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Neuropsychological Mechanisms of Mortality Acceptance: A Historical Case Analysis of Contemplative Practice and Fear Circuit Modulation

Abstract

Background: The neuropsychological underpinnings of equanimity in the face of death remain poorly understood. Contemplative traditions offer historically documented accounts of individuals who engaged with mortality without visible fear, yet these accounts have rarely been examined through the lens of contemporary neuroscience.

Objective: This paper proposes a neuropsychological framework to explain how sustained contemplative practice may modulate fear circuit activity, alter self-referential processing, and support what Terror Management Theory terms worldview defence, enabling mortality acceptance rather than anxiety.

Methods: Drawing on historical primary sources specifically Macauliffe's (1909) authoritative account of Sikh history and Singh's (1967) biographical work this study employs a qualitative historical case analysis of Guru Tegh Bahadur (1621–1675), a Sikh spiritual leader who spent over two decades in deep contemplative practice before facing execution in 1675. His documented composure during martyrdom serves as the primary case for theoretical analysis.

Results: Five converging neuropsychological mechanisms are proposed to explain the observed behaviour: (1) meditation-induced neuroplasticity producing structural amygdala changes and prefrontal strengthening; (2) dissolution of threat-relevant self-referential processing through default mode network modulation; (3) sacred value encoding that reframes mortality as a non-threat; (4) contemplative reappraisal (vairag) functioning as a sophisticated cognitive emotion regulation strategy; and (5) enhanced vagal tone providing autonomic stability under existential threat.

Conclusions: The case suggests that intensive, sustained contemplative practice may fundamentally recalibrate threat appraisal at the neurobiological level, producing functional states consistent with documented accounts of courageous mortality acceptance. These findings carry implications for clinical interventions targeting death anxiety in palliative care, trauma, and existential distress.

Theoretical Article

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Keywords: Terror Management Theory, Contemplative Neuroscience, Fear Circuit Modulation, Mortality Acceptance, Amygdala, Neuroplasticity, Sacred Values, Sikh Psychology, Death Anxiety, Polyvagal Theory.

Introduction

What enables a person to face death not reluctantly, but with deliberate, documented composure? This is not an abstract philosophical question. It is one that neuroscience, clinical psychology, and contemplative traditions have circled around from different directions without quite meeting in the middle. This paper proposes that they can, and that historical case analysis offers a surprising lens through which to bring them together.

Fear processing is not a monolithic capacity. The architecture of the brain's threat-response system involves coordinated, context-sensitive activity across a network of regions. As [1] demonstrated in foundational work on the neural bases of fear, the amygdala serves as

a critical hub for threat detection, initiating rapid defensive responses that precede conscious awareness. Research by [2] further highlights the amygdala's role in vigilance and emotional processing, emphasizing its importance in detecting and responding to biologically significant stimuli. This function is complemented by prefrontal and insular circuits that enable more nuanced evaluation of whether a stimulus genuinely warrants alarm [3]. The system is exquisitely sensitive but also crucially modifiable. When a threat becomes immediately, inescapably present, coordinated shifts occur between prefrontal executive regions and the periaqueductal gray, moving the organism from regulatory restraint into primitive defensive modes [4]. But not always. Under certain conditions that remain incompletely mapped individuals remain regulated even in the face of extreme threat. LeDoux [5] himself has argued that what we call fear is better understood as a cognitive appraisal built on top of subcortical defensive systems, a distinction with considerable implications for understanding voluntary modulation of fear-like states.

[6] provided compelling evidence that prefrontal-amygdala regulatory circuits enable deliberate attenuation of fear responses, and [7] demonstrated that the nature of amygdala connectivity is a significant individual-difference variable in emotional reactivity. What mediates such connectivity? One answer, accumulating substantial empirical weight over the past two decades, is contemplative practice. [8] drew attention to the methodological challenges but also the genuine promise of contemplative neuroscience as a field a promise that has been fulfilled in part by structural and functional imaging studies showing meditation-related changes across attention, emotion regulation, and self-referential processing systems.

In parallel with this neuroscientific inquiry, Terror Management Theory (TMT) has investigated the psychological consequences of mortality awareness. [9] proposed that awareness of one's own inevitable death generates a profound, largely unconscious existential anxiety, and that cultural worldviews and self-esteem function as psychological buffers against this anxiety. The theory has been supported by hundreds of empirical studies [10] and has been extended to address what happens when mortality salience does not produce terror under what conditions, and for whom, awareness of death becomes a different kind of motivational force [11]. [12] have shown that the attentional regulation capacities cultivated in meditation training are associated with distinctive neural signatures, and [13] offer a comprehensive account of how meditation may simultaneously modify multiple neural systems relevant to emotion regulation, attentional control, and self-referential processing. [14] extended this work by proposing specific mechanisms through which these changes translate into improved psychological functioning. [15] demonstrated, using fMRI, that values deemed sacred or protected are neurologically encoded differently from instrumental values a finding directly relevant to understanding how deeply held commitments might alter the motivational valence of death itself. [16] have catalogued the functional neural correlates of emotion regulation, providing the scaffolding needed to understand deliberate modulation of existential fear.

The historical account examined here concerns Guru Tegh Bahadur (1621–1675), ninth Guru of the Sikh tradition. According to the detailed historical records compiled by [17] and the biographical scholarship of [18], Guru Tegh Bahadur spent more than two decades in intensive contemplative retreat before emerging into active spiritual leadership. In 1675, he was executed by order of the Mughal Emperor Aurangzeb after refusing to renounce his faith or to remain silent in the face of religious persecution. By all historical accounts, he faced this execution with extraordinary composure. He did not resist. He did not beg. He expressed, by documented report, no fear.

How might neuroscience help us understand this? That is the question this paper takes seriously not as hagiography, but as a genuinely interesting problem in contemplative psychology. The following sections develop a theoretical framework drawing on TMT, contemplative neuroscience, sacred value research, emotion regulation, self-transcendence, and polyvagal theory. A historical methods section addresses the evidentiary basis for the case analysis. The proposed mechanisms section then integrates these frameworks to offer a neuropsychologically grounded account of mortality acceptance. The discussion considers clinical implications, methodological limitations, and directions for future empirical work.

Theoretical Framework

Terror Management Theory

Terror Management Theory begins with a deceptively simple premise: human beings are the only animals who know they will die, and this knowledge creates a fundamental psychological problem. [9] argued, drawing on the existential philosophy of Ernest Becker, that the awareness of mortality generates a pervasive, largely unconscious terror that must be managed if individuals are to function adaptively. The solution most humans employ involves investment in cultural worldviews systems of belief and value that confer meaning, permanence, and symbolic immortality. By identifying with something larger than oneself, whether a nation, a religion, an ideological cause, or a creative legacy, the individual gains psychological protection against the existential dread of annihilation.

[19] elaborated this framework, documenting the extensive social and behavioural consequences of what they called mortality salience the experimental condition in which participants are briefly reminded of their own death before engaging in various judgement tasks. The robustness of mortality salience effects across cultures, social contexts, and populations has been striking. [10]'s meta-analysis synthesised 277 studies and confirmed that reminders of death reliably intensify adherence to worldview-consistent beliefs, increase prejudice against worldview threats, and heighten self-esteem striving. These effects are especially strong when individuals lack alternative buffering resources.

However, the picture is more nuanced than early TMT formulations suggested. [11] identified conditions under which mortality salience produces positive rather than defensive outcomes increased prosocial behaviour, openness to personal growth, and greater engagement with intrinsic rather than extrinsic goals. A key moderating variable is the nature of the worldview itself: when a person's meaning system incorporates mortality as a meaningful rather than meaningless event, awareness of death can function as a motivational catalyst rather than a threat.

Particularly relevant to the present analysis is research demonstrating that mindfulness practice may buffer the anxiety-amplifying effects of mortality salience. [20] found that trait mindfulness moderated mortality salience effects, with highly mindful individuals showing reduced defensive responding following death reminders. The authors proposed that mindfulness facilitates acceptance of mortality rather than suppression of mortality-related cognition. This suggests a psychological pathway through which contemplative practice might, over time, fundamentally alter an individual's relationship with their own death.

Contemplative Neuroscience and Neuroplasticity

The neuroscience of meditation has matured substantially over the past two decades, moving from exploratory curiosity to a body of replicable findings anchored in structural and functional neuroimaging. The headline finding that contemplative practice changes the brain is now well-established. What matters for the present analysis is the specificity of those changes and their functional implications.

[21] provided a landmark demonstration that just eight weeks of mindfulness-based stress reduction practice was associated with decreased gray matter density in the right amygdala, with individual reductions correlating with participant-reported decreases in perceived stress. This study was significant not merely for documenting a structural change but for its timing: eight weeks is a relatively brief intervention, suggesting that neuroplastic effects on threat-processing circuitry may accumulate rapidly with consistent practice. For someone who has practiced for two decades, as the case subject did, the implications are considerably more dramatic.

Long-term practitioners show even more pronounced alterations. [22] documented increased cortical thickness in prefrontal regions and the right anterior insula in experienced meditators, regions associated with attention, interoception, and emotional awareness. [23] found enlarged hippocampal and frontal volumes in meditators compared with matched controls, along with differences in gyrification patterns. [12] examined attention regulation specifically, demonstrating that expert meditators show distinctive neural signatures during sustained attention tasks signatures consistent with effortful, selective deployment of attentional resources rather than habitual mind-wandering.

Functionally, meditation alters the dynamics of the default mode network (DMN), a set of regions characteristically active during self-referential, ruminative thinking. [24] found that experienced meditators showed reduced DMN activity during meditation compared with novices and demonstrated that the degree of DMN suppression

correlated with subjective reports of reduced self-referential thought. [25] extended this work using real-time fMRI neurofeedback to demonstrate that practitioners could learn to modulate their own DMN activity, suggesting that meditation provides a form of self-regulatory training over this system.

[26] contributed an important bridge between contemplative practice and physiological outcomes, demonstrating that mindfulness meditation was associated with increases in left-sided prefrontal activation a neural signature associated with approach motivation and positive affect as well as enhanced immune function in response to influenza vaccination. These findings suggest that meditation's effects are not confined to subjective experience but extend to measurable biological outcomes.

Two studies are particularly critical for understanding how these changes might persist across contexts. [27] examined amygdala reactivity to emotional stimuli before and after an eight-week mindfulness intervention and found that the meditation group showed reduced amygdala responses to emotional images even when not actively meditating suggesting that practice effects generalise to ordinary, non-meditative states. This is essential for the present analysis: it implies that a long-term practitioner might exhibit attenuated fear-circuit reactivity not only during meditation but in the ordinary waking state, including when facing execution.

[28] conducted a systematic review and meta-analysis of the physiological effects of mindfulness-based stress reduction, documenting significant reductions in cortisol, blood pressure, and heart rate reactivity measures that index the HPA axis and sympathetic nervous system responses to stress. Together, [13] integrative review, [14] mechanistic model, and this accumulating body of evidence converge on a picture of meditation as a practice that fundamentally recalibrates the organism's relationship with threat not by suppressing threat responses but by reducing the threshold at which prefrontal regulatory processes engage effectively.

Sacred Values and Threat-Immune Motivation

Not all values are equal in their psychological function. Decades of research in behavioural economics and moral psychology have drawn a distinction between instrumental values those that can be traded off against other considerations in a cost-benefit calculus and sacred or protected values, which are experienced as inviolable and categorically non-negotiable. What neuroscience has added to this understanding is evidence that these two types of values recruit different neural systems and are encoded differently in the brain.

[15] examined, using fMRI, what happens when individuals are asked to consider trading off sacred values against economic incentives. Critically, sacred values were associated with greater activation of the left temporoparietal junction and ventrolateral prefrontal cortex, regions linked to rule-based rather than cost-benefit reasoning. Moreover, sacred values were associated with reduced activity in regions associated with value computation, suggesting that the brain treats them as categorically exempt from ordinary trade-off evaluation. This neural profile has direct implications for understanding how a deeply held spiritual commitment might alter the psychological and neurobiological response to death: if dying for one's values is encoded as a morally required act rather than a cost, the amygdala-mediated threat response to that death may be fundamentally attenuated.

[29] extended this work to examine how sacred values interact with perceived threat, finding that the sacred value network is remarkably resistant to threat-induced updating. Whereas instrumental values become more flexible under pressure more susceptible to trade-off reasoning when the stakes are high sacred values appear to become, if anything, more entrenched. This finding is counterintuitive from a purely rational-choice perspective but makes sense when understood neurobiologically: the threat-related activation that would normally drive behavioural recalibration is, in the sacred value case, channelled into commitment rather than avoidance.

Emotion Regulation: From Reappraisal to Acceptance

Emotion regulation research has documented a family of strategies through which individuals modulate the intensity, duration, or nature of their emotional responses. [30] provided a comprehensive process model distinguishing antecedent-focused strategies before an emotional response has fully generated from response-focused strategies applied after emotion generation. Among antecedent-focused strategies, cognitive reappraisal

has received the most empirical attention, and its neural correlates are now well-characterised.

[31] delineated the prefrontal-amygdala circuitry underlying cognitive reappraisal, demonstrating that deliberate reinterpretation of emotional stimuli is associated with increased lateral prefrontal activation and decreased amygdala and insula activity. [16] extended this analysis in a comprehensive imaging meta-analysis, confirming that reappraisal reliably recruits prefrontal regulatory regions while attenuating subcortical emotional responses a pattern consistent across studies and populations. The capacity for effective reappraisal appears to depend on the strength and habitualness of prefrontal-amygdala connections, connections that, as reviewed above, are modified by sustained meditation practice.

[32] proposed a dual-process framework distinguishing between effortful, deliberate emotion regulation the kind studied in laboratory reappraisal paradigms and more automatic, implicit regulation that operates without conscious intention. Long-term meditators may shift towards the implicit end of this continuum: after thousands of hours of practice, regulatory processes that were initially effortful may become increasingly automatized, operating rapidly and without the cognitive load that effortful reappraisal demands.

[33] offered an important theoretical complement to the reappraisal literature in their elaboration of acceptance-based approaches in Acceptance and Commitment Therapy. Rather than modifying the content of aversive experiences as reappraisal does acceptance involves willingness to have such experiences without defensive avoidance or experiential suppression. Acceptance-based regulation is associated with reduced psychological reactivity to feared stimuli and, over time, with genuinely reduced distress rather than merely masked distress. This distinction matters: acceptance is not resignation but active, open engagement with difficult experience, a functional state that contemplative traditions have cultivated under various names, and that Sikh devotional practice describes through the concept of vairag a non-attached, tranquil engagement with the impermanence of existence.

Self-Transcendence and Identity Reorganisation

A recurring theme across contemplative traditions is the diminishment or dissolution of ordinary self-referential identity as a consequence of sustained practice. [34] a neurologist who also practiced Zen for many years, proposed that long-term meditation gradually erodes the sense of a bounded, separate self not as an abstract philosophical achievement but as a perceptual and experiential transformation with identifiable neural correlates. This process is relevant to mortality acceptance because much of what makes death threatening is precisely its challenge to the continuity and significance of the self.

[35] provided a systematic analysis of what they term self-transcendent experiences transient but potentially highly significant mental states characterised by dissolution of the ordinary sense of personal self-boundaries, accompanied by feelings of connection, elevation, or unity. These states occur across contemplative traditions and, importantly, are not psychopathological; they are associated with positive psychological outcomes, including increased well-being, prosocial motivation, and reduced death anxiety. [35] distinguished among varieties of self-transcendent experience that range from aesthetic awe to mystical absorption, noting that more intense forms involve more profound alterations in self-processing and are more reliably associated with lasting psychological change.

[36] offered an important methodological caveat in this context: much mindfulness and contemplative research is limited by weak study designs, poor control conditions, and inadequately specified constructs. These concerns are legitimate and are addressed more fully in the limitations section of the discussion. They do not, however, undermine the convergent validity of the structural and functional findings reviewed above, which derive from well-controlled imaging studies rather than purely self-report methodologies.

Polyvagal Theory and Autonomic Regulation

[37] proposed polyvagal theory as an account of how the autonomic nervous system mediates social engagement, threat response, and physiological self-regulation. The theory identifies three evolutionarily hierarchical response systems: a ventral vagal system associated with social engagement and safety; a sympathetic system associated with mobilisation and fight-or-flight; and a dorsal vagal system associated with immobilisation and shutdown. Under conditions of perceived safety, the ventral vagal system predominates, enabling calm, cooperative,

socially connected functioning. When threat is detected, the organism shifts towards sympathetic activation. Under inescapable, life-threatening conditions, dorsal vagal shutdown may occur the evolutionary substrate of feigned death and dissociative collapse.

[38] examined the relationship between vagal tone typically indexed by respiratory sinus arrhythmia or heart rate variability and psychological functioning, proposing an upward spiral model in which positive emotions increase vagal tone, which in turn supports greater social connection and further positive emotional experience. High vagal tone is associated with greater capacity for self-regulation, more flexible emotional responding, and more rapid recovery from stress. Meditation has been repeatedly shown to increase heart rate variability and to shift autonomic balance towards parasympathetic dominance exactly what polyvagal theory would predict should support calm engagement even in circumstances that would ordinarily trigger sympathetic mobilisation.

Historical Context and Methods

The Historical Case: Guru Tegh Bahadur (1621–1675)

Guru Tegh Bahadur was the ninth Guru of the Sikh faith, born in Amritsar in 1621. His name, conferred in recognition of his courage and spiritual depth, translates approximately as 'mighty of the sword' though the sword in question was understood metaphorically, denoting the cutting away of illusion rather than physical combat. According to [17] exhaustive historical account, compiled from Persian and Punjabi primary sources as well as Sikh oral and textual traditions, Guru Tegh Bahadur spent approximately twenty years in intensive contemplative practice, withdrawing from social life to devote himself to meditation and spiritual inquiry. This period, documented as occurring primarily in and around the village of Bakala in what is now Punjab, was characterised by what the historical sources describe as extreme inwardness and absorption.

[18] provides additional biographical detail, drawing on a somewhat different corpus of sources but converging with [17] on the essential facts: the extended contemplative period, the eventual emergence into active Guruship, and the circumstances and manner of the martyrdom. In 1675, following his refusal to acquiesce to Aurangzeb's religious coercion, Guru Tegh Bahadur was arrested, transported to Delhi, and publicly executed. What the historical sources emphasise is not only that he died but how he died: with documented composure, without apparent distress, reportedly engaging in meditation in his final hours. Three of his companions were tortured and executed before him, in part as an attempt to induce

Methodological Approach

This paper employs qualitative historical case analysis as its primary methodological approach. Case study methodology in psychology permits in-depth examination of individual instances that illuminate broader theoretical principles, and historical case analysis extends this method to subjects whose lives can only be accessed through textual and documentary records [8]. The evidentiary standard is appropriately different from experimental or clinical research: we cannot directly measure neurobiological variables in a seventeenth-century subject, and the historical accounts themselves carry the interpretive weight of religious and hagiographic traditions.

These limitations are acknowledged explicitly and are addressed further in the limitations section. The analytic strategy is to ask not whether the neuropsychological mechanisms proposed here were operating in this specific case that question is unanswerable but whether the mechanisms proposed are plausible given both the contemporary neuroscientific evidence and the available historical record. The case analysis functions as a heuristic and illustrative device, generating hypotheses and highlighting theoretical connections that might otherwise remain abstract.

The Contemplative Training Protocol

The historical sources are reasonably specific about the nature and duration of Guru Tegh Bahadur's contemplative practice. [17] describes a regime centred on nam Simran the sustained, repetitive practice of divine name recitation that constitutes the core contemplative method of the Sikh tradition. This practice, performed for extended daily periods over many years, shares structural features with practices whose neural effects have been documented in contemporary neuroscience:

focused attention, open monitoring, mantra repetition, and the cultivation of non-reactive awareness. The duration reported in the historical sources approximately two decades of intensive practice exceeds the training histories of even the most experienced practitioners studied in contemporary contemplative neuroscience research, where 'expert meditator' status is typically defined by 1,000 to 10,000 hours of practice.

Proposed Neuropsychological Mechanisms

Mechanism One: Meditation-Induced Neuroplasticity and Amygdala Recalibration

The most direct neurobiological mechanism proposed here is structural and functional modification of the amygdala and its prefrontal regulatory connections. As reviewed above, [21] documented amygdala gray matter reduction following eight-week mindfulness training, with changes correlating with stress reduction. For a practitioner with twenty or more years of intensive practice, the magnitude of such changes would likely be substantially greater and, critically, more stable across contexts.

The functional significance of amygdala structural change is not fully understood, but available evidence suggests that reduced gray matter density in this region is associated with reduced reactivity to threat-relevant stimuli rather than with impaired threat detection per se. [27] demonstrated that meditation-induced amygdala changes generalise to non-meditative states, which implies that such a practitioner would not need to be actively meditating for the regulatory benefits to operate. In the context of facing execution, this means that attenuated amygdala reactivity need not require deliberate regulatory effort; it may operate as a dispositional feature of the practitioner's threat-response architecture.

Additionally, the strengthened prefrontal-amygdala connectivity that meditation appears to produce [16] would support more efficient top-down regulation of any threat signals that did reach conscious awareness. The combination of reduced initial reactivity and enhanced regulatory capacity creates a neurobiological configuration distinctly different from that of an average, non-meditating individual confronting imminent death.

Mechanism Two: Default Mode Network Suppression and Self-Dissolution

Much of what makes death threatening is its challenge to the continuity, significance, and uniqueness of the self. Terror Management Theory locates this threat centrally: worldview defence and self-esteem striving are effective buffers precisely because they affirm symbolic self-continuation. But what if the ordinary, anxious, self-protective self has been substantially attenuated through years of contemplative practice? What if the practitioner's relationship with their own identity has been fundamentally altered?

[24] and [25] have demonstrated that experienced meditators show systematic suppression of the DMN the network most associated with self-referential rumination, narrative self-construction, and mind-wandering. This suppression correlates with reduced subjective reports of self-referential thought during practice. Prolonged reduction of DMN activity, across thousands of hours of practice, may produce more stable, trait-level reduction in the intensity of ordinary self-referential processing. From a Terror Management Theory perspective, an individual who is substantially less invested in the continuity of the self-narrative would find the prospect of death less threatening at a basic psychological level not because they have suppressed the awareness of death but because the self that death threatens has become less psychologically central.

[35] note that self-transcendent experiences often involve a subjective sense that 'the self is not the most important thing' a reorientation of concern from personal to transpersonal. Sikh devotional theology explicitly cultivates this reorientation: the practitioner's aim is the dissolution of haumai, the ego-self, and identification with something described as simultaneously immanent and boundless. The theological framing and the psychological mechanism are remarkably convergent.

Mechanism Three: Sacred Value Encoding and Threat Immunity

As [15] demonstrated, sacred values are processed by a different neural system than instrumental values one associated with rule-based, identity-constituting commitments rather than cost-benefit trade-offs. For Guru Tegh Bahadur, the protection of religious freedom was, by all available historical evidence, not merely a strongly held preference but a commitment experienced as categorically non-negotiable. His execution followed directly from his refusal to recant under extreme pressure a refusal that would, in conventional cost-benefit terms,

seem irrational. The sacred value framework makes it psychologically intelligible.

[29] found that sacred values become more entrenched, not less, under threat. This counterintuitive finding illuminates the historical account: the escalating coercion of the Mughal administration may have, paradoxically, served to deepen the practitioner's commitment rather than undermine it, as threat activated the sacred value network rather than the fear-regulatory system. Under this account, the execution was not experienced neurobiologically as a terrible cost but as the necessary completion of a commitment a fundamentally different appraisal that would recruit prefrontal rule-based systems rather than amygdala-mediated fear.

Mechanism Four: Vairag as Cognitive Reappraisal

The Sikh contemplative concept of vairag typically translated as non-attachment or renunciation, but more precisely denoting a serene, equanimous disengagement from the transient world functions, in cognitive terms, as a highly elaborated and deeply practised cognitive reappraisal strategy. Where ordinary cognitive reappraisal involves deliberately reconstructing the meaning of a specific emotional stimulus in the moment of encounter, vairag is a practised, habitual orientation towards the impermanence of all phenomena, including life itself.

[31] identified the neural correlates of cognitive reappraisal as involving lateral prefrontal cortex, medial prefrontal cortex, and anterior cingulate cortex, with corresponding reductions in amygdala and insula activity. [32]'s dual-process framework predicts that reappraisal strategies that become habitual through extensive practice should eventually operate with minimal deliberate effort and minimal cognitive load. Vairag, as a practice cultivated over decades, may represent precisely this kind of automatised reappraisal: an enduring orientation that rapidly and effortlessly recontextualises potentially threatening experiences within a framework that renders them non-threatening or even affirming.

The acceptance dimension of vairag is also relevant. [33] demonstrated that acceptance-based regulation reduces psychological reactivity to feared stimuli through a fundamentally different mechanism than suppression or avoidance: not by reducing awareness of difficult experience but by reducing the experiential fusion with that experience that generates distress. For a practitioner for whom death has been explicitly and repeatedly recontextualised as a transition rather than an annihilation, the psychological encounter with execution need not generate the terror it would for someone for whom this recontextualisation has never occurred.

Mechanism Five: Enhanced Vagal Tone and Autonomic Stability

Even if the foregoing cognitive and neural mechanisms were fully operational, the physiological demands of facing imminent execution are extraordinary. The sympathetic nervous system would be activated by immediate physical threat. Hormonal cascades would be initiated. Without some mechanism for autonomic regulation, the subjective experience of composure would be neurobiologically unsustainable.

[37] proposed that the ventral vagal system, when robustly developed through early social learning and ongoing social engagement, provides a neurobiological substrate for calm, regulated functioning even in the presence of objectively threatening circumstances. The practitioner who has developed high vagal tone through sustained meditation as documented by [28] meta-analytic review and by the heart rate variability research reviewed in the context of polyvagal theory would be physiologically better equipped to maintain parasympathetic dominance under stress.

[38] proposed an upward spiral in which vagal tone and positive psychological states mutually reinforce one another. Long-term meditation, which reliably increases heart rate variability [28], would, under this model, establish a dispositional physiological baseline characterised by greater autonomic flexibility and more efficient recovery from stress activation. Whether such a practitioner could sustain parasympathetic dominance under the acute stress of imminent execution is unknowable from available evidence; what can be said is that their starting physiological condition would be dramatically different from that of a non-meditating individual, and that this difference would be expected, on theoretical grounds, to translate into greater autonomic stability under extreme conditions.

Discussion

Integrating the Mechanisms

The five mechanisms proposed above are not independent explanations competing for explanatory primacy; they are mutually reinforcing components of a system that, taken together, accounts for the behavioural and experiential profile that the historical record describes. Neuroplastic changes in amygdala structure reduce baseline threat reactivity. DMN suppression attenuates the self-referential processing that makes death personally terrifying. Sacred value encoding reframes the execution as a morally required act rather than a cost. Habitual vairag functions as an automatised acceptance and reappraisal strategy. Enhanced vagal tone provides the physiological substrate for sustained regulatory function under acute stress. Each mechanism is individually plausible given contemporary evidence; together, they offer a convergent account of what might otherwise seem a psychologically inexplicable behaviour.

It is worth noting that these mechanisms are not unique to the Sikh tradition or to this particular historical case. TMT research on buffering conditions [11], contemplative neuroscience findings on structural and functional change [13,14], and clinical research on acceptance-based interventions [33] all point to the general principle that how one relates to one's own mortality is not fixed but modifiable through practice, meaning, and the cultivation of specific psychological capacities. The Guru Tegh Bahadur case is striking partly because the contemplative investment was so extensive, the historical documentation reasonably clear, and the behavioural outcome so unambiguous.

Clinical Implications

The theoretical framework developed here has several clinical implications worth drawing out explicitly. Death anxiety is clinically significant across a range of populations: patients in palliative care, cancer survivors, individuals with PTSD involving near-death experiences, elderly adults with existential distress, and individuals who have lived through collective trauma. Current interventions for death anxiety include meaning-centred therapy, terror management interventions, and acceptance-based psychotherapy all of which have theoretical foundations that overlap with the framework proposed here.

The present analysis suggests that the neurobiological dimension of death anxiety has been undertheorised in clinical contexts. If amygdala reactivity, prefrontal-amygdala connectivity, DMN function, and vagal tone are all implicated in the capacity for equanimous mortality acceptance, then interventions that modify these substrates including but not limited to mindfulness-based interventions should be examined as potential components of death anxiety treatment protocols. The evidence reviewed above suggests that even relatively brief mindfulness-based interventions may produce measurable neurobiological change [21]; longer-term practice would be expected to produce more substantial effects.

There are also implications for how cultural and religious meaning systems might be engaged in clinical work. The sacred value framework [15] suggests that deeply held values may do genuine neurobiological work in attenuating threat responses. Culturally sensitive clinical practice that engages with clients' meaning systems rather than treating them as epiphenomenal may be clinically advantageous, particularly in populations where religious or spiritual commitments are central to identity.

Limitations

Several significant limitations must be acknowledged. First and most fundamentally, the historical case method cannot establish the neurobiological mechanisms proposed here; it can only motivate them as plausible hypotheses consistent with both the historical record and contemporary evidence. The neurobiological account is inferential and theoretical, not empirical in any direct sense applied to the case subject.

Second, the historical sources, however carefully compiled, carry interpretive weight. Both [17] and [18] write within traditions that regard Guru Tegh Bahadur as a saint and martyr; their accounts are not disinterested. The possibility that composure in the face of death has been amplified or embellished in the transmission of the historical narrative cannot be ruled out. What can be said is that the accounts are consistent across multiple source traditions and that the basic historical facts the execution, the circumstances, the refusal to submit are not in dispute.

Third, as [36] note, much contemplative research is methodologically limited. The translation from laboratory mindfulness studies to the twenty-year intensive practice described in the historical sources is not straightforward. Dose-response relationships in contemplative neuroscience are poorly characterised. The specific

practice described in the historical sources nam Simran is not identical to the mindfulness-based interventions most studied in Western neuroscience, and these differences may be consequential.

Fourth, the framework as developed here does not account for potential alternative explanations of the observed composure. Dissociation, cultural performance of expected behaviour, psychological numbing, or genuinely different historical-cultural relationships with death are all possible partial explanations that cannot be fully excluded by the available evidence. [8] have emphasised the importance of methodological rigour in contemplative neuroscience; the present paper aspires to methodological transparency rather than methodological rigour, and its conclusions should be read accordingly.

Future Research Directions

The framework developed here generates several testable hypotheses that could be examined with contemporary participants. First, do long-term practitioners of intensive forms of meditation those with ten or more years of daily intensive practice show different neurobiological responses to mortality salience than novice meditators or non-meditators? Combining established mortality salience paradigms with functional neuroimaging could address this question directly. The amygdala, prefrontal cortex, DMN, and insula are all well-characterised targets for such investigation.

Second, does sacred value strength moderate mortality salience effects at the neural level? [15] paradigm could be extended to include death-relevant contexts, examining whether sacred value encoding predicts attenuated amygdala responses to mortality-relevant stimuli. Such a study would directly test the mechanism proposed under Mechanism Three.

Third, do acceptance-based versus reappraisal-based strategies differ in their efficacy for death anxiety, and do they engage different neural systems? [33]'s theoretical framework predict they should. Comparative neuroimaging studies of acceptance versus reappraisal strategies applied to mortality-relevant material could test this prediction.

Finally, comparative historical analysis examining multiple cases of documented mortality acceptance across different contemplative traditions could test the generalisability of the framework beyond the specific cultural context examined here. The Sufi tradition, Buddhist martyrology, and the accounts of Stoic philosophers all offer potentially relevant cases.

Conclusion

This paper has proposed a neuropsychological framework for understanding mortality acceptance, developed through a historical case analysis of a figure whose contemplative practice was unusually intensive, well-documented, and whose encounter with death unusually extreme. The five mechanisms proposed neuroplasticity and amygdala recalibration, DMN suppression and self-dissolution, sacred value encoding, vairag as cognitive reappraisal, and enhanced vagal tone are individually grounded in contemporary neuroscience and collectively coherent as an account of how sustained contemplative practice might fundamentally alter the neurobiological response to death.

What the historical case of Guru Tegh Bahadur illustrates is not a miraculous exception to ordinary human psychology but a possible, if extraordinary, outcome of ordinary neurobiological processes pushed towards their limits through decades of deliberate cultivation. The mechanisms that produced, if the theoretical account is correct, his documented composure in 1675 are the same mechanisms that contemporary neuroscience is now beginning to map in living practitioners' mechanisms that are, in principle, available to anyone willing to engage in sustained contemplative practice.

Terror Management Theory has established that how human beings relate to their own mortality shapes much of their psychological life. Contemplative traditions have long claimed that this relationship can be transformed. Neuroscience is now in a position to explain, at least in broad outline, how that transformation might work. The present analysis is a preliminary contribution to the conversation between these three traditions a conversation that has considerable implications not only for theoretical psychology but for the clinical practice of helping people live, and die, with equanimity.

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