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Five Aggregates (Pañcakkhandha) in Buddhist Psychology and Contemporary Neuroscience: An Interdisciplinary Analysis of Mind, Consciousness, and Human Experience

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***Abstract*-- The doctrine of the Five Aggregates (Pañcakkhandha)—Rūpa (material form), Vedanā (feeling), Saññā (perception), Saṅkhāra (mental formations), and Viññāṇa (consciousness)—constitutes one of the most significant psychological frameworks in Buddhist thought. The Buddha utilized this model to explain the nature of human experience, suffering, and the illusion of a permanent self. Contemporary neuroscience has increasingly adopted process-oriented models of cognition and consciousness that challenge traditional notions of an enduring self and emphasize the dynamic interaction of neural systems. This paper explores the relationship between Buddhist psychology and neuroscience through a comparative examination of the Five Aggregates. Using textual analysis of canonical Buddhist literature and contemporary neuroscientific research, the study identifies conceptual parallels between Buddhist descriptions of psycho-physical processes and modern understandings of brain function, perception, emotional processing, cognitive construction, habit formation, and consciousness. The paper argues that Buddhist phenomenology and neuroscience provide complementary perspectives on the nature of mind and human experience. Furthermore, mindfulness and Vipassanā meditation serve as valuable methodological bridges connecting subjective contemplative observation with objective scientific investigation. The findings suggest that integrating Buddhist psychology with neuroscience may contribute significantly to contemporary discussions on consciousness, mental health, emotional regulation, and human flourishing.**

***Keywords*-- Five Aggregates, Buddhist Psychology, Neuroscience, Consciousness, Mindfulness, Vipassanā Meditation, Non-self, Cognitive Science, Contemplative Neuroscience**

I. Introduction

The question of what constitutes a human being has occupied philosophers, theologians, psychologists, and scientists throughout history. Various traditions have proposed different explanations regarding the nature of mind, self, and consciousness.

Within the Buddhist tradition, one of the most profound analyses of human existence is found in the doctrine of the Five Aggregates (Pañcakkhandha), which serves as a fundamental framework for understanding the nature of experience and the causes of suffering.

More than twenty-five centuries ago, the Buddha presented a radically empirical approach to understanding human existence. Rather than postulating a permanent soul, creator-given identity, or metaphysical essence, he encouraged individuals to examine experience directly. Through careful observation, he concluded that what is conventionally called a "person" consists of five interdependent and constantly changing aggregates: material form (Rūpa), feeling (Vedanā), perception (Saññā), mental formations (Saṅkhāra), and consciousness (Viññāṇa). These aggregates arise dependent upon causes and conditions and lack any permanent or independent essence.

The Five Aggregates occupy a central position in Buddhist psychology because they provide a comprehensive account of how experience is constructed. The Buddha repeatedly emphasized that attachment to these aggregates gives rise to suffering (dukkha). Since the aggregates are impermanent (anicca) and not-self (anattā), identifying them as "I," "me," or "mine" inevitably leads to dissatisfaction and existential insecurity.

Interestingly, contemporary neuroscience has arrived at several conclusions that resonate with Buddhist insights. Modern research increasingly portrays the human mind not as a unified entity but as an emergent process arising from distributed neural networks. Advances in neuroimaging technologies such as functional magnetic resonance imaging (fMRI), electroencephalography (EEG), positron emission tomography (PET), and computational modeling have revealed that perception, memory, emotion, and self-awareness are dynamic processes generated by multiple interacting systems within the brain.

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The emergence of contemplative neuroscience during the last three decades has further strengthened the dialogue between Buddhism and science. Researchers such as Richard Davidson, Antoine Lutz, Judson Brewer, Evan Thompson, and others have investigated the neural correlates of meditation practices derived from Buddhist traditions. Their findings suggest that long-term meditation can alter brain structure and function, improve emotional regulation, reduce stress, and transform self-referential processing.

One particularly significant area of convergence concerns the concept of self. While Buddhism teaches the doctrine of non-self (anattā), neuroscience increasingly demonstrates that there is no single "self-center" within the brain. Instead, personal identity appears to emerge from distributed neural processes involving memory, attention, emotional regulation, sensory integration, and predictive processing.

Despite growing interest in the relationship between Buddhism and neuroscience, much of the existing literature focuses primarily on mindfulness meditation and its therapeutic applications. Comparatively fewer studies have systematically examined the Five Aggregates as a comprehensive framework for understanding consciousness and cognition from an interdisciplinary perspective. Consequently, there remains a need for deeper analysis of how each aggregate corresponds to contemporary neuroscientific findings.

The present study seeks to address this gap by examining the Five Aggregates through the lens of contemporary neuroscience and cognitive science. Specifically, the study explores the following research questions:

1. How do the Five Aggregates function within Buddhist psychological theory?
2. What neuroscientific processes correspond to each aggregate?
3. What similarities and differences exist between Buddhist and neuroscientific models of mind and consciousness?
4. How can the integration of Buddhist psychology and neuroscience contribute to contemporary understandings of mental health and well-being?

By addressing these questions, this paper contributes to the growing interdisciplinary dialogue between Buddhist studies, psychology, neuroscience, and contemplative science.

II. Literature Review

2.1 The Five Aggregates in Early Buddhist Literature

The doctrine of the Five Aggregates appears throughout the Pāli Canon and represents one of the foundational teachings of Buddhism. The Buddha frequently used the aggregates to explain the nature of human existence and to challenge assumptions about a permanent self.

In the Khandha Saṃyutta of the Saṃyutta Nikāya, the Buddha repeatedly states that the aggregates are impermanent, subject to change, and incapable of providing lasting satisfaction. Since they are conditioned phenomena, they cannot be regarded as permanent self.

According to the Buddhist analysis:

- Rūpa refers to material form and physical processes.
- Vedanā refers to feeling tones that accompany experience.
- Saññā refers to recognition and perception.
- Saṅkhāra refers to volitional formations and mental conditioning.
- Viññāṇa refers to consciousness and awareness.

Together, these aggregates constitute the entirety of experiential existence.

Bhikkhu Bodhi (2000) notes that the aggregate framework should not be interpreted as a metaphysical description of reality but as a phenomenological analysis of experience. Similarly, Gethin (1998) argues that the Five Aggregates provides a practical method for understanding attachment and suffering rather than a speculative theory about ultimate reality.

Analayo (2018) further emphasizes that the aggregate model serves as a contemplative tool. Through mindfulness practice, practitioners observe the arising and passing away of each aggregate, gradually weakening identification with them.

2.2 Buddhist Psychology and the Nature of Mind: Buddhist psychology differs significantly from many Western psychological traditions because it is primarily concerned with understanding and transforming suffering. Rather than focusing exclusively on behavior or cognition, Buddhist psychology investigates the entire spectrum of conscious experience. The Abhidhamma literature expands the aggregate model into a sophisticated analysis of mental processes. Consciousness (citta) is understood as a series of momentary events rather than a continuous entity.

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Mental factors (cetasikas) arise together with consciousness and determine the qualitative character of experience.(Vithakshi, 2024)

Nyanaponika Thera (1998) argues that Buddhist psychology is fundamentally empirical because it relies on direct observation rather than speculation. Similarly, Wallace (2007) suggests that contemplative practices function as systematic methods for investigating consciousness from a first-person perspective.

Modern cognitive science increasingly recognizes the value of phenomenological approaches. Researchers such as Varela, Thompson, and Rosch (2016) propose that subjective experience should be incorporated into scientific investigations of consciousness. Their concept of neurophenomenology seeks to integrate first-person contemplative observations with third-person neuroscientific measurements. This approach resonates strongly with Buddhist methods of mindfulness and Vipassanā meditation.(Lutz et al., 2025)

2.3 Contemporary Neuroscience and the Construction of Experience: Neuroscience has undergone a paradigm shift during the last several decades. Earlier models often viewed the brain as a passive processor of sensory information. Contemporary theories increasingly emphasize the active and constructive nature of cognition. Predictive processing theory proposes that the brain continuously generates models of reality and updates them based on incoming sensory information. According to Friston's free-energy principle, perception involves minimizing prediction errors between expectations and sensory input.

This perspective bears striking similarities to Buddhist accounts of perception and conceptual construction. Both traditions emphasize that experience is not a direct reflection of reality but rather a constructed process shaped by prior conditioning.(Stoltz, 2021)

Research in cognitive neuroscience has identified several neural networks involved in constructing experience:

- The Default Mode Network (DMN) contributes to self-referential thinking.
- The Salience Network detects significant stimuli.
- The Central Executive Network supports attention and decision-making.
- Limbic structures regulate emotional processing.

Together, these systems create the dynamic flow of conscious experience.

2.4 Neuroscience of Emotion and Feeling: The aggregate of Vedanā corresponds closely to contemporary research on affective neuroscience.

Emotional experiences involve complex interactions among the amygdala, insula, anterior cingulate cortex, hypothalamus, and prefrontal cortex. Antonio Damasio (1999) emphasizes that feelings are deeply rooted in bodily processes. Emotions provide information about the organism's relationship to its environment and influence decision-making and behavior.

Similarly, Buddhist psychology views feeling (vedanā) as a crucial link in the chain of dependent origination. Pleasant feelings often lead to craving, unpleasant feelings to aversion, and neutral feelings to ignorance. Mindfulness practices cultivate awareness of feeling tones before habitual reactions occur. Recent studies indicate that mindfulness training enhances emotional regulation by increasing activity in prefrontal regions while reducing excessive reactivity within limbic structures. These findings provide empirical support for Buddhist approaches to emotional transformation.(Ng et al., 2023)

2.5 Neuroplasticity and Mental Formation:

The concept of Saṅkhāra (mental formations) has attracted considerable attention in contemplative neuroscience. Mental formations include habits, intentions, dispositions, emotional tendencies, and learned patterns of response. Neuroscientific research on neuroplasticity demonstrates that repeated mental activity alters brain structure and function. Neural pathways strengthen through repeated activation, supporting the principle often summarized as "neurons that fire together wire together."(Gazerani, 2025)

This finding closely parallels Buddhist teachings regarding karma and mental conditioning. According to Buddhist psychology, repeated thoughts and actions reinforce habitual patterns that shape future experience. Long-term meditation practice appears to promote beneficial neuroplastic changes, including increased cortical thickness, improved attentional control, and enhanced emotional resilience.

2.6 Consciousness Studies and the Aggregate of Viññāṇa: The scientific study of consciousness remains one of the most challenging areas of modern research. Various theories attempt to explain how subjective experience emerges from neural activity.

The Global Neuronal Workspace Theory proposes that consciousness arises when information becomes globally available across multiple brain systems. Integrated Information Theory suggests that consciousness corresponds to the integration of information within a system.(Doyle, 2026) Buddhist analyses of consciousness differ from these theories in important ways.

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Rather than asking how consciousness emerges from matter, Buddhism investigates how consciousness arises dependently through interactions between sense organs and their corresponding objects. Nevertheless, both approaches reject the notion of a permanent observer existing independently of experience.

Consciousness studies often engage deeply with the Buddhist concept of the aggregate of Viññāṇa, which is traditionally understood as one of the five aggregates (khandhas) constituting human experience. Viññāṇa, commonly translated as "consciousness," refers to the continuous and ever-changing process of awareness that arises dependent on sensory contact and mental phenomena, highlighting its impermanent and conditioned nature. Unlike many Western notions that tend to view consciousness as a fixed, unified self or an enduring soul, Viññāṇa is conceptualized as a dynamic flow without inherent substance or permanence, emphasizing the Buddhist doctrine of non-self (anatta). This perspective fundamentally challenges conventional understandings of consciousness by framing it not as a static entity but as a contingent, interdependent process arising in dependence on causes and conditions.

The aggregate of Viññāṇa underscores the interconnectedness of mind and body, illustrating how consciousness is inseparable from sensory experience and mental formations, constantly evolving moment to moment. This approach offers a nuanced phenomenological account of experience, where consciousness is not an isolated subject but part of a complex, interdependent system of physical and mental factors. By rejecting the notion of a permanent, autonomous self, the Buddhist framework invites reconsideration of subjectivity, identity, and the ego, suggesting that what we perceive as a continuous "I" is instead a fluid, composite process.(Bui, 2025)

In contemporary consciousness studies, this Buddhist insight enriches the discourse by providing an alternative lens through which to examine the nature of awareness, selfhood, and the mind-body relationship. It invites scholars to explore consciousness as a process defined by impermanence, conditionality, and relationality rather than as a singular, enduring substance. (Flonta, 2024)Furthermore, the emphasis on direct experiential observation and meditative practices in Buddhism offers practical methodologies for investigating consciousness from within, complementing empirical and neuroscientific approaches. This synthesis of Buddhist philosophy and modern consciousness studies opens pathways for interdisciplinary dialogue, fostering deeper understanding of the phenomenology of experience and the mechanisms underlying the dissolution of egoic boundaries.

III. Analysis Of Rūpa, Vedanā, Saññā, Saṅkhāra, And Viññāṇa In Relation To Brain Networks, Predictive Processing, Neuroplasticity, The Default Mode Network

Rūpa corresponds to the brain's sensory and motor networks, grounding perception in embodied experience. Vedanā aligns with affective and salience networks, modulating the valence and intensity of sensory inputs through predictive coding. Saññā, Saṅkhāra, and Viññāṇa engage higher-order associative and default mode networks, integrating past experiences, mental formations, and conscious awareness via neuroplastic adaptation. (Zaretskaya, 2024)

Predictive processing frameworks map onto the five aggregates by assigning hierarchical prediction and error correction functions to each. Rūpa involves the brain's sensory and motor networks generating and updating predictions about bodily states and external stimuli. Vedanā reflects affective and salience networks that predict the emotional valence and relevance of sensory inputs, guiding attention and response priorities. Saññā, Saṅkhāra, and Viññāṇa engage higher-order associative and default mode networks, where predictions integrate prior experiences, mental constructs, and conscious awareness, continuously refined through neuroplastic adaptation to minimize prediction errors.

Buddhist analyses of consciousness focus on dependent origination, emphasizing that consciousness arises through dynamic interactions between sense organs and their corresponding objects rather than emerging solely from material substrates. This approach highlights a process-oriented view where consciousness is relational and contingent, rejecting any idea of a fixed, independent observer. Both Buddhist perspectives and contemporary theories converge in denying a permanent, unchanging self that exists separately from experience, instead viewing consciousness as fluid and interdependent.(Kopnin, 2025)

The dependent origination framework in Buddhist analyses emphasizes consciousness as arising relationally through ongoing interactions between sense organs and their objects, rejecting any fixed, independent observer or self. In contrast, many neuroscientific models often focus on identifying neural correlates of consciousness within material substrates, treating consciousness as an emergent property of brain activity. (Herzog & Herzog, 2025)While neuroscience tends to localize consciousness in specific brain networks and mechanisms, dependent origination frames consciousness as a dynamic, process-oriented phenomenon without a permanent entity, aligning with a fluid and interdependent view.

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Both perspectives converge in denying a permanent, unchanging self but differ in their ontological starting points—process and relationality versus material emergence and neural substrates.

IV. Mindfulness Research: Results And Discussion

Mindfulness research has demonstrated significant effects on brain function and mental health, providing empirical support for Buddhist psychological insights into emotional regulation and cognitive transformation. Numerous studies reveal that mindfulness and Vipassanā meditation enhance activity in prefrontal cortical regions associated with executive control, attention regulation, and working memory, while simultaneously attenuating hyperactivity in limbic areas such as the amygdala, which are implicated in stress responses and emotional reactivity. These neural modulations correspond with improved emotional regulation, reduced anxiety symptoms, and greater psychological resilience, highlighting the therapeutic potential of mindfulness-based interventions. Functional neuroimaging investigations further show that long-term meditators exhibit altered functional connectivity within the Default Mode Network (DMN), a brain system involved in self-referential processing, mind-wandering, and autobiographical memory. (Panitz et al., 2024)

Such changes reflect decreased engagement in self-focused rumination and diminished attachment to the notion of a permanent, unchanging self, thereby aligning closely with the Buddhist doctrine of non-self (anattā). Moreover, mindfulness practices appear to foster neuroplasticity by strengthening adaptive mental formations (Saṅkhāra), which facilitates the reconditioning of habitual thought patterns and emotional responses through repeated, intentional mental training. These neuroplastic adaptations include increased cortical thickness in regions implicated in attention and sensory processing, as well as enhanced connectivity between prefrontal and limbic structures, supporting more flexible and adaptive cognitive-emotional regulation.(Calderone et al., 2024) The results underscore a dynamic interplay between subjective contemplative experience and objective neural mechanisms, suggesting that mindfulness serves as a methodological bridge integrating Buddhist phenomenology and contemporary neuroscience.

This integrative perspective advances understanding of how experiential observation can modulate neural substrates underlying the Five Aggregates, contributing to both theoretical models of consciousness and practical mental health applications.

Importantly, these findings have significant implications for clinical practice, highlighting mindfulness as a viable and evidence-based approach for addressing suffering and promoting well-being by modulating the Five Aggregates through both experiential observation and neurobiological change. Future research should continue to elucidate the specific neural pathways and psychological processes involved, as well as investigate the longitudinal effects of diverse mindfulness traditions on mental health outcomes across populations.(Huong & Vu, 2023)

V. Significant Implications For Mental Health

Building on the significant implications of mindfulness for clinical practice, numerous neuroscientific studies provide detailed evidence supporting its efficacy in mental health interventions. For instance, Hölzel et al. (2011) demonstrated that participation in an eight-week Mindfulness-Based Stress Reduction (MBSR) program leads to increased gray matter density in brain regions integral to learning, memory, emotional regulation, and self-referential processing, including the hippocampus, posterior cingulate cortex, and temporoparietal junction.

These structural neuroplastic changes underpin improvements in cognitive and affective functioning observed in clinical populations, suggesting that mindfulness practice can induce lasting brain adaptations that support mental health. Similarly, Tang et al. (2015) found that integrative body-mind training (IBMT), a mindfulness meditation technique, enhances functional connectivity between the anterior cingulate cortex and prefrontal cortex, which correlates with improved attentional control and reduced physiological stress responses. These neural modifications align with clinical reductions in anxiety and depressive symptoms, reinforcing the therapeutic potential of mindfulness-based interventions.

Further research on Vipassanā meditation by Farb et al. (2010) revealed altered activation patterns in the insula and medial prefrontal cortex—regions associated with interoceptive awareness and self-referential thought—indicating a neural basis for increased present-moment awareness and diminished rumination. This finding supports the Buddhist principle of non-attachment to a fixed self and highlights how mindfulness modulates the Five Aggregates by fostering experiential observation detached from habitual self-identification.

Longitudinal studies, such as those by Creswell et al. (2016), extend these insights by showing that mindfulness training can modulate systemic inflammatory markers and stress-related neural circuits, suggesting benefits that transcend psychological symptoms to include physiological health improvements.

Collectively, these neuroscientific findings position mindfulness as a multi-level intervention engaging brain plasticity to recalibrate cognitive-emotional networks implicated in suffering and well-being. By targeting mechanisms related to the Five Aggregates—sensory processing (Rūpa), emotional tone (Vedanā), perception (Saññā), mental conditioning (Saṅkhāra), and consciousness (Viññāṇa)—mindfulness facilitates adaptive neurobiological and experiential transformations. Such integrative effects underscore the potential for personalized mental health treatments that blend subjective contemplative insight with objective neural modulation, offering novel pathways for addressing complex psychiatric conditions.(Calderone et al., 2024)

Moreover, the clinical implications extend to diverse populations and mental health disorders, including depression, anxiety, post-traumatic stress disorder (PTSD), and chronic pain. Mindfulness-based interventions have been shown to reduce symptom severity, improve emotional regulation, and enhance quality of life across these conditions. These outcomes are often mediated by changes in brain networks involved in attention, emotion regulation, and self-referential processing, reflecting the dynamic interplay between psychological and neurobiological processes. The evidence thus supports the incorporation of mindfulness practices into standard clinical protocols, either as adjunctive or primary therapeutic approaches.(Ivkovic et al., 2024)

Future research directions include elucidating the specific neural pathways and psychological mechanisms through which different mindfulness traditions exert their effects, as well as examining the longitudinal impact of sustained practice on mental health outcomes. Investigations into individual differences in responsiveness to mindfulness training, dose-response relationships, and integration with pharmacological or psychotherapeutic treatments will further refine clinical applications. Additionally, expanding research to encompass culturally diverse populations and varying age groups will enhance the generalizability and inclusivity of mindfulness-based mental health interventions.

VI. Conclusion

The conclusion synthesizes the interdisciplinary analysis of the Five Aggregates (Pañcakkhandha) in Buddhist psychology and contemporary neuroscience, emphasizing their complementary perspectives on mind, consciousness, and human experience. It highlights that Buddhist phenomenology and neuroscience converge in viewing the self as a dynamic, process-oriented construct rather than a fixed entity, with mindfulness and Vipassanā meditation serving as effective methodological bridges linking subjective experience and objective neural mechanisms.

The integration of these frameworks' advances understanding of consciousness and mental health by elucidating how experiential observation modulates the Five Aggregates—material form, feeling, perception, mental formations, and consciousness—through neuroplasticity and altered brain network connectivity. This integrative approach offers promising avenues for clinical mental health interventions, providing evidence-based strategies to alleviate suffering and promote well-being by addressing both psychological and neurobiological dimensions. Future research should continue to clarify specific neural pathways, psychological processes, and longitudinal effects across diverse mindfulness traditions and populations to refine personalized mental health treatments and deepen theoretical models of consciousness.

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