Mindfulness
https://doi.org/10.1007/s12671-024-02423-5

COMMENTARY

Embodied Minds: An Embodied Cognitivist Understanding of Mindfulness in Public Health

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Accepted: 26 July 2024

Abstract
In this commentary upon the article "Mindfulness in Global Health: Critical Analysis and Agenda", we articulate how scaling mindfulness technologies as multilevel public health interventions requires the framework of embodied cognition for a scientific articulation of the nuanced dynamics of mindfulness as a therapeutic technology. Embodied cognition contends that the body and bodily activity in the world are constitutive facets of mind. Mindfulness understood in terms of its embodied, enacted, extended, and embedded dimensions describes a broad set of contemplative practices that utilize the circular structure of embodiment to intervene in the complex feedback structure of the mind–body system, influencing cycles of organismic self-regulation and enactments of self-world perception. We contend that to advance the discussion, initiated by Oman, about mindfulness in public health, attention must be given to reconceiving mind–body linkages, the nature of awareness, and the vital role of non-conceptual direct experience in mindfulness interventions. This provides grounds for reconceiving mindfulness as a skillful mode of embodied social cognition and for recognizing diverse cross-cultural contemplative technologies as useful for adapting mindfulness-based interventions to specific populations needs. We also arrive at a novel model of the *decentering* skills fostered through mindfulness via non-conceptual attention to the processes underlying cognition. It also models mindfulness-based *exposure* therapy, understood not behaviorally, but through insights generated via intentionally orienting towards internal representation in order to uncover habituated patterns by which we enact both self and world perception. In this way, we may better articulate the nature of mindfulness and thus its effective application to population-scale problems.

Keywords Mindfulness · Third-wave CBT · Epidemiology · Public health · Embodied cognition · Enactivism · Fuchs · Oman · 4E cognition

Integrating Mindfulness into Public Health

The article by Oman (2023) "Mindfulness in Global Health: Critical Analysis and Agenda" explores the alignment between the mindfulness and healthcare, aiming to identify evidential bases, methods, and action agendas for the improved integration of mindfulness approaches into public health efforts. While researchers have long advocated for mindfulness' contribution to public health (Kabat-Zinn, 2019), Oman seeks to demonstrate that mindfulness proves congruent with the public health field's emphasis upon "upstream" approaches to fostering protective factors and build resilience. Meta-analyses have identified the value of mindfulness-based interventions (MBIs) in fostering the well-being of the general populations, with potential positive benefits included reducing depression and anxiety, promoting weight control, and alleviating cancer-related symptoms, as such MBIs may be cost-effective methods for building resilience at a population and systems levels. Yet, as Oman notes, attention to mindfulness remains notably scarce in literature on public health and absent from top-tier public health journals. This lack of attention has resulted in an incomplete understanding of MBIs process of change, with significant implications for the integration of mindfulness into public health interventions.

Our commentary on Oman's project will demonstrate the value of utilizing the framework of embodied

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Published online: 07 August 2024

cognition in attempting to understand mindfulness' process of change. We argue that attending to the embodied, embedded, enacted, and extended facets of mind proves better suited to dealing with the population-scale problems addressed by public health interventions.

Oman's article identified 14 axes along which mindfulness and public health are aligned to varying degrees. Existing commentaries have predominantly targeted two specific areas, Oman noted, in which that mindfulness was lacking, namely (i) the need for clearer epidemiological foundations and (ii) the promotion of intercultural mindfulness interventions. Our elucidation of mindfulness via embodied cognition offers utility in providing a framework that synthesizes these subjects. Additionally, our research contributes to the understanding of an area Oman mentions as being in alignment but does not include as an axis for comparison, namely (iii) physical-mental health linkages. As such our commentary has creative implications for the generation of novel multilevel intervention strategies, in line with Oman's broader project.

To appreciate how embodied cognition provides stronger foundations for the integration of mindfulness interventions into public healthcare, we will briefly outline the focus of existing commentaries on Oman's work. Our understanding of mindfulness' process of change as embedded, enacted, extended, and embodied contributes to our understanding of the *epidemiological foundations* of mindfulness as a population health indicator (Levin, 2023); the integration of digital MBIs in post-pandemic settings (Barcaccia et al., 2024); and the meta-analysis of the effects of MBIs on global cognitive functions (Zainal & Newman, 2023). Understanding the manner in which mindfulness is always already culturally embedded, religiously extended, and socially enacted provides utility for commentaries exploring (ii) the intercultural and interreligious competencies of MBIs (Henning et al., 2024), including subjects such as the applicability of mindfulness to ethnically diverse populations (Sandage & Stein, 2024); connecting contemporary mindfulness with its Buddhist roots (Furnell et al., 2024); highlighting the shared foundations between mindfulness and complimentary modalities such as compassion training; identifying diverse "mindfulness-based" contemplative practices (Galante & Van Dam, 2024); and attending to specific non-Buddhist contemplative traditions such as Christianity (Knabb & Vazquez, 2023; Wang, 2024).

As we will demonstrate, embodied cognition offers enhanced understanding of the process of change undergirding MBIs. Resultingly, it constitutes an integrative framework for evolution in our understanding of the evidential bases, and forthcoming action agendas, required for optimal integration of mindfulness into future public health efforts.

The Nature of Mindfulness

Before elucidating the embodied cognition-based understanding of mindfulness process of change, we begin by raising the foundational question: what is mindfulness? Several commentaries on Oman's work focus on the difficulties associated with the current use and understanding of the term mindfulness. We agree with Sedlmeier (2023), for instance, in his suggestion that the current lack of agreement on what mindfulness practice(s) are, and how their effects can be explained, proves detrimental to integration of mindfulness into public health. Widely diverging conceptions of mindfulness practice exist, and different mindfulness practices yield quite different effects. While heterogeneous nature of the models describing mindfulness practice presents problems, embodied cognition provides us an overarching tool whereby we can describe the *general category* of contemplative technologies, while also identifying with specificity particular culturally embedded mindfulness practices, thereby causally elaborating these differential effects. In this way, we may better appreciate when, how, and why specific mindfulness practices work and for whom.

Despite the plethora of diverging mindfulness(es), discussion benefits from starting with a taken-for-granted definition. We utilize the definition offered by Kabat-Zinn, founder of Mindfulness-Based Stress Reduction (MBSR): "the awareness that emerges through paying attention on purpose, and nonjudgmentally, to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). Central to this definition is attention to "present moment" experience, achieved via the regulation of attention onto occurrences in real-time—be they sensations, thoughts, or feelings. Mindfulness in third-wave cognitive behavioral therapy (CBT) is commonly understood as just such a "present-centered" and "non-evaluative" mode of awareness (Kabat-Zinn, 2003). This mode of awareness is assumed to have intrinsic value as a means of both promoting mental well-being and interrupting negative discursive thought patterns. While Kabat-Zinn's definition of mindfulness captures many contemplative practices, it is not necessarily universalizable. Galante and Van Dam (2024) in their commentary suggest that rather than incorporating ever more contemplative practices under the umbrella term "mindfulness," it may be better to provide more delineated attention to diverse contemplative practices. These authors rightly identify problems that emerge when mindfulness is defined via a limited set of specific processes and practices.

Oman similarly juxtaposes the "essential characteristics" view of mindfulness against the critiques offered by Eleanor Rosch—notably, a foundational scholar in the

dialogue between Buddhism and embodied science. Rosch (2015) presents a view of MBSR practice as not teaching "just mindfulness" as described by Kabat Zinn (2003, p. 283), but rather viewing MBSR as involving "a potpourri" of practices, from which she provides on a "template of the factors at work". These include:

> "bodily movement practices; vigilance, interruption, correction of habitual patterns and thought distortions; enhanced relaxation and sense of agency; sleep facilitation activities; better discrimination between sensations, feelings, emotions, and thoughts" (Rosch, 2015, p. 279).

Such factors extend beyond the "essential" characteristics identified by Kabat-Zinn. Rosch identifies the necessity to move beyond core components of MBIs identified in foundational models. As Oman notes, developers do not always fully understand the dynamics of their own creations. Before providing an embodied cognition-based understanding of mindfulness, we will consider the ambition, present in a number of Oman commentaries, to bridge clinical mindfulness constructs with deeper themes in traditional Buddhist psychology,

One concern raised with attempts to identify the essential characteristics of mindfulness interventions is that this project has diverged from the traditional contexts out of which mindfulness is derived. Commentators Furnell et al. (2024) recognize that many contemporary mindfulness practices have become disconnected from their roots in Buddhist ethics and wisdom principles such that the fundamental essence of the practice is no longer recognizable. The desire to bridge clinical mindfulness constructs with deeper themes in traditional Buddhist psychology is reflected in the attempt by Maloney et al. (2024) to adapt MBIs to offer supplementary programs to support graduates into deeper Buddhist psychological themes, while commentators Jiang et al. (2023) orient attention towards the traditional Buddhist interrelation of compassion and mindfulness, which shared foundations, complimentary effects, and common goals; commentators Gilbert et al. (2024) seek to enhance this dialogue by offering a three-way exposition of compassion from a clinical, Theravadin and Mahayana perspective, in order to foster insight, understanding, and the training of compassion. Gallagher et al. (2024), similarly, explore the mechanism of mindfulness turning back to engage core insights from Buddhist psychology, concerning mind–body phenomena and the self-pattern. The ambitions of these commentators reflect the desire for a fuller contextually embedded understanding of mindfulness, responding to the limitations that follow from taking mindfulness in a decontextualized, disembedded form.

While still drawing upon the popular concept of Buddhist psychology as an "age-old tradition of Eastern Wisdom," incorporation of mindfulness as a therapeutic tool has proceeded without serious engagement with the original Buddhist sources from which mindfulness technologies derived. While the reinterpretation of Buddhist technologies in a modern context is not intrinsically problematic—acculturation is an inevitable and universal process—the application of Buddhist psychology derived technologies in varied contexts may be better served by careful attention to the contexts from which mindfulness(s) arose. To speak of *the* Buddhist view of mindfulness must be resisted. While therapeutic application of mindfulness derives predominantly from Southeast Asia, mindfulness practices hold an important place across many eastern contemplative traditions; consequently, a range of traditional understandings of mindfulness go unacknowledged (Dreyfus, 2013).

Contemporary clinical discussions of mindfulness would benefit from elaborating the various Buddhist mindfulness(es). One illustrative example of this project has been undertaken by Anālayo (2024) who attempts to distil from the textual sources of early Buddhism, information on central functions, and core characteristics of mindfulness. As Anālayo notes, the long process of textual transmission available in the Pāli discourses, alongside Chinese, Sanskrit, and Tibetan lineages, often present perspectives that differ from later meditation traditions, thereby inviting an exploration of alternative modalities of implementing mindfulness-related practices into clinical settings. Here, Anālayo's project is not to narrow down the perspective so as to arrive at the one and only "correct" type of mindfulness, instead the intention is rather to broaden perspective by exploring just one out of several valid alternatives. Despite this plethora of contextually situated mindfulness practices, the majority of MBIs utilize highly secularized models of mindfulness conceived under the auspices of third-wave CBT.

CBT utilizes mindfulness as a set of tools and coping strategies towards the ends of *cognitive restructuring* and *behavioral modification.* Mindfulness is so understood to support CBT's goals of *cognitive restructuring* by challenging maladaptive thought patterns, increasing awareness of automatic thoughts and emotional reactions. It supports *behavioral modification*, via enhancing emotional regulation and reducing automatic reactions through the paying of nonjudgmental attention to distressing stimuli; mindfulness thereby fosters a space between stimulus and response, facilitating the desensitization goals of exposure therapy. In these ways, mindfulness is understood to promote adaptive ways of engaging one's experiences (Shikatani et al., 2014). Renderings of mindfulness within CBT rely upon subtle misconceptions of mindfulness, which we suggest limit the full range and utility of MBIs in public health.

These limitations are absent when mindfulness is approached, rather, from within an embodied cognition framework. This is as embodied cognition provides a scientific means of articulating the nuanced dynamic feedback loops through which self-world perception is enacted. This will provide the theoretical foundations for the relationship between mindfulness, mind–body linkages, and the nature of awareness. It will also offer alternate modelling of mindful *decentering* via attention to the process underlying cognition, and mindful *exposure therapy* via the therapeutic effects of intentionality cultivation and exposure to internal representations. With this clinical reconceptualization of mindfulness, we finish by elucidating the implications for public health interventions.

Embodied Understandings of Mindfulness

Embodied cognition holds that cognition is derivable from and dependent on our bodily interactions with the world (Shapiro, 2011). From this perspective, the functioning of the human mind is inextricably tied to the mind's subjective experience of the body-in-the-world. This attention to the subjective experience of mind offers a richer understanding of mindfulness. We will utilize a specific model of embodied cognition known as 4E cognition, which characterizes cognition being as not just embodied, but also embedded, enacted, and extended—in the understanding of minds and disorders of minds (de Haan, 2020). This offers a better parallel with Buddhist psychological understanding of the mind as generated and specified through operations of sensorimotor processes that cross the domains of the brain, body, and world. To describe, 4E cognition: we can say that cognition is *Embodied*, an organism's body plays a constitutive role in the cognitive system. Cognition is *Embedded* in a physical or social environment. Cognition is *Extended* as environmental and social resources are not merely useful tools, but *constituents of* a larger cognitive system. Cognition is *Enacted* as cognition emerges from or is constituted by sensorimotor activity and thus conceived in terms of the biodynamics of living systems (Varela et al., 2017). Understanding the embodied, enacted, extended, and embedded nature of cognition proves vital to appreciating how mindfulness attention to present moment sensory experience is effective in producing therapeutic change, both in its clinical utilization and on a public health system's level.

The Phenomenological Approach to Mindfulness

Phenomenology involves exploring the structure of consciousness as directly experienced from the first-person perspective. Such phenomenological attention to the lived body undergirds the embodied cognition framework and explicates a view of the body-mind relation which sheds light on the breadth of mindfulness' clinical utility. Conversely, biologicalism, or biological reductionism, describes a tendency to conceive the subject as a "thing" understandable solely by recourse to constituent material parts. In attempting to model mindfulness as instantiated in neural networks visible through the use of brain imaging tools, cognitive neuroscientists have been guilty of biologicalism. Such an approach confuses the biological conditions for mindfulness with mindfulness itself, which, as traditionally described, consists in the exercise of a range of experiential skills in directed and ethically situated action (Thakchoe & Tempone Wiltshire, 2019; Tempone-Wiltshire & Matthews, 2024). It is vital to understand that embodied cognition is a phenomenological rather than a biologicalist framework.

The founder of phenomenology, uses the term *chiasme* to refer to a crossing of two lines in bodily life. We do not *have* a body, but rather, *are* bodily. To be bodily is to share a radical openness with the world. The lived body is not an *object in* the world, but rather self and world are seamlessly interwoven, and a constitutive condition of a world in perception. As a consequence, to understand minds is to understand embodiment. Our embodiment is constituted by dual aspects—the living and lived body—body as subject (*Leib*) and body as object (*Körper*). These dual aspects exist in circular relation bringing forth one another, and our embodied subjectivity in the world depends upon this circular relation. We can understand *Leib*, as the transparent, pre-reflective background of our world-directed perspective, while *Körper* is an explicit part of our subjective experienceable world (Stapleton & Froese, 2016, p. 124).

Biologicalist, as reductive material accounts, seeks to *describe* the living "object" body; *Körper*, in an attempt to provide totalizing *explanations* of the human subject. However, the body is not just a corporeal presence reducible to biological interactions (*körperhaft*), the body is also a lived "subject," *leib*. It is this "bodily" (*leibhaft*) manner that shapes our worldhood (Merleau-Ponty, 1962). The body, thus, is not an object amongst other objects, but rather the subjectively lived grounding dimension to the horizonal structure of experience and the life world. Thus, the body as often presented, as object ontologically separate from what constitutes one's subjectivity, is an absurdity. From this perspective, we can begin to understand mindfulness as a set of technologies that facilitate the disclosure of the embodied experience of the lived-subject, and in this way make direct contact with the real affective and sensate enactments of life.

Fuchs is one of the few thinkers who pragmatically applies these phenomenological and embodied principles to clinical applications, particularly through the notion of circularity. As Fuchs (2020) suggests, this lived body is the organism itself under the aspect of a holistic aliveness, and

such an aliveness is manifested subjectively and intersubjectively. The mind is not merely a disembodied internal representation of an external world or a system of mental algorithms for predicting the world, rather the *embodied* mind integrates the state of the entire organism in interaction with its environment. The mind is not a discrete or separate entity but rather a subject whose experience extends over the lived body, and who, via its mediation, is in constant contact with the world. Embodied cognition offers a means to attribute a more than epiphenomenal role to bodily subjectivity and a causal role to the embodied awareness of the lived body.

Mindfulness, Circularity, and Looping Affects

Fuchs (2020) examines the clinical implications of the embodied view by expanding upon Merleau-Ponty's chiasmatic world. By chiasmatic, Merleau-Ponty describes the inescapable intertwining of the world, and its perception. Fuchs adds to this his notion of circularity, to describe the relation between the phenomenology of lived experiences and the dynamics of organism-environment interactions. Circularity can be described in a threefold manner: as referring to the *circular structure of embodiment* (the homeostatic cycle between the brain and body); *circular causality* (the causal feedback between the organism embedded in its environmental system); and *circularity of process and structure in development and learning* (the role of subjective experience in the process of sense-making that in turn modifies underlying neuronal structures).

Such attention to circularity and feedback effects offers us a different perspective on the processes of change undergirding mindfulness practices, offering a conception on which mindful awareness, or bare attention to embodied experience, supports the processing of *brain-body* and *body-environment* interactions, which in turn has a formative ordering effect upon underlying physiological processes. Such a phenomenological reconception has important implications for public health conceptions of the mind–body relationship.

The circular feedback loops that constitute embodiment connect the upper cortical processes of cognition to affective, sensate, and environmental levels of human experience (Schore, 2019). Such a view has gained increasing support empirically and provides a rich basis for conceptualizing mindfulness' clinical utility. Despite this, circularity is failingly absent from public health discourse. Empirical support for this principle of circularity between self-world relationships is present, for instance, in the field of interpersonal neurobiology. In recent years, hyper-scanning studies have been developed which can quickly measure the brainwaves of two people as they interact in real time. Such technology has illuminated the role that physiological inter-brain synchrony plays during psychotherapy as an indicator of effective therapy and that inter-brain plasticity might be a biological mechanism underlying the experiential encounter of attunement which drives therapeutic change (Sened et al., 2024). This has demonstrated how attending to the neuronal activity of an individual in isolation reflects a failure to understand how brains synchronize, and minds exist in relationship. The work of Schore (2019) has further progressed our understanding of the interpersonal regulation of affect, through illustrating the way in which an infant learns self- and co-regulatory capacities as part of an open dynamic system with an emotionally responsive adult. By reconceptualizing the mind as a process regulating the flow of energy and information through neurocircuitry when it is shared and regulated between people, through engagement, connection, and communication, we are making headway in understanding how the synchronization of minds produces therapeutic change.

The mind cannot be presumed to end at the boundary of the skin: nor understood as the possession of a singular organism in isolation, rather mind critically involves organism-in-environment relations (Tempone-Wiltshire & Dowie, 2023a, 2023b). Understanding mindfulness' process of change requires a radical reconceptualization and a turn in emphasis away from the cognitive restructuring emphasis upon *degree of belief* a person holds in their thoughts, to direct insight into their "self" as product of self-in-environment dynamic interactions, and as a construction generated by perceptual models which shape one's life experience and exteroceptive perception of the world. Therapeutically beneficial effects such as increased neuro-cortical integration and reduced generalized states of reactivity flow from such a re-perspectivization (Brown & Engler, 2020).

Mindfulness, Interoception, and Feedback Loops

From an embodied perspective, mindfulness plays an important role in a number of vital cyclic processes. This includes mindfulness' role *in* cycles of *organismic self-regulation*, as facilitating the making of contact with one's basic bodily sense of self, and thereby facilitating self-insight, self-understanding, meta-cognitive awareness, and reflective function (Bateman & Fonagy, 2019). Mindfulness also facilitates awareness of sensorimotor coupling between the organism and environment, thereby offering a more "ecological" or "extended" understanding of one's embodied coupled relationship with their surroundings, including how we orient towards *self*, *world*, and *other*. Not only is mindfulness an important technology for enhancing bodily self-awareness and self-regulation but also influences how we co-regulate in relationship and communicate affective, sensate, and cognitive content through inter-brain synchrony. This has

important public health implications as will be seen; the epidemiological foundation of MBIs requires an awareness of these various forms of mind–body and self-other-environmental coupling.

Findings in affective neuroscientific research have demonstrated that an organism's self-sustainment depends upon a background consciousness of the homeodynamic regulation of the entire body (Damasio, 2011). MBIs would benefit from appreciating the role that mindfulness plays in intervening in such homeodynamic regulation. Mindful contact with the lived body utilizes our animate felt and sensate perception of self-in-environment dynamics, to foster and nourish our self-sustainment. Such self-sustainment includes and draws upon a range of centers in the brain stem, hypothalamus, and insular cortex, which are involved in the generation of a "self-concept" via the transfer of information from the felt interiority of the body (Tempone-Wiltshire & Dowie, 2024b). This has been characterized as an "interoceptive loop" which sustains organismic homeostasis. The feeling of being alive is generated through such interoceptive feedback, the hue of comfort or discomfort, pleasure or displeasure, relaxation or tension, and other basic moods—the basic bodily self-affection or a minimal form of subjectivity or "personhood" (Tempone-Wiltshire & Dowie, 2024a). In this way, the basic processes of mind and self are ultimately rooted in homodynamic regulation between the brain and body.

Such interoceptive feedback is complexified by Hofstadter's (2007) notion of a "Strange Loop," which refers to self-referential structures or processes that feed back into themselves in a recursive, seemingly paradoxical, manner. Hofstadter suggests that the mind can be understood as the product of intricate, self-referential loops which give rise to consciousness and self-awareness. The self is "strange" in that it is a feedback loop that involves seemingly paradoxical level-crossings, whereby higher-level symbolic representations can impact lower-level physiological processes, in a continual evolving cycle. The notion of "circular causality," or downward/upward causation, describes the causal relation that emerges between higher- and lower-level processes, and between the whole and components of a system (Fuchs, 2020). These causally circular phenomena describe how mental processes, such as embodied awareness, are not merely epiphenomenal by-products but constitute integral acts of living organisms that shape an organism's physical behavior.

The causal power of subjective embodied awareness should be understood to affect physiological processes not as an external force, but as a top-down formative influence. Just as the bodily experience of hunger and anxiety lead to the actions required to satisfy hunger or avoid threat, so too, mindful awareness of difficult emotional content, traumatic memories, and overwhelming affect can function to overcome or transform one's experience of these phenomena, re-working interoceptive maps of reality by combatting experiential avoidance (Dowie & Tempone-Wiltshire, 2022, 2023). Awareness of dysregulating affect, while held within one's window of tolerance, offers a means by which the individual can safely encounter what was previously conceived to be overwhelming, and had thereby produced distortions in self-, other-, and world-perception. In this way, a re-organization of one's perceptual experience of reality may occur. The reconceptualization afforded by mindfulness, from a 4E standpoint then, provides a means to mediate, organize, and integrate the totality of self in the world. Such a construal is more in alignment with traditional understandings and utilizations of mindfulness as part of a wider structure of practices for gaining direct insight into the pre-fabrication of perception.

Mindful Perception and Operative Intentionality

To understand the role of mindfulness in generating therapeutic insight into the pre-fabrication of perception, we will utilize the concept of operative intentionality. The operative intentionality of a bodily "subject" refers to the interoceptive feedback between awareness and the visceral deep body, which is generative in both perceptual sense-making and in turn *action* in the world.

Our embodied subjectivity is extended in our being toward-the-world, yet importantly this extension is mediated by the habitual functioning (Fuchs, 2020). This operative intentionality describes habituated patterns of feedback sent from the visceral deep body to the brain which provides the sense of "mineness" that pervades all interactions with the world. It is this visceral bodily self that is compromised in mental illness, and this which is the target of mindfulness practice. Through bare attention to present moment experience, one can come to understand the ways in which self is enacted through habituated patterns of interoceptive reactivity.

Perception is best understood, then, as an active process of sense-making through subject-environment interactions, and mindfulness is understood to constitute an intervention in the circular relation that holds between perception and sense-making. Via habituated cycles of sensorimotor interaction, the lived body pre-reflectively enacts a world in perception. In this way, interoception serves as the basis of exteroceptive world perception. This relation undermines any assumed separation of mind from body, and body from world. Perception, then, is anchored in self-awareness—consequently to perceive the world is to co-perceive oneself. We arrive at a notion of action as embedded in, and dependent upon, the operative intentionality of a bodily subjectivity,

responsive to interoceptive circular feedback, via the chiasmatic interweaving of the living and lived body.

Foundationally, from an embodied cognitivist perspective, the mind is intersubjectively formed from birth; the plastic matrix of the infant's brain is shaped by the higher-order patterns of social interactions (Kuhl, 2010). Such interactions both restrict and determine what the growing embodied mind takes as meaningful "social affordances," and what remains meaningless. This is an endless process that involves the constant incorporation of experience in the perpetual incarnation of existence. From this perspective, we can appreciate the role of mindfulness, when transmitted through imitation and joint attention, as an embodied social practice, or higher-order social interactional pattern, that exerts downward causal influence upon the plastic matrix of the brain. We arrive on this account, at a view of mindfulness as an apprenticeship into shared ways of sense-making constituting a novel cultural affordance that counteracts involuntarily learnt and habituated patterns produced by harmful enculturation. In this way, mindfulness offers new ways that living being can make sense of the environment, new affordances, and possibilities of action.

Mindfulness and Physical-Mental Health Linkages

By considering the role of operative intentionality, interoception, and circular feedback, it becomes apparent that the foundations of subjectivity and self-world perception reside in the visceral deep body, and that mindful interoceptive awareness offers a technology to transform both one's underlying physiological processes and self-world perception. Embodied cognition therefore offers the attention Oman calls for, implication of the linkage between physical and mental health for MBIs.

The existing framework of CBT gives insufficient attention to the nature of physical-mental health linkages and therefore fails to acknowledge the way mindfulness may cultivate resilience on individual and collective scales. Such linkages are better appreciated via embodied cognition, which provides a framework for appreciating the intricate feedback mechanisms that hold between the endocrine, immune, and nervous aspects of the mind–body system (Tempone-Wiltshire & Dowie, 2024b). This framework can even more comprehensively describe the interrelation between intra- and inter-personal challenges, extending into the dynamic systems exchanges between conflicting cultural groups and populations. As argued elsewhere in relation to non-ordinary states of consciousness, this holistic approach underscores the interconnectedness of individual physiological processes and broader social dynamics, with important public health implications for the multifaced nature of health and well-being (Tempone-Wiltshire & Dowie, 2023c; Tempone-Wiltshire & Matthews, 2023). This highlights the potential role of mindfulness in addressing both personal and collective factors in health interventions.

Public health interventions require an account of the relation between mental-physical states, as well as the self-world states that are deeply inculcated in human suffering and reactivity. Such an account sets the foundations for appreciating the broader implications of mindfulness interventions, and also proves more congruent with Buddhist psychology from which traditional mindfulness techniques are derived. As akin to Indigenous psychologies, mindfulness originates from within Buddhist traditions which conceive the mind and body as parts of a functional unity (Tempone-Wiltshire, 2024a). Buddhist psychology emphasizes an understanding of mind–body phenomena as co-produced by interdependent factors within the mind, body, and environment—a concept known as dependent or co-dependent origination (Anālayo, 2020). The reciprocal relationship between consciousness and bodily experience, and internal experience in dynamic exchange with the external world, places Buddhist psychology in congruence with the framework of embodied cognition.

An Enactive Understanding of Decentering

The framework of embodied cognition is better equipped to understand the nature of mindful "decentering" in clinical practice. Decentering describes the ability to observe one's thoughts and feelings without being fully identified with them (Segal et al., 2018). Third-wave CBT understands decentering as observing one's thoughts more "objectively," rather than automatically accepting thoughts as accurate and allowing them to dictate emotional responses.

CBT through attempting to reflect upon the content of cognitions misconstrues mindful decentering. Mindfulness in traditional context focuses not upon content but instead attends to the underlying origination of cognitions to achieve insight into the *process* of thought directly (Anālayo, 2020). In mindfulness practice, through nonjudgmental attention to the present moment, individuals learn to observe the arising of "experience" without entanglement. Such "bare attention" involves paying deliberate, nonjudgmental attention, moment by moment to whatever comes into awareness. This "process-oriented" form of decentering intentionally abstracts away from engagement with the *conceptual content* of thought, to gain insight rather into the deeper underlying *patterns* of thought that are repeatedly enacted. This enactive perspective emphasizes the individual's *relationship* to their thoughts over the thoughts themselves, supporting the capacity to observe one's experience and thoughts as *subjectively generated phenomena* which are transient and

constructed rather than objective and real. This turns attention away from the *degree of belief* a person holds in their thoughts, towards the *way they respond to* their thoughts, emotions, and physical sensations.

In contrast to the cognitive behavioral understanding of decentering via addressing irrationally held conceptual beliefs, mindfulness emphasizes the use of a non-conceptual, directly experiential form of awareness. Such mindful decentering requires the development of increasingly subtle awareness of the mind–body relationship, via the felt sense of the lived body. Bare attention to an object of the lived body—be it the breath, bodily sensations, or emotions—may generate insight into the construction of self-, other-, and world-perception. This insight, in turn, may generate the therapeutic change process. The above account of interoceptive world-building, i.e., the circular feedback structure of embodiment, supports our understanding of the visceral programming of the lived body in enacting self-world relations, and the potential for mindfulness to interrupt habituated patterns of perception and behaviors.

Mindful Awareness, Non-conceptuality, and the Lived Body

The form of decentering achieved through mindfulness depends upon the generation of direct, non-conceptual insight into our experience (Anālayo, 2020). While such non-conceptual insight forms the basis of Buddhist psychological understandings of mindfulness, it is difficult to integrate into cognitive behavioral frameworks.

In contrast, embodied cognition supports an understanding of the central role of non-conceptuality in mindfulness, in line with its function in traditional contexts. This is as embodied cognition begins not from cognition alone, but from sensorimotor processes and operations which crisscross and integrate the brain, body, and world. The conceptual element of cognition is recognized within a 4E framework as only one aspect of lived experience. A broader embodied conception of mind provides a basis for understanding the therapeutic function of bare attention to bodily and worldly experience.

While cognitivist and behavioral theory both view bodily activity as influencing cognition, in mindfulness it is not bodily activity itself that influences cognitions, rather it is awareness of the body that is the agent of therapeutic change. The body that matters to mindfulness is not the living body, but the body that is *lived*. As such, the cognitive behavioralist emphasis upon modifying observable behaviors fails to recognize that in mindfulness, it is awareness itself that constitutes the intervention. This distinction becomes even more apparent if we consider CBT's understanding of mindfulness as a form of exposure therapy.

While compelling similarities exist between Buddhist mindfulness practice and behavioral exposure–based therapeutic interventions, important divergences exist too, relating to the role of awareness and the lived body. Rather than mere exposure to real-world external events, mindfulness places emphasis upon the cultivation of an intentional stance and relation to one's underlying internal representations. To appreciate how mindful attention to internal representations transforms external perception, it is necessary to understand how interoceptive loops generate exteroceptive pre-reflective enactment of a world of perception.

Is Mindfulness Exposure Therapy?

Exposure therapies are designed to respond to sensitization or desensitization processes. As a consequence of trauma, organisms can develop problematic sensitization responses that amplify over time to a disproportionate point of radically heightened reactivity (Tempone-Wiltshire, & Dowie, 2024b). The nature of exposure is to gradually desensitize an individual to a stimulus. As such trauma-exposure approaches construct desensitization protocols, utilizing tools such as the Subjective Units of Distress Scale (SUDs). Such self-rating systems are utilized to titrate situations in which a traumatized individual is gradually given increased exposure to a stimulus that is activating and yet still tolerable in order that individuals may gradually increase their tolerance towards the distressing stimuli.

Mindfulness has been conceptualized as just such a form of exposure therapy (King et al., 2016). There are evident hallmarks of similarity between Buddhist mindfulness and exposure therapies. The Buddhist notion of "Dukkha" understood commonly as *suffering* or *primal confusion* (Garfield, 2014), we contend, may also be conceptualized as *reactivity.* This is because the path out of suffering requires attending to experience as it is, without the embellishment of aversion and craving (*taṇhā*) which generate reactivity and results in suffering. In this way, Buddhist mindfulness practice and behavioral exposure–based therapeutic interventions share similarities in their focus upon redressing reactivity in the mind.

To understand how conceptualizing MBIs as exposure therapy does not capture the full mechanism of Buddhist mindfulness, we turn to the Satipaṭṭhāna Sutta. The Satipaṭṭhāna Sutta is one of most celebrated discourses in the Pāli Canon, acting as the foundation for modern vipassana meditational practice (Anālayo, 2020). These suttas stress the practice of "sati" or mindfulness and identify four "foundations of mindfulness" for the extinguishment of suffering. The Satipaṭṭhāna Sutta details these four ways of establishing mindfulness to relate to present moment experience via mindfulness of the body,

feeling tones, mind, and mental objects. Buddhist traditions emerging from the Pāli Canon, such as the Burmese Buddhist Goenka lineage, place emphasis upon the mindfulness (*vedanānupassanā*) of *vedanā* in meditative practice (Tempone-Wiltshire, 2024a). Vedanā may be defined as pleasant, unpleasant, or neutral feeling tones that arise when the sense organs come into contact with objects of perception. By interceding through the cultivation of equanimity—involving mindfulness, or nonjudgmental awareness of, *vedanā* or feeling tones—the patterned, habituated reactions (*saṅkhāra*) which are expressed as either aversion or craving towards the sensations of the lived body may be deprogramed. Mindfulness practice, so conceived, may be understood as a method for utilizing awareness to reduce reactivity. Exposure therapy might also be understood as a method of reducing reactivity, but crucially only to specific external stimuli. Buddhist mindfulness offers a more detailed attenuation of the reactive features of the mind. As a result, rather than an emphasis upon alleviating phobic avoidance through desensitization to a particular distressing stimulus, in mindfulness this alleviation occurs primarily through the practitioner's intentional orientation towards internal experience. Through bare attention to arisings in the field of awareness in the here-and-now, the practitioner comes to understand how their reactive suffering is driven by aversion and craving for different sensations, and how this in turn generates the broader pattern by which one *enacts* both self and world perception.

Public Health Implications of Embodied Cognitive Understanding of Mindfulness

Having provided an embodied cognitive understanding of the nuanced dynamic feedback loops through which self-world perception is enacted, we have theoretical foundations for understanding mindfulness' process of change. To elucidate the implications of our embodied understanding of mindfulness for public health interventions, we return to the concerns raised by Oman: that mindfulness uptake in public healthcare has provided insufficient epidemiological foundations, inadequately generated multilevel interventions, and calls for greater incorporation of cultural and religious adaptations. Through our explication of mindfulness' process of therapeutic change, we have already addressed the issue of lacking epidemiological foundations. We turn in what follows to elucidating the relevance of this understanding to scaling mindfulness to multilevel interventions and adapting MBIs to be culturally and religiously embedded in social context.

Multilevel Embodied Mindfulness Interventions

A major overarching recommendation provided by the US Institute of Medicine (2000) is that:

> "Rather than focusing interventions on a single or limited number of health determinants, interventions on social and behavioral factors should link multiple levels of influence (i.e., individual, interpersonal, institutional, community, and policy levels)" (p. 9).

As described in previous sections, embodied cognition's emphasis upon strange loops of causal feedback across levels reflects the social-ecological approach needed to strategically implement mindfulness as multilevel interventions. Applying MBIs as multilevel interventions benefits from an understanding of embodied cognition, because pathology and well-being are relational and emergent processes of sense-making through a lived body, inseparable from the world that we shape and that shapes us. Public health policy not governed by such a focus renders interventions that are detached from the meaning of distress, as meaning itself is a relationally embedded, culturally facilitated phenomenon (Fuchs, 2020). Interventions that take place exclusively within a medical framework therefore lack the capacity to engage with cultural and social dimensions.

While as Oman notes, social determinants of mindfulness are rarely acknowledged, a 4E conceptualization of mindfulness may augment MBIs' broader determinants of well-being and application for specific populations. One way in which 4E cognition contributes to understanding the determinants of public health concerns the inclusion and incorporation of first-person and second-person research methodologies, in congruence with the recent qualitative turn in public health research (Bernard, 2017). As will be seen, understanding the development and learning of mindfulness is vital to implementing mindfulness within preventative health systems.

Learning and Development of Mindfulness as Embodied Social Practice

The understanding of how mindfulness achieves therapeutic change provides a useful framework for appreciating how MBIs are necessarily socially embedded and culturally enacted. The development and learning of mindfulness tools, and consequently the scaling of mindfulness interventions at different levels, requires this 4E conceptualization. We will provide a 4E account of the baring of embodied awareness upon the process by which one learns

and develops mindfulness, akin to the way other cultural techniques are acquired, that is, in the course of *embodied social practice*—through imitation, joint attention, and cooperative learning, a socio-cultural environment of shared practices (Kendal, 2011).

As an embodied social practice, understanding mindfulness calls for appreciating its relational components, the dimension of interpersonal learning. Thus, from a 4E perspective, the development and learning of mindfulness practices may require something like an apprenticeship, during which the personal meditative experience of the clinician, and utilisation of relational mindfulness exercises, conveys via imitation the method of cultivating mindfulness and embodiment skills. Indeed, authors including Molloy Elreda et al. (2019) examine the role of an educator's interpersonal mindfulness in improving classroom quality, enhancing emotional supportiveness, and reducing burnout. More recently, Mischenko et al. (2022) have emphasized the role of relational trust in delivering mindfulness-based social-emotional learning programs in elementary programs. This is in line with Oman's suggestion that, at least in practice, a partially standardized facet of mindfulness interventions is attention to the mode of *instructional leadership.* A mindfulness instructor is expected to have "the capacity to embody the qualities and attitudes of mindfulness within the process of the teaching" based on "a sustained commitment to cultivating mindfulness through regular daily formal and informal mindfulness practices in everyday life" (Crane et al., 2017, p. 995) From a 4E perspective, mindfulness, as a mode of skillful, embodied, internalized social cognition, depends upon the social and cultural environment.

Mindfulness Socially Embedded in Preliminary Practices

Viewing mindfulness as a set of culturally embedded practices dependent upon internalized social cognition has important implications for public health intervention. Mindfulness practices under this view should be carried out only after preparatory practices, variously conceived, have been completed. Such preparatory practices may have to be reconstrued according to the population served. As an illustration, within traditional Buddhist contexts, mindfulness practices were understood as higher level practices following the development of ngöndro or "preliminary practices" (Khyentse, 2012). These Buddhist preliminary practices were traditionally intended to turn the mind from fearful negative states towards joyful and compassionate orientations that allows mindfulness meditation to be possible. Yet, the clinical sciences, in abstracting mindfulness from its developmental context, end up applying these tools in therapeutic settings without appreciating the groundwork that fosters mindfulness in practice. For this reason, scaling mindfulness interventions is unlikely to be maximally successful should inadequate attention be given to the provision of culturally relevant preparatory practices that facilitate mindfulness goals.

Indeed, commentaries by Furnell et al. (2024), amongst others, have called attention to how forgoing the sociocultural context of Buddhist mindfulness can yield adverse effects. Mindfulness applied purely as a concentration exercise may result in decreased prosocial behavior, increased self-centeredness, and reduced psychological well-being. For this reason, they call for incorporating the traditional Buddhist "three trainings" or "triśikṣā" into MBIs. Triśikṣā presents concentration, insight, and ethics as interpenetrating domains, which ought necessarily be cultivated together. This attention to ethics offers a useful illustration of the culturally *embedded* nature of cognition, the *extension* of mind through conduct, and the circular *enactment* of self in world; more in alignment with our proposed understanding of the enactivist process of change undergirding mindfulness. This offers one illustration of how mindfulness ought to be understood within the larger systems of Buddhist belief and practice. This has implications for how MBIs ought to be structured in community settings; the role of the facilitator and peer relationships; how best we enact multilevel intervention strategies; working with children, adolescents, and peer-mindfulness groups; mindfulness in group work settings; and to business and governmental agencies (Tempone-Wiltshire, 2024c). This also ties into the need to develop functional substitutes and cultural adaptations, for the evolution in mindfulness in public health.

Mindfulness as Culturally Embedded Contemplative Practices

At present, there exists a paucity of cultural adaptation of mindfulness interventions. As one learns and develops mindfulness as an embodied, contextually embedded, social practice, the most effective way to do so is in a culturally relevant manner. What is called for is the development of culturally relevant construals of mindfulness-technologies, as this has implications for the development of population-based, nonclinical interventions and activities. As Crane et al. (2017) write, a mindfulness teacher should possess "knowledge, experience and professional training related to the specialist populations that the mindfulness-based course will be delivered to" (p. 993). This is in line with Oman's suggestion that mindfulness initiatives should promote intercultural and interreligious competencies. The commentary by Sandage and Stein (2024) extends Oman's concern by proposing a developmental model of interreligious competence for helping professionals using mindfulness, while Chacko et al. (2024) highlight the need for

cultural adaptation of MBIs to better engage ethnically diverse and underrepresented minority populations, specifically Pacific peoples. Adapting MBIs to specific populations calls for the integration of mindfulness with pre-existing culturally embedded contemplative technologies. This requires consultation which engages with the broader enactive and embedded dimensions of contemplative practices relevant to specific populations. For MBIs to resonate with Pacific worldviews, for instance, attention must be given to language, spirituality, and Pacific cultural values and protocols, as these constitute the embedded, enacted, extended, and embodied cultural container in which the mindfulness intervention will take place.

Commentaries by Knabb and Vazquez (2023), and Wang (2024) affirm the need for tailoring mindfulness interventions to diverse religious and cultural contexts. As we suggest, the necessary forthcoming investigation of contemplative practices within, for instance, Christian traditions will benefit from adopting an embodied cognition perspective. *Embeddedness* requires recognizing the diverse religious systems, responsiveness to various spiritualities, and sociocultural realities, in which a culture is embedded; *enaction* involves applying broader cultural and religious protocols in developing mindfulness interventions; *extendedness* recognizes the role of the broader faith context in elucidating these programs; efficacy; and *embodiment* proves necessary to understanding the cultural experience of the mind–body interface. Embodied cognition naturally proves supportive of the development of embedded public health solutions responsive to local community problems, advocating for worldview-sensitive options. This approach aligns with the origins of embodied cognition, which seeks dialogue between cognitive sciences and religious traditions, as seen in foundational dialogue between Western psychology and Tibetan Buddhism in Varela, Rosch, and Thompson's "The Embodied Mind."

Contemplative practices with functional features overlapping with mindfulness have emerged independently in a wide range of cultures. For this reason, as Karl et al. (2022) state: "we can identify practices that strongly resemble mindfulness in spirit and practice" (p. 180). Our 4E conceptualization of mindfulness process of change provides a mechanism for identifying how certain culturally specific technologies might share a mechanism for therapeutic change. This is inclusive of Indigenous cultural embodiment and mindfulness practices (Tempone-Wiltshire, 2024b). It also provides a means of identifying congruences and distinctions, facilitating both cross-cultural dialogue and culturally adapted appropriate interventions. Such cross-cultural understandings open a wider set of options to address treatment gaps—in this way appreciating the "contextual" features of mental health and illness. This facilitates the generation of "counterflows" whereby approaches to mental health that are adopted in low-income countries can be adopted by higher income countries facilitating a complementary exchange between Western biomedical and local traditional approaches to treatment (Patel et al., 2018).

Embodied cognition thereby provides a framework for acknowledging the treatment efficacy of psychosocial strategies generated in distinct culturally embedded practices *adjacent* to mindfulness, for addressing mental health problems. Such cross-cultural dialogue facilitates the development of collaborative referral networks between indigenous healers and Western-trained mental health professionals provide methods of narrowing the treatment gap and "reduce fragmentation by encouraging more integrated care" (Shields et al., 2016, p. 368).

Conclusion

Oman's exploration of the integration of mindfulness interventions in public healthcare has raised some important considerations concerning, foundationally, the process of change undergirding mindfulness as a therapeutic tool. In this article, we have explored the utilization of the framework of embodied cognition for capturing the process of therapeutic change and demonstrating mindfulness's relevance for population-scale problems addressed by public health interventions. In contrast to the conception of mindfulness dominant in contemporary public healthcare, we offer an embodied reframing of mindfulness across the domains of embodiment, enaction, extension, and embeddedness. Mindfulness describes a method of utilizing bare attention to the lived body or visceral deep body, to intervene in the complex feedback structure of the mind–body system. Through the circular structure of embodiment, and the strange loop of self-perception, individuals are able to influence cycles of organismic self-regulation.

Embodied cognition presents a scientific means of articulating the nuanced dynamic feedback loops through which self-world perception is enacted. This provides a novel theoretical understanding of the relationship between mindfulness, mind–body linkages, and the nature of awareness. It also offers an alternate modelling of mindful *decentering* which occurs via non-conceptual attention to the processes underlying cognition, and mindful *exposure therapy* which occurs through insights generated via practitioner's intentional orientation towards internal representations, and how these habituated patterns *enact* both self- and world-perception.

By specifying the 4E facets of mind, mindfulness may be understood as a skillful mode of embodied social cognition. A range of cross-cultural contemplative technologies may therefore facilitate the goals of mindfulness so understood. Adapting MBIs to specific populations and scaling them to act at multiple levels calls for integrating mindfulness with pre-existing culturally embedded contemplative technologies. In this way, we may better articulate the nature of mindfulness and thus its effective application to population-scale problems.

Acknowledgements Citations of authorship are in the "References" section.

Author Contribution Julien Tempone-Wiltshire conceived and developed the theoretical framework and drafted the manuscript. Floren Matthews critically reviewed and contributed to the manuscript's intellectual content. Both authors have read and approved the final manuscript.

Data Availability Not applicable. This paper is a theoretical work and as such, no data were generated or analyzed during the current study.

Declarations

Ethical Approval Not applicable. This study is theoretical and did not involve any experimental research on human participants or animals.

Informed Consent Not applicable. No human subjects were involved in the study.

Statement Regarding Research Involving Human Participants and/or Animals This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest The authors declare no competing interests.

Use of Artificial Intelligence Statement AI was not used.

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