed, meditators in these traditions described how changes in their sense of self could be frightening. One Zen practitioner described experiencing “terror” when he “couldn’t find the boundary between myself and everything around me,” which he understood as an “insight” into emptiness through an experience of “interconnectedness” and “interdependence.” Another Zen practitioner described how his “sense of self kept vanishing, and it reached a point that scared the hell out of me. I remember feeling like I was about to fall into an abyss.” Similarly, a Tibetan Buddhist practitioner reported a “sense of annihilation, just a sense of dissolution—that I was literally just falling apart,” which he felt was on

the verge of becoming a “horrific experience.” Other practitioners similarly would “collapse” or “pull away from” experiences of “dissolution of perception, of self, of solidity” that felt like they would be too frightening (Lindahl and Britton 2019).

Multiple meditation teachers interviewed for the VCE study thought that meditation could exacerbate anxiety for certain people. However, those working in a context in which fear was a known if not expected stage of practice were keen to distinguish normative states of fear or terror from other sources or causes of anxiety. These include what one teacher called “garden-variety neurosis” as well as fears that arise as a result of connecting with trauma stored in the body. One way in which teachers commonly made this differentiation was based upon whether or not the fear was a consequence of insights into impermanence or selflessness. Thus, if a practitioner reported fear while also using language such as “everything is dissolving in front of me,” or “there’s no self here; there’s no substance to anything,” or “everything’s insubstantial; there’s no solidity anywhere,” teachers would interpret these kinds of descriptions as indicating that the fear is a response to key Buddhist insights and not potentially concerning psychopathology (Lindahl et al. 2020).

Non-Referential Fear States

Some states of fear, however, were not derivative of insights into impermanence and selflessness; rather, these states were more of a global mood independent of reference to a specific event or experience. For example, a Theravāda Buddhist practitioner who was undertaking extensive retreats in Asia described involuntarily oscillating between states of intense positive and negative emotion. Around this time, he described “noticing more subtle changes—quicker-moving sensations” while meditating on the sensations of breathing. Initially, these were accompanied by a state of “quiet fullness of happiness” that he identified with the Pali concept *sukha*, a term typically translated as happiness or pleasure. Then, “for some reason it just started to flip, and I can’t even remember exactly what flipped,” such that the state of *sukha* became interrupted with moments of terror. As he continued to practice,

the periods of terror grew longer and the periods of *sukha* grew shorter until it was only terror and no *sukha* at all. [...] When things would switch into terror my body was so agitated, I really couldn’t sit still. But in that first week it would switch back and forth, and I would switch it back into *sukha*. [...] When it was in the terror state, I was so agitated that it was not possible to sit—I could barely make it through a sitting. [...] One thing is that the fear state just makes you extremely sensitive in certain ways.

Another Theravāda practitioner was engaged in the practice of *vipassanā* according to the teachings of S. N. Goenka, in which meditators are trained to move attention throughout the body. He described being overcome by a “really big wave of fear, a huge wave of fear” while observing body sensations. He clarified that “when I’m sitting in my room and I fear something, there’s no external stimulus that’s telling me to be afraid; it’s only the internal thing.” Other practitioners made similar contrasts. One woman on a ten-day *vipassanā* retreat in the tradition of S. N. Goenka described feeling surprised that intense fear could arise while she “was completely concentrated on the body and there weren’t any thoughts.” Contrasting her experience with ordinary fears, she explains:

it was not fear; it was complete, utter terror. It’s a feeling that I still have a lot of difficulty articulating because it took over my body. It wasn’t just a feeling that: “Oh, something happened. I saw something fishy on the street. I was afraid. I just left.” It’s not that kind of fear. It was much, much, much deeper, and much more organic this time, so it manifested in each and every cell of my body.

She described it like “being in fight-or-flight mode, 24/7.” Another practitioner in the same tradition, who “never had a panic attack outside of retreat like this,” described how “it felt almost like I was having a panic attack; [...] my body would shake and I would be sweating.” A young Zen practitioner who had been meditating for only two months had an experience in which he “was very calm and then, all of a sudden, the deepest, most intense fear I had ever had an experience of in my entire life totally gripped me. My heart was pounding. I thought I was going to pass out or die or something. It was so awful.” This experience was so frightening that he mostly avoided meditation for the next fifteen years. One Theravāda practitioner described her experience as “a nameless dread” and, similarly, a Tibetan Buddhist practitioner used the term “existential dread” in recounting a feeling that “something is horribly wrong, [...] there was just something wrong with my existence.” He too contrasted this with a “normal kind of fear” of seeing a scary dog or being on a frightening mountain road: “It wasn’t at all that kind of fear.”

For contemporary practitioners and teachers in Tibetan Buddhist traditions, certain experiences of fear, terror or paranoia could be appraised as *nyams*. One teacher described how *nyams* can amplify existing emotions, such that “if you have some paranoia, the paranoia gets really strong.” A practitioner engaged in a long-term retreat practicing *śamatha*, a meditation technique aimed at calming and stabilizing the mind, reported having “a tremendous amount of terror,” which periodically interfered both with her waking life and with her dreams and sleep for more than a year. She described

how once “the terror overtook me, the darkness—from back behind my mind, to over the top of my mind, and then my visual fields—became so thick that there was not an awareness of the room around me, and there was also not an awareness of me being in a body.” She also reported numerous other types of *nyams* associated with *śamatha* in Dudjom Lingpa’s *The Vajra Essence*, including lights, bliss, vibrations, a “bright, alert energy,” and perceptual sensitivities “as though [she] could see the Brownian movement in the molecules of the wall.” Consistent with the tradition, her teacher also appraised many of these experiences as *nyams*. However, drawing instead upon a neuroscientific discourse, she attributed “that terror coming up” to the “activation of my sympathetic nervous system,” an idea she supported by recounting co-occurring sweating and cardiac changes in addition to other physiological and perceptual changes.

A Cognitive Model of Meditation-Induced Fear

Why would experiences of fear, terror or anxiety arise from the practice of meditation? Some of the Buddhist texts discussed above suggest that fear arises on account of or in conjunction with insights into impermanence or emptiness that radically differ from a practitioner’s default view of self and world. However, this would not account for the occurrence of non-referential fear as a transient meditation experience. Sources on “meditation sickness” or transient “meditation experiences” don’t explain why fear specifically (as well as other associated physiological, perceptual, affective, or cognitive changes) would arise from meditation. In an attempt to account for depictions of meditation-related fear in Buddhist literature, we develop an explanatory model based upon research in the cognitive and affective neuroscience of meditation as well as neuroscientific research beyond the specific scope of meditation. We begin with a model that could account for non-referential fear states, which we will suggest could shed additional light on the relationship between fear and insight in Buddhist textual traditions.

Sensitization and Non-Habituation in Meditation Research

Meditation-induced fear states can be accounted for by multiple possible mechanisms that are already well established in the meditation research literature. Here we discuss a generalized form of nervous system upregulation known as “sensitization” and two pathways of sensitization engaged by meditation: one via training of attention and one by way of somato-affective amplification through body awareness (interoception) and activation of the insula cortex.

Sensitization is the name for the process in which repeated exposure to a stimulus leads to a larger psychophysiological response with each exposure, leading to a state of widespread, multi-system neuronal excitability. Exposure to a repeated stimulus can result in an increased response (sensitization), in no change in response (non-habituation), or in a progressively lessened response (habituation) with each exposure. Because habituation conserves energy, it tends to be the dominant response. However, even studies that demonstrate an average overall habituation are likely to be masking a number of sensitization responses if the data were examined more closely (Eisenstein et al. 2012). Because habituation is considered the normal response to a repeated stimulus, non-habituation is often considered a form of sensitization.

Non-habituation to repetitive sounds was documented in one of the earliest neuroscientific studies of meditation. Brain activity called alpha blocking was recorded in non-meditating controls and in Zen monks during meditation. While the controls and some meditators showed a rapid habituation in response to a series of repetitive clicks, three advanced Zen masters showed roughly the same levels of neural response on the twentieth click as on the first one (Kasamatsu and Hirai 1966). The authors described the phenomenon as “dehabituation” and hypothesized that it was correlated with meditative proficiency.

Since then, research has demonstrated non-habituation both in advanced meditators (Antonova, Chadwick and Kumari 2015; Levenson, Ekman and Ricard 2012) and among participants in mindfulness programs (Hölzel et al. 2016; Turan et al. 2015). In their study of experienced Tibetan Buddhist meditators versus novices with no prior meditation practice, Antonova, Chadwick and Kumari (2015) used the acoustic startle reflex as an index of habituation. The acoustic startle reflex is when facial muscles contract in reaction to a sudden loud noise, and it is a reliable index of habituation because it occurs in many species and almost always leads to habituation by the fourth or fifth occurrence of the loud noise. This study found that the initial startle response to the first loud sound did not differ between non-meditating controls and meditators. However, meditators were more likely than controls to show non-habituation to repeated startling sounds, and meditators with a more intensive practice background showed significantly less habituation. In the context of a mindfulness program, Hölzel et al. (2016) assessed the physiological fear response (skin conductance) to electric shocks in both mindfulness meditators and waitlist controls. While the waitlist control group habituated to the electric shocks, the mindfulness group maintained the same high level of physiological fear reactivity. The authors explain how

a preservation of the sensitivity to the conditioning process makes sense in the light of what is being trained by mindfulness practice. Mindfulness training teaches to remain open, non-judgmental, and curious to what is occurring from moment to moment and refrain from engaging in internal avoidance. Consequently, previous studies have reported decreased habituation in experienced meditation practitioners; i.e. they maintain the freshness of attention for each incoming stimulus. (Hölzel et al. 2016, 9)

The Role of Attention in Sensitization

What aspects of meditation practice might be responsible for this upregulation of nervous system excitability that has been demonstrated across neurological and physiological systems? One of the most obvious answers is simply the intensive training of the faculty of attention, or actually multiple forms of attention, all of which have significant overlap with systems that underlie arousal (Langner and Eickhoff 2013).

Arousal is complex and multidimensional, with multiple distinct but overlapping inputs including from cortical, autonomic, endocrine, cognitive and affective systems. Behavioral concomitants of arousal include increased heart rate, sweating, psychomotor agitation, enhanced startle and insomnia, while cognitive and affective concomitants include sustained attention (vigilance), anxiety and, at higher amounts, fear and panic (Kandel and Pfaff 2019). Attention and arousal systems share overlapping brain areas such as the pre-frontal cortex, parietal lobe, anterior cingulate and brain stem, as well as neurotransmitter systems (catecholamines: dopamine and norepinephrine). Stimulant drugs that increase attentional performance like amphetamine, Ritalin, and caffeine also increase arousal and inhibit sleep (Koelega 1993) as well as trigger fear states like anxiety and panic attacks (Favrod-Coune and Broers 2010). Individuals with high levels of endogenous norepinephrine are prone to panic attacks (Goddard et al. 2010; Kalk, Nutt and Lingford-Hughes 2011).

It is possible that meditation also induces fear states through increasing norepinephrine. Non-Buddhist forms of meditation (viz., Transcendental Meditation, a Hindu-inspired meditation tradition involving the silent recitation of a *mantra*) have been found to increase circulating norepinephrine (Lang et al. 1979; Morrell and Hollandsworth 1986) but it is unclear whether these findings generalize to Buddhist forms of practice. However, pupil dilation is a reliable indicator of norepinephrine activity (Koss 1986), and Buddhist meditation has been shown to increase pupil dilation suggestive of high norepinephrine (Brefczynski-Lewis et al. 2007).

Like attention-enhancing drugs, behavioral tasks that engage sustained attention increase arousal, both in humans and in other animals. In rats, a sustained attention task but not a spatial memory task disrupted subsequent

sleep via the release of wake promoting brain chemicals (Gritton et al. 2012). In humans, both short and long-term attention training through meditation is reliably associated with activations in arousal-related brain areas that overlap with cognitive attention and alertness systems, such as the dorsolateral pre-frontal cortex, inferior parietal lobe, anterior cingulate and brain stem reticular activation system (Britton et al. 2014; Fox et al. 2016; Gotink et al. 2016; Vestergaard-Poulsen et al. 2009). One brain-wave (EEG) signature of attention and arousal (P3 / P300), which increases in response to alertness-enhancing stimulants like caffeine and amphetamines, has also been found to increase with meditation training, including short (6–30 minutes) mindfulness meditation sessions (Delgado-Pastor et al. 2013; Eddy et al. 2015; Lakey, Berry and Sellers 2011) and 8-week mindfulness training programs (Smart et al. 2016). Atchley et al. (2016) also found a stronger P3 response in both novice and expert Buddhist meditators compared to non-meditators, which they proposed as a candidate objective measure of meditation competence.

Different types of meditation practices can affect arousal systems in different ways (Amihai and Kozhevnikov 2014). Attending to the sensations of breathing was found to be less arousing than loving-kindness or meta-cognitive practices when arousal was measured by cardiac indices (heart rate) (Lumma, Kok and Singer 2015). However, in the same study, when arousal was measured as cortisol (a stress hormone) reactivity to a laboratory stressor, attending to the sensations of breathing was found to be more arousing (Engert et al. 2017). Despite this variability, these findings share a general observation that meditation practices that develop concentration through directing attention to salient stimuli while inhibiting irrelevant stimuli can have arousing effects on both endocrine and brain systems of arousal (Eddy et al. 2015; Engert et al. 2017). Whether increased through attention training, threat or drugs, increasing arousal systems can lead to fear states like anxiety and panic (Geiger et al. 2014). Thus, meditation could activate fear states by activating arousal systems and neurotransmitters through the training of sustained attention.

Sensitization and the Insula Cortex

In addition to arousal-related brain areas correlated with attention, meditation may also induce fear states by activating arousal-related areas associated with emotion, in particular with the bodily experience of emotions and emotional intensity. The insula cortex is a complex multi-purpose brain area that is associated with integrating interoceptive, cognitive and emotional information; arousal and autonomic responses; as well as emotional awareness and subjective feeling states (Craig 2009, 2011; Critchley

2005; Critchley et al. 2000). Increases in the size and activation of the insula cortex is one of the most common findings in meditation research (Fox et al. 2014; Fox et al. 2016; Gotink et al. 2016) and has been recorded during multiple forms of meditation (Zeidan et al. 2015; Fox et al. 2016), following mindfulness-based interventions (Allen et al. 2012; Farb, Segal and Anderson 2013; Hölzel et al. 2013; Gotink et al. 2016), and in cross-sectional studies of meditators versus non-meditators (Lazar et al. 2005; Hölzel et al. 2008; Luders et al. 2012), especially in response to negative emotional stimuli (Magalhaes et al. 2018). Amount of meditation practice has also been found to be correlated with increased insula size (Hölzel et al. 2008; Luders et al. 2012) and insula activation (Allen et al. 2012).

Meditation researchers typically describe meditation-related increases in insula size and activation as reflecting superior body awareness (interoception) in meditators, which has also been documented as resulting from meditation practices, especially mindfulness-based interventions (Treves et al. 2019). While there is a widespread assumption that increases in interoceptive accuracy and/or insula activation through meditation will be associated with higher levels of wellbeing, neither of these assumptions have been empirically verified. While meditation-related increases in insula activation may correspond to enhanced body awareness, increased insula activation and body awareness typically serves to amplify emotional arousal and the intensity of emotions, including fear. Indeed, insula activation is associated with a wide range of fear states and syndromes, including anxiety (Chua et al. 1999; Osuch et al. 2000; Simmons et al. 2004, 2006; Stein et al. 2007), panic disorder (Graeff and Del-Ben 2008), post-traumatic stress disorder (Liberzon and Phan 2003; Moeller-Bertram, Keltner and Strigo 2012), and traumatic re-experiencing (flashbacks) (Hopper et al. 2007; Osuch et al. 2001; Whalley et al. 2013). Insular seizures or direct cortical stimulation of the insula can induce intense fear and anxiety, sometimes accompanied by uncontrollable screaming (Mazzola et al. 2009; Nowacki et al. 2015). Similarly, higher levels of the self-observation dimension of mindfulness and objectively measured interoceptive accuracy have been found to be associated with increased anxiety-specific arousal symptoms, but not general distress or depression (Dunn et al. 2010; Desrosiers, Klemanski, and Nolen-Hoeksema 2013). Thus, fear states in meditation may also be caused by paying attention to the body, which not only increases body representation in the brain (insula), but also results in an amplification of the somatic dimensions of emotional arousal, including fear.

Indications of Convergent Validity

The theorized mechanisms of generalized arousal, attention-related arousal, and/or somato-affective sensitization can be validated via testable hypotheses. For example, if generalized or central sensitization is a mechanism, then we would expect meditation-induced fear states to be accompanied by other conditions that are also caused by sensitization, including pain syndromes and headaches (Coppola et al. 2013; Woolf 2011), tinnitus (Walpurger et al. 2003), and perceptual hypersensitivities such as photophobia or hyperacusis (Ståhlberg, Palmquist and Nordin 2018). Many of these, and other similar experiences, are referenced both in abovementioned textual sources such as *The Vajra Essence* as well as across the qualitative reports from meditation practitioners in the VCE study.

If sensitization via upregulation of attention-arousal systems is a mechanism of meditation, we would expect to see both better attention and higher levels of arousal correspond with more meditation practice. Indeed, in a review of the relevant literature, Britton et al. (2014) found that higher amounts of meditation practice were associated with multiple indices of increased cortical arousal, including lower sleep propensity that sometimes manifested as insomnia. If sensitization via insula activity and body awareness is a mechanism, we would expect to see meditation-related fear co-occur with other insula-related experiences, such as pain syndromes and emotional lability, which again is documented in both Buddhist textual sources and the qualitative reports above. Furthermore, practices that specifically target body awareness should produce higher levels of fear-related states or biomarkers. Supportive of this idea, Engert et al. (2017) found that meditation training that emphasized interoceptive awareness and body-based attention anchors (body scan and attending to the sensations of breathing) resulted in higher levels of cortisol stress reactivity compared to non-body-based practices that emphasized social perspective-taking, metacognition of thoughts, or compassion.

Conclusion: What Can Cognitive Historiography Explain?

These mechanisms drawn from the neuroscience of meditation as well as the broader cognitive and affective neuroscience of sensitization suggest possible explanations for how meditation could lead to anxiety, fear or terror, as well as reasons why these experiences might co-occur with other perceptual and physiological changes. In particular, they offer a potential account both for the inclusion of non-referential fear as a side-effect of meditation as well as for the incidence of non-referential fear alongside other phenomena associated with heightened arousal such as insomnia, pain, and perceptual

hypersensitivity as found in Dudjom Lingpa's list of *nyams* associated with *śamatha* meditation and in accounts of meditation sickness.

However, when applying cognitive models to explain religious phenomena, it is crucial to not lose sight of the historical side of cognitive historiography. First of all, it is important to recognize that in building a cognitive model, we are making comparisons across cultural contexts, and also to potentially distinct practice approaches and degrees of practice depth or intensity. Given the limited information available from the contemporary neuroscience of meditation (and the types of practices and people studied in that research), the application of a cognitive model based upon this literature remains partly speculative. Furthermore, it is important to remain cognizant of the fact that the vast majority of research in Western psychology and neuroscience in general is undertaken with WEIRD—Western, Educated, Industrialized, Rich, and Democratic—subjects whose historical and cultural contexts are rather different than the authors of classical Buddhist meditation literature in Asia (Henrich, Heine and Norenzayan 2010). So, too, participants in the VCE study were Western practitioners who were almost exclusively not raised Buddhist, but instead gravitated towards Buddhist meditation later in life (Lindahl et al. 2017). That being said, as explained above, some fundamental aspects of the cognitive model we propose—such as the relationship between attention and arousal, and habituation to the startle response—have even been demonstrated across species, so we would expect them to be stable across cultures as well.

We should also acknowledge the potential limits of the cognitive models with respect to the complexity of the historical data from Buddhist traditions. In the present case, while the cognitive models shed particular light on the affective character of meditation experiences that are presented as non-referential, these models offer less information that could help us to understand fear and terror that are described as resulting from insights into impermanence or selflessness. Psychological research has found that individuals who experience depersonalization—the feeling that the self and/or the external world are unreal—often respond to this shift from their ordinary experience with fear, and that this initial fear can be mitigated by subsequent normalizing or magnified by catastrophic appraisals (Hunter, Salkovskis and David 2014). This suggests that one account for insight-related fear could be the unfamiliarity of the experience and its impact on the practitioner's sense of self and world.

Another possibility worth considering is that insights into impermanence and selflessness could themselves be a consequence of the heightened perceptual sensitivities associated with sensitization, and that these are accompanied by fear by virtue of their shared mechanism. This would help

us to understand why perceptual changes such as the perception of phenomena as tiny particles are also presented as *nyams* in Lingpa's text, and it might also explain why the insight knowledge of appearance as terror is presented as following the knowledge of dissolution, in which the cessation of momentary mental and perceptual phenomena is observed. In *The Progress of Insight*, Mahāsi Sayadaw (1994, 22) describes this stage as analogous to "seeing the continuous successive vanishing of a summer mirage moment by moment; or it is like the quick and continuous bursting of bubbles produced in a heavy shower by thick raindrops falling on a water surface." A similar image is also found in *The Path of Purification*, which employs various other metaphors to communicate what knowledge of dissolution is like, including describing it as "like fine dust being dispersed" (Buddhaghōṣa 1991, 667). Some practitioners and teachers interviewed in the VCE study also connected a change in sense of self to a more fine-grained attention to perceptual, embodied and agentive processes. Thus, insight-related fear might not always be a result of a change in worldview; it could be the case that fear associated with insight is a result of how both emerge through the process of sensitization.

Although these cognitive models may help us to understand why certain perceptual and affective experiences may arise in meditation, as well as why cognitive insights valued in the Buddhist tradition may be related to them, there remains one other aspect of the historical data that is unaccounted for: namely, the conceptual and analytical dimensions of Buddhist meditation, which have scarcely been studied in neuroscientific research on meditation (Davidson and Dahl 2017). Indeed, scholarship on early Buddhism by Hamilton (2000), Collins (2013) and Shulman (2016), among others, has made the case for an understanding of Buddhist meditation as not only involving a "bottom-up" process of observing sensations, but also entailing the utilization of "top-down" cognitive frameworks that appraise sensations in accordance with core Buddhist concepts such as impermanence, unsatisfactoriness, and not-self. In line with philosophical and empirical research into the cognitive penetrability of perception (Zeimbekis and Raftopoulos 2015), the neuroscience of meditation would be enriched by taking into consideration the ways in which meditation-related worldviews and analytical meditation practices could shape associated experiences. We hope that these observations regarding the complexity and diversity of Buddhist meditation practices and resultant experiences will be further investigated by scientists and humanists alike.

Notes

1. Jared R. Lindahl is Visiting Assistant Professor in Brown University's Department of Religious Studies. Since 2014, he has directed the Varieties of Contemplative Experience research project, the largest study to date on the topic of meditation-related challenges. His research examines contemplative practices in a range of contexts—from Greece, India, and Tibet to Buddhist modernism and the mindfulness movement in the United States. His research attempts to integrate historical and textual studies of contemplative traditions with phenomenological and neurobiological approaches in order to investigate the relationship between contemplative practices, resultant experiences, and culturally situated appraisals of meaning and value.

2. Willoughby B. Britton is Associate Professor of Psychiatry and Human Behavior in the Warren Alpert Medical School at Brown University and is Director of Brown's Clinical and Affective Neuroscience Laboratory. She has been studying the effects of contemplative practices on the brain and body for more than a decade. She is especially interested in practice-specific effects and moderators of treatment outcome. Britton is a trained instructor of MBSR and MBCT and has taught mindfulness to clinical and non-clinical populations. She now specializes in helping meditators who are experiencing meditation-related difficulties and providing meditation safety training to clinicians and organizations.

3. David J. Cooper is a Research Assistant in the Department of Psychiatry and Human Behavior at Brown University and has worked on the Varieties of Contemplative Experience study since 2014. He received an MA in Religious Studies from the University of California, Santa Barbara, where he focused on Buddhist traditions. David is interested in narrative and social dimensions of religious experience, particularly those relating to the sense of self and to the body. He has experience both practicing with and studying contemplative communities in Asia, North America, Europe and the Middle East.

4. This paper also includes data from a subsequent replication study of meditation-related challenges as reported by practitioners (n=8) and teachers (n=1) in the tradition of *vipassanā* as taught by S. N. Goenka.

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