Embodied Models of Health:
A Theoretical Framework of Mind-Body Unity

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Abstract: In this article, we review the literature on placebo effects and its overlap with the literature on health mindsets. We propose an Embodied Models of Health theoretical framework to account for the array of mind-body effects discussed in our literature review. While beliefs and expectations are widely acknowledged as fundamental drivers of placebo effects – physiological improvements that result exclusively and directly from psychological processes – the role of attention is often neglected in theoretical accounts of the placebo phenomenon and remains poorly understood. We argue that placebo effects and health mindsets are a product of continuous interaction between attention, beliefs, and expectations. We end by discussing novel predictions generated by the Embodied Models of Health framework and highlight opportunities to leverage the role of attention in mind-body dynamics to improve health and wellbeing.

Introduction

The Principle of Mind-Body Unity

The mind and body form an integrated whole, and growing evidence shows that psychological processes can directly influence physical health outcomes (e.g, Aungle & Langer, 2023). Phenomena ranging from placebo analgesia to the surprising effects of mindset on exercise and aging indicate that our thoughts, beliefs, and expectations are *embodied* – they can produce measurable changes in physiology and health (Ashar et al., 2017; Langer, 2009, 2023; Levy, 2022). Mainstream models of health, however, have yet to fully embrace the principle of mind–body unity. For example, the widely cited biopsychosocial model acknowledges biological, psychological, and social factors (Engel, 1977), but it essentially treats them as separate, co-equal domains to be "taken into account" in every case (Bolton & Gillett, 2019). This flat perspective lacks a hierarchy or mechanism for how the mind might systematically drive bodily outcomes. Put simply, prevailing frameworks stop short of treating mental processes as *primary* organizers of health.

Traditional health psychology theories likewise fall short of explaining mind–body unity. The Health Belief Model (Hochbaum et al., 1952) and Theory of Planned Behavior (Ajzen, 1991), for instance, focus on how personal beliefs and attitudes influence health behaviors (e.g. deciding to exercise or get a screening). These models have been invaluable for predicting when people take action to support their health, but by design they address behavior change, not direct mind–body interactions. They cannot explain cases where health outcomes change without any overt behavioral intervention – for example, when a patient's mental states alone lead to physiological improvement (e.g., Demers et al., 2022; F. Pagnini et al., 2015; Zilcha-Mano & Langer, 2016). Indeed, neither HBM nor TPB accounts for situations in which mindsets shape physiology independently of behavior or mood. Similarly, while the biopsychosocial model is holistic, it remains descriptive and non-mechanistic. It offers no guidance on how a psychological factor like a person's beliefs translates into a biological change. This leaves phenomena such as placebo effects, nocebo effects, or even the influence of perceived time on healing puzzlingly outside the realm of existing theory.

This conceptual gap motivates our proposed Embodied Models of Health (EMH) framework, which explicitly centers the unity of mind and body and offers a novel, hierarchical model of health. In EMH, higher-level psychological processes – our attention, beliefs, and expectations – continuously regulate and inform lower-level physiological processes. In other words, mental context is not just another factor in health; it is an organizing principle for bodily responses. This marks a departure from the "all factors equal" approach of the biopsychosocial paradigm. Crucially, EMH introduces a specific mechanism to explain mind–body effects**:** the role of attention as a *belief-weighted* mediator "between" mind and body (we find it difficult to avoid dualistic language altogether, too). Here we adopt the view, in line with predictive coding theories (e.g., Pagnini et al., 2023), that attention optimizes the weighting of sensory information based on our prior expectations (Ransom et al., 2017). In simple terms, what we believe influences what we pay attention to, and what we pay attention to influences how our body responds. Through this lens, a person's health-related beliefs can directly alter physiology by directing attention (and thus biological resources) toward certain sensations or outcomes. For example, if one firmly expects to feel fatigue, heightened attention to normal bodily tiredness can magnify it into real fatigue (Camparo et al., 2022; Matta et al., 2025; Matta et al., 2024); conversely, expecting better vision can literally improve visual acuity in the moment (Langer et al., 2010). By weighting incoming signals according to belief, attention serves as the bridge by which expectations shape physiology.

Contextualizing the Embodied Models of Health Framework

The EMH framework goes beyond existing models by unifying a range of mind–body phenomena under one explanatory umbrella. It suggests that placebo responses, mindset effects, and even subtle priming influences on health are not isolated curiosities, but expressions of the same underlying process of embodied cognition (e.g., Khoury et al., 2017). In the EMH framework, beliefs do not just contribute to health alongside other factors – they continually tune physiological states via attention allocation and expectation formation processes. This perspective helps explain findings that otherwise challenge conventional wisdom, such as improvements in objective health measures without lifestyle changes (e.g., Crum & Langer, 2007) or physiological responses tracking what we expect to happen rather than what has objectively happened (e.g., Kirsch, 1985). By foregrounding mind–body unity and specifying how the mind influences the body, EMH offers a novel hierarchical approach to health.

In previous research, we noted that the phrase “mind-body connection” is far more common than “mind-body unity,” and that this subtle difference in terminology obscures the breadth of psychological influences on physical health (Aungle & Langer, 2023). Mind-body unity is a more apt descriptor because the mind literally arises from the body: thought is physical, primarily shaped by activity in the central nervous system (e.g., Kandel, 2013), but also by activity in the peripheral nervous system (e.g., Craig, 2002), and the bidirectional influence of mind on body and body on mind is simultaneous and continuous.

The first influential demonstration of the breadth and strength of psychological influences on physical health, and the first test of mind-body unity (Langer, 2023) as such, was the counterclockwise aging study conducted by Langer and colleagues (Langer et al., 1990). In that study, elderly participants were taken to a retreat that had been retrofitted to appear as if it was occurring 20 years in the past. Everything, from the furniture at the retreat to the technology and periodicals, was designed to mentally transport participants to an earlier period in their lives. One group of participants simply attended the retreat. The other group of participants was further instructed to speak as if the present tense referred to events 20 years prior, i.e. to verbally inhabit the past as well. Relative to baseline measures, participants in both groups experienced significant improvements in measures of physical health and cognitive performance: hearing, vision, memory, joint flexibility, and hand strength improved, and judges blind to the study design and hypothesis believed participants looked significantly younger in photos taken after the retreat compared to photos taken before. Participants in the group instructed to verbally inhabit their 1959 selves saw even greater improvements in joint flexibility, as well as improvements in manual dexterity and cognitive performance.

Around the same time that Langer's landmark "counterclockwise" study demonstrated the profound effects of psychological factors on health and aging, George

Engel made an influential and compelling case to replace the purely biomedical model of health with a more holistic biopsychosocial model (Engel, 1977). Engel's model broadened the scope of medicine by insisting that to fully understand illness, one must consider not only biological factors but also psychological and social influences. The biopsychosocial approach is now widely regarded as an improvement over reductionist biomedicine, and it is broadly endorsed in principle by clinicians (Sadigh, 2013). Our mind–body unity model builds upon this foundation and goes even further, not by rejecting Engel's framework but by subsuming and reorganizing it around a clear center of gravity. We propose a psychologically mediated hierarchy of health: psychological processes are the core integrative mechanism – the "final common pathway" – through which all other determinants of health (genetic, microbial, environmental) ultimately exert their effects. In other words, whether the initial cause of an illness is a virus, a gene mutation, a toxin, or trauma, its impact on a person's health is eventually channeled and realized through the mind–body interface. Philosophically, our stance aligns with monism, the view that mind and body form an integrated whole rather than two separate realms (e.g., He & Lang, 2017), which implies that health cannot be fully understood by treating parts in isolation.

We recognize that claiming *all* illnesses are ultimately psychologically mediated is bold. Yet a growing body of empirical evidence lends credence to this claim (e.g., Ader & Cohen, 1975; Barbiani et al., 2024; Cohen & Herbert, 1996; Cohen et al., 2007; Crum & Phillips, 2015; Crum, Leibowitz, et al., 2017; Langer, 2009, 2023; Langer, 1992; Langer et al., 1975; Langer & Rodin, 1976; Laza et al., 2025; Leibowitz et al., 2021; Miller et al., 2009; Pagnini et al., 2023; Pagnini et al., 2020; Francesco Pagnini et al., 2015; Phillips & Pagnini, 2014; Rodin & Langer, 1977; Segerstrom & Miller, 2004; Zahrt & Crum, 2020; Zion & Crum, 2018). Even Engel observed that a biochemical abnormality or genetic predisposition is "necessary but not sufficient" to produce illness on its own; additional psychosocial factors determine whether a disease potential becomes an actual illness (Engel, 1977). Modern research confirms that ostensibly external or genetic causes of disease still operate through mind–body interactions. For example, a pathogen's ability to cause illness depends on the host's immune response, which is significantly weakened by chronic psychological stress (e.g., Littrell, 2008). Psychoneuroimmunology studies have shown that stressful emotions can diminish white blood cell function – making infections more likely and wounds heal more slowly – whereas psychological interventions (like talk therapy) can enhance immune function and improve the body's ability to combat disease. Likewise, placebo research further illustrates the mind's central role in health: the mere expectation of relief can trigger the brain to release endogenous opioids and dopamine, producing real physiological analgesia (Ashar et al., 2017), while negative expectations (nocebo effects) can induce pain, nausea, and other symptoms in the absence of any organic cause (Niazi, 2024). Similarly, studies in health psychology find that mindsets and beliefs directly shape outcomes – patients who believe strongly in a treatment's efficacy often experience greater actual benefits (Shiv et al., 2005), and reframing stress as something positive can measurably boost physiological indicators of health (for instance, enhancing immune and cardiovascular function) (Crum et al., 2023). In short, factors once deemed purely "biological" or "external" still translate into illness through cognitive-emotional and neurophysiological pathways. The embodied models of health (EMH) framework we advance here, grounded in the principle of mind–body unity, formalizes the mechanisms by which psychological factors cumulatively shape health over time, effectively subsuming the biopsychosocial model into a more integrative paradigm.

Although there are substantial literatures on the role of expectations (see Placebos section) and beliefs (see Mindsets section) in shaping health outcomes, and a much smaller but still extant literature on the role of attention and health (see Attention section), there is currently no framework that ties all three influences together in a mechanistic model of psychological influences on physical health. In this paper, and a complementary companion paper (Aungle, Matta, Loecher, et al., in prep), we propose a unifying framework for understanding the diverse array of mind-body effects on health, allowing us to connect disparate literatures and generate novel predictions for future research. We argue that beliefs are the fundamental driver of mind-body effects on health, but, crucially, that this is because of their influence on attention allocation and expectation formation. See Table 1 for working definitions of these terms as used in our framework.

Table 1: Working definitions of core pillars of the EMH framework

	Definitions for the three pillars of the EMH framework
Beliefs	Beliefs refer to an individual's core assumptions or convictions about health, performance, wellbeing, and medicine that shape how information is interpreted and acted upon. Beliefs bias perception and can directly influence physiological processes. For example, believing one's daily work counts as exercise can lead to measurable health improvements without changing behavior. More generally, mindsets (a class of broad beliefs) have been shown to affect what we pay attention to and how our bodies respond: a person who views stress as enhancing, for instance, tends to exhibit more adaptive hormonal and cardiovascular profiles than one who believes stress is debilitating.
Expectations	Expectations are essentially predictions about specific outcomes or experiences. They represent what an individual anticipates will happen in a given health context (e.g., expecting a medication or therapy to

	relieve pain). The belief "stress is enhancing," for example, translates into an expectation of enhanced performance when experiencing stress. Expectations conform to underlying beliefs and often serve as self-fulfilling prophecies: in situations that are otherwise identical, positive expectations tend to foster beneficial outcomes while negative expectations tend to engender adverse symptoms.
Attention	Attention denotes the selective focus of consciousness on certain stimuli or aspects of one's internal or external environment. It is the mechanism by which some signals are amplified and others filtered out, thereby modulating one's experience and bodily responses. In other words, attention is a *weighting mechanism*. In a health context, where one directs attention, and the beliefs underlying that focus, can alter physiological outcomes: for instance, focusing on signs of healing or safety (as opposed to symptoms or threats) can dampen distress and improve recovery (Barbiani et al., 2024). Attention is a key mediator of mind-body effects – directing cognitive focus toward some cues and away from others can significantly influence pain perception, stress reactivity, and other health-relevant processes.

The Three Mind-Body Pathways

Together, attention, beliefs, and expectations shape how we feel, how we act, and how our bodies function. Indeed, mind-body effects on health are typically understood to operate through three interrelated but distinct pathways: an affective pathway, a behavioral pathway, and a direct physiological pathway (Zahrt et al., 2023). Though the vast majority of mind-body effects on health engage all three pathways, it is often useful to think of the pathways separately when trying to deconstruct the underlying mechanisms that result in an effect. For example, when someone holds a negative aging stereotype and perceives themselves to be experiencing age-related decline, they are likely to experience and express higher levels of negative affect and stress (Levy, 2009, 2022). Higher levels of negative affect and stress, in turn, will then exacerbate any genuine decline (Levy et al., 2016). In some cases, the affective influences of negative aging stereotypes may even cause age-related decline where it would otherwise not occur (Wurm et al., 2013).

In conjunction with affective influences, negative aging stereotypes also influence behavior in ways that can make it more likely the stereotype is borne out by experience. For instance, many people believe one consequence of getting older is that you need less sleep (Walker, 2017). Someone with a negative aging stereotype who is regularly experiencing insufficient sleep and who has reached an age they consider to be "old" may passively and prematurely accept that level of sleep rather than look for opportunities to improve it, e.g., by changing their nighttime routine (Exelmans & Van den Bulck, 2016; Irish et al., 2015), incorporating short naps where possible (Milner & Cote, 2009), increasing the amount they exercise (Kredlow et al., 2015), or engaging any of the other myriad behavioral changes that are known to positively influence sleep duration (Buysse et al., 2011; Van Straten et al., 2018).

And negative aging stereotypes can directly affect physiology. For example, in two (in)famous studies that primed the concept of old age, participants who saw the old age primes walked more slowly following the primes than participants in control conditions (Bargh et al., 1996). Though this result has received substantial attention and criticism, with at least a few proposed moderators (e.g., Cesario et al., 2006; Doyen et al., 2012), the general idea that conceptual primes directly shape physiological processes remains well supported, even if the mechanics of these effects remain poorly understood. The direct physiological pathway is perhaps the most interesting of the three mind-body effect pathways, but we currently lack a useful theoretical framework for understanding it (see

Pagnini et al., 2023 for an attempt at linking the Bayesian brain hypothesis to attention allocation processes). Mind-body effects that are primarily attributable to a direct pathway between thought and physiology regularly engender skepticism (e.g., Gelman & Brown, 2024), surprise (e.g., Beecher, 1955), and wonder (e.g., Thomas, 1995). The purpose of this paper is to outline a framework for thinking about mind-body effects on health, especially those that result primarily from the direct link between mental processes and physiological outcomes. Our goal is to more clearly understand how mindsets have the profound effects on health that they do, highlight the crucial role of attention in this process, and point to new and fruitful approaches for future research. The empirical examples we explore in detail are not meant to represent an exhaustive list of relevant empirical work. Rather, they are meant to clearly illustrate how we believe the proposed framework enriches our understanding of seemingly inexplicable influences of thoughts on health.

In the sections that follow, we detail the components and evidence for the EMH framework. We begin by examining attention and conceptual priming as drivers of physiological change, laying the groundwork for how top-down cognitive processes organize bodily outcomes. We then explore expectations and placebos through the EMH lens, showing how belief-driven expectations lead to measurable biological effects. Next, we discuss beliefs and mindsets, such as beliefs about aging and stress. Then we illustrate how the EMH framework integrates these psychological factors into a mechanistic framework that shapes health outcomes over time. We end by suggesting directions for future research. Throughout, we highlight how each aspect – attention, expectations, and beliefs – interacts within a unified mind-body system.

Attention, Conceptual Priming, and Physiology

We had three objectives in mind when deciding to include attention in our model of mind-body effects on health. Our first objective is to discuss the nature of attention and its connections to physiology. Our second objective is to link research on conceptual priming, attention, and the processes underlying placebo and health mindset effects. Our third objective is to illustrate the ways in which attention can be manipulated to shape physiological processes. Just as the three pathways driving mind-body effects typically do so in tandem, these aspects of attention similarly complement and interact with each other.

The Nature of Attention

Despite the often-observed connection to eastern mindfulness traditions (e.g., Kabat-Zinn, 2003), the literature on mind-body health effects infrequently discusses the role of attention (Lutz et al., 2008). Even within eastern mindfulness traditions, the relationships among attention, attentional control, health, and wellbeing often centers on the importance of present-moment awareness (e.g., Brown & Ryan, 2003). But within the present moment, the focus of attention can vary substantially, with different consequences.

Attention can be directed externally or internally. Externally, attention can center on aspects of experience that result in *positive* or *negative* affective responses. For example, when attention is devoted to fearful faces rather than distracted by other stimuli, people experience higher levels of activity in their amygdale, amplifying negative affective responses (Vuilleumier, 2005). The specific targets of externally directed attention can also modulate the *intensity* of one's affective responses. For instance, directing attention toward emotionally salient stimuli — such as threatening faces or distressing images — has been shown to amplify emotional reactions, both physiologically and subjectively (Carretié, 2014). Conversely, diverting attention away from such stimuli can attenuate these responses (Morawetz et al., 2010). Perhaps the idea that the targets of attention influence our emotions is uncontroversial and obvious, but we include it here because we have agency over what we pay attention to (e.g., Astle & Scerif, 2009), we know our emotions influence our health over time (e.g., Chida & Steptoe, 2008), and this research highlights how our attentional targets directly feed into the affective mind-body pathway and thus shape our physiological responses (e.g., Bar-Haim et al., 2007).

Conceptual Priming and Attention

Earlier, we mentioned research on conceptual priming. Unlike perceptual primes, which are based on the form or physical features of stimuli (Roediger, 1993), conceptual priming relies on the meaning or semantic content of the stimuli to have an effect. An example of a perceptual prime would be exposing to participants to the word “library” which then causes them to later complete the word stem "lib___" as library rather than liberty or libido, whereas an example of a conceptual prime would be exposing participants to the word “library” which then causes them to more quickly recognize related words such as “novel” and “author” (Meyer & Schvaneveldt, 1971).

The priming of old age discussed earlier is an example of a conceptual prime influencing a physical process, namely walking speed. The research on conceptual primes suggests that we are regularly exposed to primes that influence how we think, feel, and act (i.e., that influence all three mind-body pathways). For example, priming individuals to view stress as beneficial results in more adaptive physiological responses to stressors, such as reduced vasoconstriction and healthier cardiovascular responses (Jamieson et al., 2013). Priming people with competition-related concepts such as *dominance* and *power* increases testosterone and improves readiness for competitions (Schultheiss et al., 2004). But readers might be wondering, how is attention related to conceptual priming effects?

Some researchers have argued that conceptual priming is a form of implicit attentional tuning: conceptual primes bias the attentional system toward semantically related representations, making them more likely to capture attention when encountered (Bargh, 2006). We also know that conceptual priming effects tend to be stronger under conditions of low attentional load (Mulligan, 1997), suggesting that attention mediates priming effects by determining which concepts guide behavior and enter conscious awareness. Moreover, we know from neuroimaging studies that conceptual primes not only activate brain areas associated with semantic knowledge (e.g., in the temporal lobe) but also involve frontal and parietal regions associated with self-knowledge and executive functioning (e.g., the dorsolateral prefrontal cortex and inferior parietal lobule) (Binder et al., 2009). Thus, conceptual primes shape what we pay attention to, how we think about what we pay attention to, and the weights we assign to those inputs.

We argue that the activation of a health mindset is a form of conceptual priming, in the sense that conceptual primes and health mindsets orient attention toward semantically related constructs, increase the accessibility of associated beliefs and goals, and bias interpretation in a direction consistent with the prime or mindset. Health mindset interventions — such as learning that stress is enhancing (Crum et al., 2013) or being led to believe more time has passed and objectively healing more (Aungle & Langer, 2023) — introduce a semantic frame that shifts the salience and perceived meaning of subsequent experience. When someone is cued to believe that stress facilitates performance, or that symptoms are signs of healing, their attention is drawn to observations that confirm or reinforce that belief. In that sense, mindset interventions act as high-level conceptual primes by implicitly suggesting causal explanations that drive attention allocation and expectation formation in ways that reinforce the suggested explanations (e.g., believing stress is enhancing, noticing stress, paying attention to and expecting better performance, repeat). Framed this way, mindset effects are continuous with the broader conceptual priming literature, but with health-relevant content and longer-lasting downstream effects. Importantly, using the lens of conceptual priming to understand health mindset effects underscores the attentional mechanisms by which beliefs gain traction: they shape what is noticed, what is encoded, and how those inputs are weighted in forming expectations and guiding physiological responses. Within the Embodied Models of Health framework, this perspective highlights how beliefs, attention, and expectations form a self-reinforcing system — context-dependent, conceptually primed mindset activation sustains selective engagement with belief-consistent evidence.

Manipulating Attention to Influence Physiology

The following examples illustrate how attention can be manipulated in ways that shape physiology, supporting our contention that attention is a core component of mind-body effects on health. Across diverse domains – from autonomic nervous system control to clinical therapy and peak performance – research converges on the idea that attention can be intentionally leveraged to improve physiological functioning and enhance health and wellbeing.

For example, “biofeedback” research – in which participants use various devices to monitor physiological signals such as heart rate, blood pressure, or muscle tension – has repeatedly shown that people can learn to gain control over processes once thought automatic. By attending to real-time fluctuations in these physiological signals, participants in these studies have learned how to increase heart rate variability, reduce physiological stress, and improve cardiovascular regulation (Balaji et al., 2025); lower their blood pressure (Jenkins et al., 2024); and reduce experiences of chronic migraines (Nestoriuc & Martin, 2007).

Cognitive reappraisal – an emotion regulation strategy that changes how one interprets a situation – can also be construed as a form of manipulating attention to influence physiology. Perhaps the most obvious examples come from research on appraisals of stress. Stress can be viewed as a challenge or a threat (Tomaka et al., 1997), or as enhancing or debilitating (Crum et al., 2013; Crum et al., 2023), and the view someone takes influences the physiology they experience (Jamieson et al., 2013). In our Directions for Future Research section, we describe a study design to test the hypothesis that the targets of attention underly these differential effects of stress on physiology and performance.

One of us (Langer) has also employed an “attention to variability” paradigm in numerous studies designed to improve health and wellbeing among people suffering from a range of chronic illnesses (e.g., F. Pagnini et al., 2015; Pagnini et al., 2022; Tsur et al., 2021). The attention to variability paradigm is predicated on the idea that when someone is diagnosed with a chronic health condition, they tend to 1) believe that the diagnosis reflects their symptomology in relatively static ways and 2) only notice evidence consistent with that static understanding of the diagnosis. In the attention to variability framework, however, study participants are encouraged to notice that there are times when their symptoms are better or worse than normal and to reflect on the environments they are in when they notice this variability. This simple change has helped patients suffering from ALS, Parkinson's, MS, and other chronic conditions improve both their subjective and physical wellbeing.

Mindfulness and focused-attention meditations are yet another suggestive illustration of the role attention plays in health and wellbeing. Over the past two decades, numerous studies have demonstrated broad physiological benefits from meditations in which attention is harnessed to trigger a relaxation response. In a recent meta-analysis, for example, mindfulness meditation interventions were found to lower resting heart rate, ease blood pressure, reduce cortisol levels, and decrease markers of inflammation such as C-reactive protein and TNF-α (Pascoe et al., 2017). Even a short 8-week mindfulness meditation training program was found to strengthen immune function and increase left-frontal cortical activation, a pattern associated with positive emotion and approach motivation (Davidson et al., 2003). These effects are the direct result of learning to channel attention toward health-promoting, stress-reducing sensations, thoughts, and emotions.

Deliberate manipulation of attention is also used in clinical contexts to help people suffering from pathological physiological reactions. In anxiety disorders, for example, patients often exhibit an attentional bias toward perceived threats, contributing to hyperarousal states (e.g., elevated heart rate, galvanic skin response, etc.) and heightened anxiety. Training socially anxious participants to disengage from threat cues has been found to reduce their anxiety and physiological reactivity during a subsequent stressor (e.g., a public speech) compared to controls (Amir et al., 2008). Similarly, training people suffering from chronic pain to divert attention away from their painful sensations can produce genuine analgesic effects (Buhle et al., 2012; Johnson, 2005). In both cases, attention appears to be a significant mediator between the pathological condition and its physiological consequences.

The benefits of training attention extend to peak performance research as well (e.g., Wulf et al., 2010). In a simulated race-driving study, for example, participants instructed to adopt externally-oriented attention (concentrating on the *effects* of their actions and the features of the race track) – compared to those instructed to adopt internally-oriented attention (monitoring their hand movements on the steering wheel) – exhibited higher heart rate variability, indicating calmer and less effortful cognitive control, and they performed better (Mullen et al., 2012). Similarly, tactical breathing exercises have been found to improve marksmanship among military cadets (Ibrahim et al., 2024), and marines who received 8 weeks of mindfulness-based mind fitness training showed significantly greater heart rate reactivity and enhanced recovery in both heart rate and breathing rate, as well as lower plasma neuropeptide Y concentrations, following a stressful combat training exercise (Johnson et al., 2014).

Taken together, this research supports our contention that attention allocation processes significantly influence physiology and health. Whether through biofeedback, cognitive reappraisal, attention to variability, mindfulness, attentional retraining, or performance optimization, the deliberate redirection of attention alters how the brain and body respond to internal and external cues. These effects span autonomic regulation, immune function, hormone activity, and neural processing – core physiological systems implicated in both resilience and dysfunction. Within the EMH framework, such diverse findings illustrate how manipulating attention can change not only what individuals notice, but also how those precepts are interpreted and integrated into ongoing physiological regulation. In this way, attention emerges not as a passive lens, but as an active ingredient in shaping mind-body outcomes – a modifiable mechanism through which beliefs, expectations, and contextual cues are transduced into biological change.

Expectations and Placebos

While the concept of placebos dates back to ancient times (De Craen et al., 1999), it developed its more modern connotation as "a usually pharmacologically inert preparation prescribed more for the mental relief of the patient than for its actual effect on a disorder" as a result of research done by Henry Beecher following his experience treating soldiers during World War II (Beecher, 1955). Faced with a severe shortage of morphine, Beecher and his colleagues sometimes resorted to administering saline injections to wounded soldiers, telling them it was a powerful analgesic. To his astonishment, many soldiers reported significant pain relief, even though they had received no active medication. After the war, Beecher returned to Harvard Medical School and Massachusetts General

Hospital, where he began to systematically study the phenomenon he had observed. He was driven by the question: How could an inert substance produce real therapeutic effects? His findings underscored the necessity of including placebo controls in clinical trials to distinguish between the particular efficacy of treatments and the effects of patients' expectations, leading to the widespread adoption of randomized controlled trials (RCTs) in medical research (Kaptchuk, 1998).

Since Beecher's groundbreaking research, we have learned that the kinds of expectations underlying placebo effects influence nearly all treatment outcomes (Benedetti et al., 2005; Colloca & Miller, 2011; Crum & Phillips, 2015; Crum & Zuckerman, 2017; Finniss et al., 2010). For example, people who receive a placebo analgesic cream paired with actual pain relief over several trials later experience significant reductions in pain when the same cream is applied without the active agent (Voudouris et al., 1985, 1990) – highlighting how cues associated with past treatments can themselves come to produce positive effects via classical conditioning. Patients who interpret side effects from medical treatments as indicators of treatment efficacy experience greater physiological improvements compared to patients who interpret them as unfortunate consequences of requiring treatment (Howe et al., 2019). Patients who believe they are taking an expensive medication experience greater therapeutic benefits than patients who believe they are taking a less expensive but identical medication (Shiv et al., 2005). Patients who are unaware that they are receiving an active medication experience fewer therapeutic benefits than do patients who are aware they are receiving such treatment (Benedetti et al., 2003). These examples strongly suggest that the influence of expectations on treatment outcomes is the norm rather than the exception, even if the proportion of therapeutic benefit accounted for by implicit and explicit expectations varies (Ashar et al., 2017; Wager & Atlas, 2015). Across treatment contexts, most everyone agrees that our expectations surrounding our health are in fact important drivers of our health (note: we omit a discussion of "learning," a word often used in the placebo literature that generally refers to classical conditioning processes, as we consider this to be a form of implicit expectation).

Beliefs and Mindsets

Although beliefs and expectations are fundamental to the psychological mechanisms underlying the effects of placebos and health mindsets, we have grouped our discussion of expectations with placebos and beliefs with mindsets because mindset research tends to illustrate the power of beliefs outside of medical contexts. Within medical contexts, the belief that receiving an effective treatment will have an ameliorative effect is so intrinsic to the context, scholars tend to focus on the expectation for improvement created within recipients as the key psychological ingredient (e.g., Enck et al., 2013). We use "beliefs" to refer to one's ideas and assumptions about how things work in general, and we use "expectations" to refer to what one assumes will happen to them in specific situations (see Table 1 in the introduction). Beliefs and expectations are usually closely related, but they are conceptually distinct. For example, someone might believe that regular exercise improves mood and long-term health, yet not expect a specific workout to affect their mood or health.

Outside of medical contexts, the relationship between beliefs and expectations becomes more variable and context-dependent, which is one reason why the effects observed in this research often meaningfully vary across individuals and studies. Much of the research illustrating the powerful effects of our beliefs and expectations, in and out of medical contexts, has centered around the concept of mindsets (see Chanowitz & Langer, 1981 for a seminal paper in this area), which have been defined as, "Core assumptions regarding a domain or category [that] help organize, simplify, and interpret information, thereby orienting us toward a particular set of expectations, attributions, and goals" (Zahrt et al., 2023), or, alternatively, as, "a mental frame or lens that selectively organizes and encodes information, thereby orienting an individual toward a unique way of understanding an experience and guiding one toward corresponding actions and responses" (Crum et al., 2013). Researchers have shown that we have nutritional mindsets that affect the physiology of satiety (Crum et al., 2011), stress mindsets that affect the physiology of stress (Crum, Akinola, et al., 2017; Crum et al., 2023), genetic mindsets that affect the physiology of aerobic exercise and satiety (Turnwald et al., 2019), activity adequacy mindsets that affect the physiological benefits conferred by physical activity (Crum & Langer, 2007; Zahrt & Crum, 2017), fatigue mindsets that shape experienced fatigue (Camparo et al., 2022; Matta et al., 2025; Matta et al., 2024), side effect mindsets that influence the physiological benefits conferred by medical treatments (Leibowitz et al., 2021), health care mindsets that affect our responsiveness to medical treatments (Crum & Zuckerman, 2017; Crum, Leibowitz, et al., 2017), healing time mindsets that affect actual healing times (Aungle & Langer, 2023), labeling mindsets that affect the onset and trajectory of illnesses (Aungle & Langer, 2024), and presumably many others that have yet to be named or studied. Similar to the research on heuristics and decision-making, which has become increasingly unwieldy as the number of named and studied heuristics has ballooned (Gigerenzer & Gaissmaier, 2011), the literature on health mindsets continues to grow without a unifying account of the underlying psychological processes. Is there a way to frame our understanding of health mindsets that integrates existing findings with those from the literature on placebos and leaves room for the discovery of new health mindset effects that seem sure to follow as research in these areas continues to evolve? Are there measures we can include that can help clarify the psychological processes that result in physiological effects?

Across the literature on health mindsets, the definition of mindset has varied enough to make an explicit unifying account difficult to grasp, beyond an intuitive sense that how we think about our capacity for good health significantly influences our ability to obtain it. In the framework we propose, we place beliefs at the center of our model. We argue that beliefs are the most influential factor orienting the psychological processes – especially attention allocation – that produce the physiological effects that have been studied. Across the full array of findings about mindsets and health outcomes, researchers tend to take participants' underlying beliefs for granted. As we discuss in the section articulating our model, we think it is worthwhile for researchers to more intentionally consider and measure participants' existing beliefs, as well as the ways in which their experimental interventions are likely to interact with those beliefs, when constructing their experimental designs.

In the language of Embodied Models of Health, a health mindset is simply a contextually activated belief that dominates attention allocation and expectation formation. In the ordinary course of events, beliefs are the fundamental drivers of health mindset effects, but clever experimental and intervention designs leverage all three EMH pillars, which is a topic we return to in our Illustrative Examples and Directions for Future Research sections.

The Embodied Models of Health Framework

As we have said, beliefs are the most fundamental ingredient in our model of mindsets, placebo effects, and of mind-body unity generally. Beliefs govern what we pay attention to, the weights we place on what we notice, and the expectations we develop as a result. This is depicted schematically in figure 1. The arrows pointing from beliefs to attention and from beliefs to expectations are thicker than any of the others, reflecting the central role played by beliefs in our framework. But all elements in the model are interrelated. The image shown in Figure 1 depicts bidirectional relationships among all three components: each component influences the others. The strength of that influence is not uniform, however, which is why some of the arrows are thinner.

This schematic is a highly simplified construct but one we think is useful, primarily for two reasons. First, our model offers a generalizable definition of a “mindset”: a mindset is a contextually activated belief that determines what we notice, the meaning we assign to what we notice, and the expectations we form as a result. For example, consider the well-established mindsets around aging (Levy, 2009; Wurm et al., 2013), intelligence (Blackwell et al., 2007; Yeager et al., 2019), and stress (Crum, Akinola, et al., 2017; Keller et al., 2012). Many people believe something akin to, “aging equals deterioration,” such that when the concept of aging is activated (e.g., when they forget something), they tend to expect and notice evidence of deterioration, which, in turn, leads to actual deterioration. Similarly, many people believe that intelligence is fixed and the less of it you have, the harder you have to work; when they notice that they are working hard, they infer that their fixed ability is low and expect to do worse. Likewise, many people believe that stress is debilitating, such that when they notice they are stressed, they expect to perform worse. In all three cases, there is some truth in the underlying beliefs, but there is also truth in their opposites – namely, aging is maturation, intelligence is malleable, and stress is enhancing. Cultivating these opposite beliefs leads to demonstrably better outcomes. People who believe aging is maturation live longer (Levy et al., 2002). People who believe intelligence is malleable achieve more (Burnette et al., 2023). People who believe stress is enhancing perform better (Jamieson et al., 2012). Within the EMH framework, we argue this is because beliefs drive attention allocation and expectation formation.

Second, our model highlights the fundamental role played by attention in shaping mind-body effects on health. Although attention is rarely discussed explicitly, it often plays a pivotal role in the experimental designs of mindset and placebo studies. For example, in a study designed to test whether providing false feedback about physical activity affects the benefits people experience from their physical activity (Zahrt et al., 2023), the authors did a number of things to leverage the EMH framework: they focused the false feedback on the amount participants walked each day; only selected participants for whom walking was their self-reported primary form of exercise; told participants the purpose of the study was to develop more accurate fitness-tracking algorithms, thus making the fitness-tracking feedback more salient; provided handouts that focused on the health benefits of walking to influence how participants weighted the information about their step counts; and required daily check-in reports to ensure participants were aware of their step-counts. Although the researchers did not design this experiment with the EMH framework in mind, their design underscores our argument about the fundamental role of attention as a weighting mechanism. All of the aforementioned design elements were intended to increase the salience and weight of participants' daily step count, which, uncoincidentally, was the primary variable the researchers manipulated.

We named our framework Embodied Models of Health rather than The Attention, Beliefs, and Expectations Model because we are arguing that the closer an embodied model of health is to accurate understandings of how behavior and interactions with the environment affect health and wellbeing, the stronger the effects on related physiology (see our discussion of Directions for Future Research for elaboration on this point). This understanding need not be conscious – it can develop through experiential associations between perceived cause and effect, as we saw earlier with the analgesic placebo cream example – but the degree to which an embodied model reflects true underlying dynamics shapes the extent to which it produces real physiological effects.

By arguing that *all* mind-body effects are a result of continuous interaction between attention, beliefs, and expectations, we hope to encourage researchers to think more intentionally and precisely about how their intervention designs can leverage these three pillars of the EMH framework to produce health benefits, replace counterproductive beliefs, and create durable positive expectations that improve health and wellbeing.

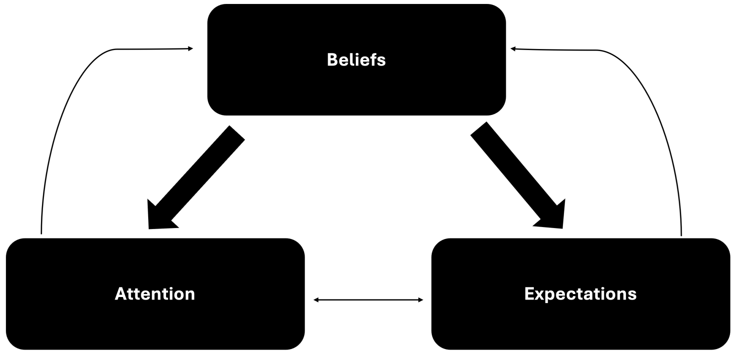

Figure 1: What we believe – about ourselves and about the world – determines what we pay attention to and what we expect to happen. By shifting our attention and expectations, we can alter even deeply internalized beliefs. We can also change what we attend to by changing our expectations, and we can change our expectations by changing what we attend to. The interactions among our beliefs, attention, and expectations determine the mindsets we adopt, which, in turn, shape the physiological outcomes we experience.

Illustrative Examples

Imagine a professor who, on a Friday in May, is feeling overwhelmed by fatigue and thus unable to function at their normal capacity. Their week has felt nonstop, and though they have gotten 7-8 hours of sleep each night, they feel as if they have barely had a moment to breathe. Imagine further that they have a packed calendar that Friday too, and that they will need to devote some of their weekend to catching up on what they have been unable to do during the week because of finals, theses defenses, lab meetings, and so on. Feeling fatigued in such circumstances would be quite understandable, as would the belief that, "this level of fatigue undermines performance." If they are operating with that belief, however, they are more likely to notice, and thus more heavily weight, thoughts and sensations that reinforce that feeling, with consequences for their performance (Matta et al., 2024). But within any experience there are always multiple perspectives available (Langer, 1989), and there are always many more possible targets of attention than the target(s) to which one attends. The belief that "this level of fatigue undermines performance" is very likely to be true, and it would certainly make sense to feel fatigued in this context, but are there other aspects of experience that they could focus on that might activate a different motivating belief?

That Friday, one of the professor's favorite graduate students is defending her thesis, and this will be the first time the professor will get to meet the student's parents. The professor is looking forward to that. Is that feeling not also one to which the professor could attend? How might feelings of fatigue influence performance and physiology if the focus of attention shifts to this experience? After her defense, the student's parents are so proud of their daughter, and so grateful to the professor, that their emotions are contagious – the professor leaves the defense feeling a great deal of pride and gratitude as well. While still fatigued in some sense, particularly if the professor has continued to focus on thoughts and sensations consistent with that feeling, by devoting attention to the positive emotions they experience as a result of their student's defense, the professor is likely to feel enlivened as they head to their next meeting (Fredrickson, 2001).

The professor's day will continue to unfold at a fast pace, but the effects of the day on physiology and performance largely depend on which beliefs orient the professor's attention allocation and expectation formation processes. We offer this hypothetical example because the empirical examples we review do not allow us to comment on the inner experiences of the study participants. The framework we develop in this paper, however, suggests the observed effects in these data result from analogous psychological processes. Now let's take a look at some of the empirical examples.

In Aungle and Langer (2023), the authors used cupping therapy to create mild bruises on participants' forearms during three different lab sessions. Participants were asked to complete healing observation surveys every few minutes and instructed to monitor the timer in front of them to know when to complete the next survey. Unknown to them, the timer was manipulated during two of their three sessions – running half as fast as clock time in one, and twice as fast as clock time in the other. The authors predicted that objective healing would follow the amount of perceived time that had passed, even though the elapsed time was the same during all three sessions, which is what they found. Digging deeper into the data, we can account for this finding within the Embodied Models of Health framework. Participants who had preexisting beliefs that they healed more easily and quickly than others tended to notice more variability in healing in their healing observation surveys, and this, in turn, predicted their responsiveness to the perceived time manipulation. In other words, participants' preexisting beliefs about how quickly they heal shaped how they attended to the healing process during their lab sessions, and this relationship predicted whether they were affected by the perceived time manipulation.

In Leibowitz et al. (2019), the authors wanted to better understand the factors that predict responsiveness to open-label placebos: a supportive patient-provider relationship, a medical ritual, positive expectations, and a rationale about the power of placebos. The authors used four conditions to explore this question, starting with a control condition that only included a supportive patient-provider relationship and then additively layering the three other factors across the three remaining conditions. They predicted that responsiveness to the open-label placebo would increase in tandem with each additional factor that was added to the condition, but that is not what they found. Instead, there was a significant interaction between participants' preexisting belief in placebos and the factors believed to underlie responsiveness to open-label placebos: participants who received all four factors, and who already believed in placebos, exhibited significantly greater placebo effects than participants in any of the other conditions. Within the Embodied Models of Health framework, we can explain this in terms of the interactions among attention, beliefs, and expectations. Preexisting belief in placebos influenced how participants attended to the other factors, particularly the rationale about the power of placebos, and thus how they weighted those factors when forming expectations for their own responsiveness to the open-label placebo, which, in turn, drove a significantly greater response to the placebo treatment.

Attention is a weighting mechanism, and the specific weightings given to the targets of attention are determined by the quality of the attention given, the content of the underlying beliefs, and the activation strength of the underlying beliefs. The same physiological phenomenon can be attended to and nonetheless have different physiological effects, depending on the beliefs that structure attention. For example, in Howe et al. (2019), participants undergoing treatment for peanut allergies were recruited for a study on side effects. Half of the participants were led to believe that side effects are a sign that the treatment is working, whereas the other half believed that side effects were merely an unfortunate consequence of requiring treatment. Those who believed that side effects were positive signals of effective treatment experienced significantly greater increases in a biomarker of allergic tolerance to peanuts (IgG4). The benefits of seeing side effects as signals that the treatment is working have been reported in a number of other studies as well (Leibowitz et al., 2021). In all such cases, participants noticed side effects, but their treatment outcomes varied depending on the underlying beliefs that structured that awareness.

Some researchers argue that the physiological effects of placebos are fully mediated by attention, but only when the incoming sensory information is aligned with the beliefs primed in context (Aigner & Svanum, 2014). Similarly, the Bayesian brain hypothesis argues that attention modulates sensory information in terms of primed beliefs – amplifying signals consistent with the primed belief (or "prior") and minimizing inconsistent signals (Pagnini et al., 2024). *In most health mindset research, however, researchers do not measure or explicitly specify the beliefs they intend to prime, nor do they measure or computationally specify the ways in which attention acts as a weighting mechanism. If we want to better understand the causes of mind-body effects on health, this is a problem.*

Even a cursory review of existing health mindset research makes clear that the experimental designs the researchers employ rely heavily on priming and attention – as we already highlighted above in our discussion of Zahrt et al. (2023), which explored the effects of false physical activity feedback on health. In another study that explored the effects of false genotypic feedback on physiology (Turnwald et al., 2019), the authors similarly employed a number of tactics to leverage the pillars of the EMH framework. First, they told participants they were interested in the psychology of learning one's genetic risk information for obesity-related genes. Second, they provided test report pamphlets to study participants that described in detail the connections between their genotype and their underlying physiological responses to aerobic exercise and experiences of satiety (i.e., how quickly their bodies signal that they are "full" while eating). Third, they had participants complete survey measures of perceived risk of poor exercise capacity and poor satiety, respectively – ensuring participants were saliently aware of the connections between their genotype and the way they were likely to experience the outcome measures the experimenters were studying. Participants who were told they had a high-risk genotype for exercise capacity exhibited lower endurance and decreased cardiorespiratory efficiency during a treadmill test – even when their true underlying genotype should have had protective effects. Similarly, in the satiety condition, those told they carried a protective gene variant reported greater feelings of fullness and showed elevated GLP-1 levels following a standardized meal, even when their true genotype suggested opposite effects. Although this experimental design implicitly leveraged the EMH framework, it would have been interesting if the authors had included a measure of participants' preexisting beliefs about the extent to which genes determine physical traits and characteristics. Based on the EMH framework, we would predict that those participants who strongly endorsed more deterministic attitudes would be the same participants who exhibited the strongest effects from their genotypic feedback.

To conclude, we are making two important points in this section. One, across studies of mind-body effects on health and performance, we can explain the results in terms of the EMH framework. Whether we are talking about mindsets about aging or stress or intelligence or genes, the effect of the mindset is driven by its effect on attention allocation and expectation formation, which is an idea we explore more mechanistically in a companion paper (Aungle, Matta, Chen, et al., in prep). Two, to advance research in this area, study designs should more explicitly leverage the three pillars of the EMH framework. In practical terms, that means they should a) measure participants' preexisting beliefs about ideas central to the research question, b) intentionally direct participants' attention to aspects of the design that are most likely to reinforce the hypothesized effect, and c) as they design the study, consider how preexisting beliefs might interact with attention allocation in ways that could counteract or amplify the hypothesized effect.

Directions for Future Research

To test the role of attention in shaping physiological outcomes, a useful first step would be to replicate and build on the findings from Aungle and Langer (2023). One promising approach would involve a 2 (Time: Normal vs. Fast) × 2 (Attention: Healing vs. Diverted) between-subjects design. In all conditions, participants would undergo the standardized cupping procedure employed by Aungle and Langer and be asked to complete a brief task at regular intervals (e.g., every 4 minutes). In the Healing Attention conditions, participants would complete healing observation surveys identical to those used in Aungle and Langer (2023), which draw attention to specific features of the healing process. In the Diverted Attention condition, participants would instead complete a task unrelated to healing — such as a brief consumer preference survey or reaction time task — designed to occupy attention without prompting somatic self-monitoring. The timer used to know when to complete each survey would either run at a normal speed or twice as fast as normal time, creating four conditions in total.

Thus all participants would track the passage of time and engage in a task at predictable intervals, but only those in the Healing Attention conditions would be prompted to direct attention toward their healing. If attention mediates the effect of time on healing, we should see the most healing in the Fast Time x Healing Attention condition. Such a result would provide strong evidence that attention is not just correlated with — but necessary for — the link between subjective time and physiological outcomes.

More broadly, this experimental design would help isolate attention's unique contribution to the direct pathway described in the EMH framework. The EMH model implies that for those participants who strongly associate healing with time, they should experience more healing in the Healing Attention conditions than in the Diverted Attention conditions.

Another promising direction for future research would be to build on the work of Crum and colleagues on stress mindsets by testing whether the physiological and performance consequences of adopting a particular stress mindset are contingent on the targets of attention. In this study, participants would first be randomly assigned to adopt either a *Stress is Enhancing* or *Stress is Debilitating* mindset using previously validated video interventions (e.g., Crum et al., 2013, 2017). Then, in a second manipulation, attention would be experimentally directed either *inwardly* (e.g., toward participants' bodily sensations and subjective stress responses) or *outwardly* (e.g., toward solving a cognitively demanding task or engaging socially with a confederate). Prior research suggests that a *Stress is Enhancing* mindset promotes outward engagement with challenge, whereas a *Stress is Debilitating* mindset prompts heightened somatic vigilance and internal monitoring. If attention serves as a mechanism through which these mindsets exert their physiological effects, then redirecting attention away from the typical trajectory should attenuate or reverse the mindset effect (e.g., Ille et al., 2013). For example, inward attention should weaken the benefits of a Stress is Enhancing mindset, while outward attention should buffer against the physiological and performance costs of a Stress is Debilitating mindset. This would provide strong support for the claim — central to the Embodied Models of Health framework — that beliefs shape health by orienting attention, and that attentional direction can in turn constrain or amplify the effects of belief-based mindsets on physiology.

Earlier we discussed the relationship between cognitive reappraisal, attention, and physiology, arguing that the effects of cognitive reappraisal strategies on health are mediated by their influence on attention allocation and expectation formation processes. According to the EMH framework, in which beliefs orient attention and shape expectation formation, we suggest that cognitive reappraisal affects physiology by replacing counterproductive beliefs with alternative, contextually relevant beliefs that change what someone notices, the meaning assigned to that information, and the expectations that form as a result.

Building on previous research showing that cognitive reappraisal predicts differences in symptom severity and immune activity during rhinovirus infection (Brown et al., 2020), and consistent with the EMH contention that the more accurate or functional the underlying model of health, the more powerful its physiological effects, we propose extending this work by intervening on the *specific content* of the reappraisals participants employ. One particularly promising direction would be to test whether encouraging participants to reappraise fever – commonly viewed as a distressing symptom – as evidence that the body is actively killing pathogens improves recovery outcomes. This reappraisal aligns with immunological research showing that fever plays a functional role in enhancing immune surveillance and pathogen clearance (Evans et al., 2015). A study comparing this reframe to more generic reappraisal instructions (e.g., “this illness is manageable”) would allow researchers to test whether content-specific reappraisals, grounded in accurate health beliefs, exert stronger effects on both symptom severity and underlying immunological markers. Such findings would provide robust support for the EMH framework by linking belief content to attention allocation, expectation formation, and downstream physiological outcomes.

A provocative hypothesis emerging from the EMH framework is that biomedical treatments may be less effective in the absence of an activated health model—i.e., when patients are unaware of the treatment or fail to engage with it in a meaningfully embodied way. Though challenging to test directly for ethical reasons, a conceptual study could, for example, involve three groups of participants enrolled in a clinical weight loss trial. One group would receive Ozempic (semaglutide) and know that they are in a clinical weight loss trial assessing the efficacy of the medication; a second group would receive hidden administrations of Ozempic, such that they do not expect to receive any active intervention; and a third group would receive a placebo. If the EMH framework is correct, the hidden administration group should exhibit weight loss outcomes intermediate between the active Ozempic group and the placebo group. That is, even when the pharmacological mechanism remains intact, the absence of activating attention, beliefs, and expectations regarding treatment efficacy should blunt the full physiological impact of the drug. While such a design would face ethical and practical hurdles, it highlights a core contention of the EMH framework: that biomedical interventions achieve their full potency only when accompanied by actively embodied models of health.

Conclusion

We began this paper by juxtaposing the principle of mind-body unity with other frameworks for understanding our health, arguing in favor of a hierarchical model in which nearly all health outcomes are ultimately psychologically mediated. We call our framework Embodied Models of Health. While the importance of beliefs and expectations has been widely discussed in the health mindset and placebo literatures, we argue that the role of attention is the missing link between those literatures and computational Bayesian brain theories of mind-body dynamics. Crucially, we argue that attention is a belief-weighted mediator between “mind” and “body,” determining what we notice and how we value what we notice. Within the EMH framework, rather than being isolated curiosities, placebo effects, mindset influences, and subtle priming effects on health are outcomes of the same embodied cognitive dynamics. The EMH framework reflects the principle of mind-body unity, a phrase we strongly prefer to “mind-body connection,” since the latter phrasing obscures the breadth of psychological influences on physical health (Aungle & Langer, 2023). Langer’s body of research, in which she and her colleagues have argued that good health is the product of mindful engagement with the world (Langer, 2009, 2023; Langer, 1989; Langer & Ngnoumen, 2017; Pagnini et al., 2023), is based on the principle of mind-body unity.

We followed our discussion of mind-body unity by explaining how mind-body effects on health can be understood to operate through three interrelated pathways: two indirect pathways, behavior and affect, and a direct pathway between psychological processes and physiological outcomes. We used aging stereotypes to illustrate how our beliefs about a physiological process can become self-fulfilling via the three mind-body pathways. The latter of these pathways is the most interesting, least understood, and most relevant to our proposed framework, so we devoted the following section to the connections between attention, conceptual priming, and physiology.

Comparatively little has been written about the role of attention in either the placebo or health mindset literature, and attention is a core component of our proposed framework. Attention is often discussed in the literature on mindfulness, but the focus is often on present moment awareness (e.g., Kabat-Zinn, 2003). That is an important aspect of mindfulness, but we argue that within the present moment there are many things to which one can attend, and the focus of attention shapes its physiological consequences.

At the most basic level, within the present moment, attention can be directed either outwardly or inwardly – to what's happening in the environment around us or to what's happening in our bodies and minds. Here again, however, the distinction between external and internal focus neglects the full array of possible targets. Somatosensory awareness can spotlight perceived problems, or it can focus on what is working well. Similarly, awareness of our external environment can focus on stimuli that provide a sense of opportunity and possibility, or a feeling of threat and uncertainty. We devoted several paragraphs to a discussion of the links between conceptual priming and attention because it is important to appreciate that we are constantly surrounded by cues that prime us to think along lines that feel most consistent and aligned with past experience and contextually relevant beliefs. We hope to leave readers with at least three takeaways from our discussion of attention: the specific things we attend to influence how we think, feel, and act; we exist in environments full of conceptual primes that influence what we pay attention to and how we pay attention to it; how we pay attention, and what we pay attention to, directly shapes our health.

Then we moved to a discussion of placebos and health mindsets. Within each respective literature, there is a tendency to focus on just one of the three pillars in our proposed framework: placebos and **expectations**, and health mindsets and core **beliefs**. What EMH adds is a unifying perspective that explicitly knits together belief-driven expectancies with attentional selection to explain a broad spectrum of mind-body phenomena. The EMH framework stands on the shoulders of placebo research, health mindset studies, and Bayesian brain theory, but by integrating insights from all three, EMH provides a novel comprehensive explanation for how our mind (through what we believe and attend to) can profoundly influence our body's health outcomes.

In the section introducing the embodied models of health framework, we put the pieces together to show how each of these components contribute to mind-body interactions that affect health. Beliefs dominate the process in our framework, which is consistent with placebo research, which assumes beliefs in medical science underly the positive expectations that lead to placebo effects, as well as health mindset research, which argues "core" beliefs are the fundamental ingredient in mindset formation and activation. But we also uniquely spotlight the role of attention – both in the maintenance of one's dominant embodied models of health, as well as in the process of updating and changing the beliefs at the center of such models.

Many people, especially those outside of these areas of research, read about placebo and health mindset effects and infer that there is value in tricking themselves into adopting beliefs that have little basis in reality (e.g., "this fatty, high-calorie milkshake is actually good for me!"), but this is the wrong way to think about this body of work. While it is true that many of the experimental paradigms employed in this research involve deception, deception is *not* the way to bring the value of these findings into one's everyday life. Indeed, as we discussed earlier, embodied models of health reflect causal associations and beliefs about the factors that shape our health. The genotype study worked because many people believe genes cause them to have certain physical traits and abilities (Dar-Nimrod & Heine, 2011). The milkshake study worked because people learn to causally associate caloric intake with feelings of satiety, and because some foods are more likely to prime the concept of indulgent consumption than others (Wansink & Chandon, 2006). The perceived time and healing study worked because many people causally associate the passage of time with physical healing (e.g., Crawford & Marsh, 2023). The competence and warmth of the attending physicians amplified placebo effects because many people causally associate effective treatment with competent and warm physicians (Kraft-Todd et al., 2017). And so on.

The closer beliefs are to true causal relationships, the stronger the effect of beliefs (and their consequent effects on attention and expectations) are on the underlying physiological processes. Rather than trying to trick oneself into believing something that has little basis in reality, one can notice a counterproductive belief – often by noticing when one is paying attention to unhelpful aspects of experience and working backward to the belief motivating that attention – and replace it by imagining a more constructive belief that is also true and applicable in context, then noticing elements of experience that support that belief. Alia Crum and colleagues' essentially took this approach in their study of metacognitive approaches to stress, demonstrating that simply educating participants about the "stress is debilitating" and "stress is enhancing" mindsets led more participants to effectively adopt a "stress is enhancing" mindset (Crum et al., 2023).

In our discussion of Directions for Future Research, we proposed two experiments to directly test our contention that the influence of an EMH on health and wellbeing depends in part on the accuracy of the model. One of the two proposals is a hypothetical design, since it would require an unethical and logistically challenging procedure – namely giving participants a GLP-1 weight loss drug without their knowledge – but it nonetheless underscores an important assertion of our framework: the more accurate the EMH, the more effective it is at shaping underlying physiology and wellbeing. The other proposal based on this premise is to extend research on cognitive reappraisal and recovery from rhinoviral infection. This design would provide a robust test of our contention that the accuracy of an EMH is directly related to its effects on health, since research has already shown that cognitive reappraisal significantly influences recovery from infection.

Throughout this paper, we have argued that attention, beliefs, and expectations are continually interacting with each other in ways that shape health and wellbeing. Although beliefs typically exert the greatest influence on this process, they do so by orienting attention and guiding the formation of expectations – two mechanisms that translate abstract conceptions of health into behavioral, affective, and direct physiological change. By highlighting the role of attention as a dynamic and underappreciated pathway through which beliefs exert their effects, we extend existing models of mind-body interaction and offer a more mechanistic account of how psychological processes influence physical outcomes.

The Embodied Models of Health (EMH) framework we propose clarifies not only how beliefs shape health over time, but also when and why certain beliefs gain traction in the body: when they orient attention toward health-relevant inputs, alter the perceived meaning of those inputs, and give rise to expectations that modulate physiological processes. Beliefs that align with a person's attentional landscape and that are reinforced through contextual cues (e.g., symptoms, social feedback, biofeedback, diagnostic language, etc.) are more likely to become embodied, because they influence what is noticed, how it is interpreted, and ultimately how the body responds. Conversely, beliefs that are not attentionally reinforced, or that remain abstract and disconnected from lived experience, are less likely to exert lasting physiological influence. The EMH framework we propose opens new avenues for both theory and intervention. If attention is a modifiable filter that weights incoming information, and expectation is a flexible forecast shaped by belief, then health itself is far more malleable than traditionally assumed. Integrating these insights into clinical, behavioral, and public health contexts holds promise for amplifying treatment effects, improving patient outcomes, and ultimately building a more integrative science of health.

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