FROM MYTHOLOGY TO NEUROBIOLOGY: KEY INSIGHTS INTO DREAMS AND CREATIVITY

Marleide da Mota Gomes[1]

ABSTRACT
The intricate phenomenon of dreams and their connection to creativity are explored in this concise narrative study. The review is organized into three main sections: (1) *Historical Evolution*, covering the journey from ancient Greek mythology to contemporary multidisciplinary research on dreams; (2) *Theories of Dreams*, primarily neural and physiological, documenting the shift from paranormal to neurobiological explanations, with emphasis on the role of REM sleep, emotional regulation, and memory in fostering creativity; and (3) *Complex Brain Interactions*, highlighting recent neuroscientific findings on brain networks such as the Default Mode Network (DMN) and their involvement in both creative and dreaming processes. By synthesizing historical, psychological, and neuroscientific perspectives, this paper provides a comprehensive understanding of how dreams can influence creativity.

Keywords: Dreams; Creativity; Neurosciences; REM Sleep; Emotional Regulation; Memory; Default Mode Network.

DA MITOLOGIA À NEUROBIOLOGIA: PRINCIPAIS INSIGHTS SOBRE OS SONHOS E CREATIVIDADE DREAMS THEORIES AND CREATIVITY

RESUMO
O intrincado fenômeno dos sonhos e sua conexão com a criatividade são explorados neste estudo narrativo conciso. A revisão está organizada em três seções principais: (1) *Evolução Histórica*, abordando a trajetória desde a mitologia grega antiga até a pesquisa multidisciplinar contemporânea sobre os sonhos; (2) *Teorias dos Sonhos*, principalmente neurais e fisiológicas, documentando a transição das explicações paranormais para as neurobiológicas, com ênfase no papel do sono REM, regulação emocional e memória no fomento à criatividade; e (3) *Interações Cerebrais Complexas*, destacando descobertas neurocientíficas recentes sobre redes cerebrais, como a Default Mode Network (DMN), e seu envolvimento nos processos criativos e no fenômeno do sonho. Ao sintetizar perspectivas históricas, psicológicas e neurocientíficas, este artigo fornece uma compreensão abrangente de como os sonhos podem influenciar a criatividade.

Palavras-chave: Sonhos; Criatividade; Neurociências; Sono REM; Regulação Emocional; Memória; Default Mode Network.

INTRODUCTION

Throughout history, artistic, scientific, and philosophical discourse has been greatly impacted by persistent curiosity with dreams and creativity. These occurrences were frequently viewed via supernatural or divine prisms in antiquity. Views evolved toward psychological and neuroscientific explanations as scientific knowledge increased. This essay seeks to offer a comprehensive analysis of the evolution of ideas surrounding dreams throughout history, as well as an investigation of the neuroscientific processes that underlie these experiences.

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This short review is organized into distinct sections: historical perspectives on dreams[1-4], the neural mechanisms and theoretical frameworks of dreaming[5-20], and the complex brain interactions that link dreams to creative processes[6,19, 21-26] .

HISTORICAL EVOLUTION OF THE VALUE OF DREAMS AND THEIR THEORIES

Askitopoulou[1] examines the role that dreams and sleep played in ancient Greek culture, especially as it related to medicine. Beginning with the epics of Homer and Hesiod in the eighth century BCE, sleep and dreams were highly valued in ancient Greek society. This is seen in the myths surrounding Hypnos, who was connected to ancient deities associated with darkness, such as his mother Nychta (Night), twin brother Thanatos (Death), and sons, the Oneiroi, who were said to reside "beyond the gates of the dead." By the 6th century BCE, the practice of inducing sleep, known as "enkoimesis" or dream incubation, had become a well-established healing ritual in the sanctuaries of Asklepios. In Greek medicine around the fourth century BCE, sleep and dreams were increasingly acknowledged as vital bodily functions, especially in the writings of Hippocratic physicians. By distinguishing between dreams that are thought to be sent by the gods and those that are created by the soul, the treatise On Regimen IV highlighted the diagnostic and predictive usefulness of dreams. It was believed that the spirit kept an eye on the body as it slept, utilizing dreams to alert the body to any possible health issues. Hippocratic physicians were able to evaluate a patient's state and modify treatments to avoid sickness by interpreting these dreams. This shift from mythological to medical perspectives in ancient Greece illustrates the evolving understanding of sleep and dreams, which were increasingly seen as vital to both human health and divine well-being, paving the way for more rational approaches in Greek medical practice.

Shaw's2[*] paper delves into the historical significance and contemporary understanding of dreams, sleep, and their connection to creativity from a neuroscience perspective. It reflects on how dreams have captivated philosophers and psychologists for centuries, beginning with classical thinkers like Plato and Aristotle, who explored the psychological and physiological aspects of dreams. The paper examines the views of key philosophers on dreams and reality. Plato, in *The Republic*, links dreams to the dreamer's psychological state, suggesting that a person who engages in rational thinking before sleep will experience calmer dreams compared to one who indulges in excess. In *Dialogues of Plato*, Socrates questions the distinction between wakefulness and dreaming, challenging the reliability of perception. Aristotle, on the other hand, was less concerned with Plato's questions about perception in dreams and focused more on classifying and understanding the functions of dreams. He recognized that both humans and animals sleep, indicating that sleep must serve an essential function for survival. Aristotle questioned the origin of dreams, arguing that since we see with our eyes closed during sleep, dreams must be perceived internally rather than through external sense perception. He considered dreams to be illusions, suggesting that if the brain can be tricked, it can also perceive dreams as reality. Thus, Aristotle believed that when external senses are inactive, dreams are generated internally.

René Descartes later questioned how one could be certain they were not dreaming at any given moment. He was struck by the realization that there are no clear signs distinguishing wakefulness from sleep, leading him to acknowledge the fine line between the two states. Descartes recognized that this uncertainty, or the belief in the illusion of reality, is closely related to madness—a concern also discussed by Plato and Aristotle in their philosophical investigations.

Shaw[2] also examines and contrasts the theories of Sigmund Freud and Carl Jung on dream interpretation. Freud viewed dreams as expressions of repressed and unconscious desires, emphasizing their psychological relevance. Jung, however, believed that dreams addressed unresolved issues in a person's psyche and served a more predictive role.

Shaw[2] highlights significant discoveries in neurology, such as the connection between dreaming and Rapid Eye Movement (REM) sleep. Neuroscientific studies continue to uncover the complexities of memory consolidation during sleep, including how emotionally charged dreams enhance retention and how REM sleep influences mood regulation. Research has shown a correlation between unpleasant emotional states and increased REM sleep, emphasizing the interconnection between memory, dreaming, and emotional processing.

In conclusion, Shaw[2] asserts that contemporary neuroscience not only builds upon Freud's theories of the unconscious but also affirms historical philosophical inquiries. While much remains to be understood about the mechanisms of dreaming, the relationship between sleep, dreams, and creativity remains a profound area of exploration that bridges ancient philosophical insights with modern scientific understanding.

Sheriff's[3] article highlights the significance of dreaming in human culture and cognition while examining the complex relationship between dreams and creativity through a historical lens. It makes the case that dreams ought to be at the heart of anthropological research since they are universal phenomena that are cultural artifacts shaped by a variety of social and historical circumstances.

Sheriff's[3] paper also explores how anthropological studies have evolved in understanding the role of dreams in creativity. Early scholars such as Tylor and Spencer linked dreams to religious thought and cognition, while Freud's influence emphasized dreams as wish fulfillment, with anthropologists extending this view to include societal conflicts and creative dissent. Mid-20th-century research highlighted dreams as spaces for creativity within cultural contexts, and more recent studies focus on how dreams inspire artistic practices and reflect cultural and identity dynamics. In newer studies, Sheriff identifies a shift towards exploring the connection between dreaming and creative processes within specific cultural contexts. The author advocates for interdisciplinary collaboration, particularly with neuroscientific research, to deepen the understanding of how dreams contribute to cultural creativity and the formation of social identities. By synthesizing both historical and contemporary perspectives, Sheriff calls for a cohesive anthropological framework that acknowledges the relational and socially embedded nature of dreaming, ultimately positioning dreams as essential components of human experience and cultural innovation.

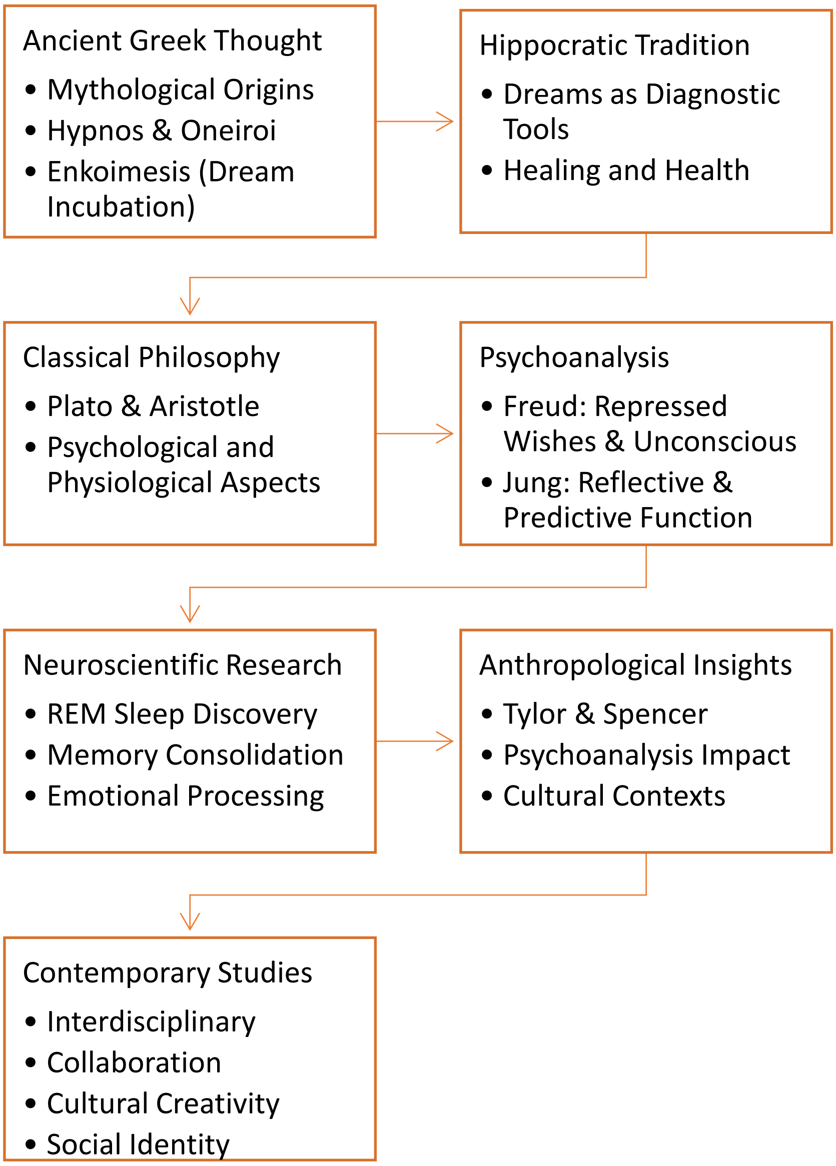
The review by Palagini and Rosenlicht[4] examines the historical development of dream theories, linking them to sleep, mental health, and emotional experiences. Ancient civilizations viewed dreams as divine messages, while Greek and Egyptian cultures saw them as prophetic and connected to mental health. Philosophers like Aristotle shifted the focus to dreams as products of the mind's residual perceptions. In the Renaissance, dream analysis was revived, and Sigmund Freud's psychoanalysis suggested dreams reflected emotional states and unresolved conflicts.

The discovery of REM sleep in the 20th century introduced a physiological framework for understanding dreams, linking dream content to psychiatric disorders. Research has shown that sleep patterns, particularly in conditions like depression and PTSD, can influence dream recall and content. Neuroimaging has revealed the complex relationship between sleep, brain function, and emotional regulation during dreaming. The activation-synthesis hypothesis proposed that dreaming is a physiological process, and recent findings suggest dreaming occurs across various sleep stages.

The connection between dreams and mental health has been highlighted throughout this evolution, with sleep disturbances and psychiatric disorders influencing each other. Current research calls for further investigation into the role of brain activity during dreaming and its emotional implications, aiming to refine our understanding of how dreams and sleep relate to mental health diagnostics and treatment.

The following flowchart diagram (figure 1) captures the evolution of thought regarding dreams and creativity from ancient Greek mythology through contemporary interdisciplinary studies.

Figure 1 - Historical and Contemporary Perspectives on Dreams.



DREAM THEORIES

Several reviews synthesize various dreaming theories, bridging traditional and contemporary perspectives[4-7].

Ruby's[5] paper delves into the complexities of dream research, integrating insights from experimental psychology and neuroscience to explore theories on dream content, frequency, and function. Key hypotheses highlighted include the Continuity Hypothesis, which links waking thoughts to dream experiences, and the Threat Simulation Theory, which suggests that dreams serve as a rehearsal for handling threats. The paper also discusses perspectives that view dreams either as incidental byproducts of REM sleep or as integral to emotional regulation and memory consolidation. Additionally, Ruby[5] examines psychoanalytic perspectives, focusing on Freudian theory and neuropsychoanalysis, which will be further expanded in this section.

Tsunematsu[6]´s article highlights a departure from psychoanalytic views, including those of Freud, in favor of neuroscientific methods that look more deeply at the neurological processes underlying dreaming. The study of dreams as viewed by Tsunematsu[6] encompasses diverse theories, each shedding light on the complex brain processes underlying dream formation, interpretation, and function. Together, these theories and mechanisms provide a comprehensive understanding of the neural underpinnings and physiological functions of dreams.

Tsunematsu[6] categorizes dream theories to outline major approaches. Group 1, Neural Mechanisms of Dreaming**,** includes theories centered on the underlying neural processes that produce dreams. These theories suggest that dreaming results from specific brain mechanisms and neural patterns such as: Activation-Synthesis Model (Hobson & McCarley, 1977); PGO Waves Theory (Bizzi & Brooks, 1963); Activation-Input-Modulation (AIM) Model (Hobson et al., 2000); Dopaminergic Forebrain Mechanism (Solms, 2000). Regarding Group 2, Physiological Functions of Dreaming, examines the potential adaptive functions of dreams, suggesting that dreaming may play a role in mental and physiological health such as: Threat Simulation Hypothesis (Revonsuo, 2000); Reward Activation Model (RAM) (Perogamvros et al., 2012); Unlearning Theory (Crick & Mitchison, 1983); Role of Dreams in Development (Roffwarg et al., 1966); Role of Dreams in Creativity (Walker et al., 2002);

Hoel[7] addresses diverse viewpoints on the purpose of dreams by analyzing current theories on the phenomenology and biological importance of dreaming. The Emotional Regulation theory, influenced by Freudian ideas, suggests that dreams help process emotions, though it is critiqued for not distinguishing dreams from general sleep functions. The Memory Consolidation theory posits that dreams integrate new and old memories, while the Selective Forgetting hypothesis claims dreams help unlearn undesirable connections, though this is more associated with slow-wave sleep than with dreaming itself. The Preparation for Real-World Problems theory views dreams as simulations for practicing strategies, but only a few dreams involve realistic problem-solving. The Simulation Refinement theory suggests that dreams refine predictive models, aligning with predictive processing theories. However, Hoel[6] argues that these theories often overlook the unique aspects of dreams, particularly their hallucinatory nature. Finally, Hoel[7] proposes a new theory to be presented at the end of this section.

Recent neuroscience advancements suggest that sleep is essential for various memory tasks, with REM sleep playing a particularly vital role in developmental processes and procedural learning. Sleep consists of REM and non-REM stages, each contributing differently to cognitive functions. While REM sleep supports visual cortex development and procedural learning, NREM sleep enhances problem-solving abilities. Although scientific understanding of dreams has historically been limited, new experimental methods now allow for the manipulation of dream content, enabling a more objective study of how dreams may influence sleep-dependent memory processing. Integrating neuroscientific and psychological data could thus deepen our understanding of dreaming, shedding light on its role in memory and cognitive functions.

Collectively, these theories provide a multi-layered understanding of dreaming, revealing its functional roles, neurological underpinnings, and broader implications for human behavior and development. Some of these perspectives are detailed below:

Psychoanalytic Theory (Sigmund Freud, 1900) posits that dreams are manifestations of repressed desires and thoughts. Koslowski et al.[8] discuss how Freudian theory, predictive processing, and psychedelic research intersect to enhance understanding of dreaming's psychological significance. Freud's 1900 concept of the "royal road to the unconscious" suggests that dreams reveal hidden impulses and conflicts. Key discoveries in the early 20th century, especially with electroencephalography, led to the identification of REM sleep in 1953, a phase correlated with dreaming[7]. Freud believed that through free association in dream analysis, one could uncover unconscious motivations[6]. Despite early dismissal by neuroscientists, Freud's ideas gained traction in 2000 with the emergence of neuropsychoanalysis, led by Mark Solms. Solms demonstrated that dream formation involves specific brain mechanisms, such as the activation of emotional and motivational centers during REM sleep, supporting Freud's view of instinctual drives surfacing in dreams. This stance faced opposition from neuroscientists like Alan Hobson, who proposed the Activation-Synthesis Model**,** which suggests that dreams are random brainstem activity without inherent meaning[6].

Psychoanalytic and neuroscientific research increasingly support the idea that dreams reflect personal concerns and can serve functions like problem-solving. Integrating psychoanalytic theories of meaning with neuroscientific methods may substantially advance our understanding of dreams' emotional and cognitive functions[6].

Roesler[9]'s paper compares psychoanalytic dream theories with empirical research findings. It revisits core psychoanalytic debates on dream functions—such as wish-fulfillment, compensation, and the distinction between latent and manifest content—and shows how empirical findings provide valuable insights. Roesler emphasizes that empirical research, especially from German-speaking countries, is often overlooked in psychoanalysis. The paper suggests a revised theory, proposing that dreams integrate emotional experiences and memories, creatively expanding consciousness by providing additional information and aiding problem-solving. Rather than countering consciousness, dreams broaden it through access to extensive memory networks and mental functions.

Jungian Dream Theory (Carl Jung), in Analytical Psychology, presents a unique view, differing from Freud's by depicting dreams not as censored distortions but as direct, symbolic reflections of the unconscious mind[10]. Jung saw dreams as revealing—rather than concealing—the dreamer's internal landscape, often personifying various aspects of their personality. He believed dreams play a compensatory role, providing insights and possible resolutions to conflicts, and possessing a natural capacity for self-healing. Unlike Freud's perspective, where dreams protect sleep by suppressing repressed content, Jung emphasized dreams as open channels through which the unconscious communicates, guiding individuals toward personal growth and wholeness. His concept of the collective unconscious suggested that dreams contain universal archetypes that constructively shape personality development. In Jungian therapy, dreams are vital for helping patients identify subconscious conflicts and foster psychological development. They convey individual and collective unconscious material through symbols, metaphors, and analogies, shedding light on personal struggles and responses to therapy. Dreams also offer insights into relationship patterns, aiding patients in resolving past issues. With a language steeped in imagery and associations, dreams provide deep understanding and support individuation, encouraging personal fulfillment beyond mere material success. Despite their theoretical importance, empirical evidence for using dreams to predict therapeutic outcomes is limited, indicating a need for further research and clinical guidelines.

Activation-Synthesis Model (Hobson and McCarley in 1977)[11] suggests that dreams result from random neural activity during REM sleep, which the brain synthesizes into coherent experiences. proposing that dreams emerge from the brain's attempts to make sense of chaotic neural activity during REM sleep, resulting in subjective experiences without intrinsic meaning. The theory involves the Activation-Synthesis process, positing that dreams are interpretations of spontaneous neural signals. Ponto-Geniculo-Occipital (PGO) waves, neural activations during REM sleep, are thought to contribute to the vivid visual and hallucinatory elements of dreams.

In 2000, Hobson introduced *the Activation-Input-Modulation (AIM) Model*[12]**,** which builds upon the Activation-Synthesis theory by incorporating new insights into how brain states influence dream content. The AIM model uses these values to highlight the similarities and differences between waking and dreaming states within a three-dimension and each component means: activation (A), input-output gating (I), and modulation (M)—interacts in a unique and interconnected way. Technological advancements have facilitated the collection of new data and insights into neural regulation, leading to a clearer definition of consciousness states using these three values.

Unlearning Theory (Crick and Mitchison, 1983)[13] proposes that the function of REM sleep and dreaming is to eliminate unwanted or "parasitic" memories from the cerebral cortex. Crick and Mitchison suggest that REM sleep performs a "cleansing" function, discarding irrelevant information to preserve cognitive efficiency. This Theory posits that REM sleep helps refine mental clarity by removing superfluous memories, thereby enhancing cognitive focus, which posits that dreams help in "unlearning" unnecessary neural connections, thus maintaining mental efficiency.

Threat Simulation Hypothesis (Revonsuo, 2000)[14] suggests that dreams simulate threats, allowing individuals to rehearse responses to potential dangers, enhancing survival readiness. Recent studies, such as those by Abbas et al.15, analyzed dream content during the COVID-19 pandemic, finding predominantly negative dreams involving unfamiliar people, supporting the Threat Bias Hypothesis and partly the Social Bias and Strengthening Hypotheses. These findings support Revonsuo’s theory, suggesting that dreams help individuals rehearse and prepare for real-world threats, potentially enhancing their chances of survival.

Dopaminergic Forebrain Mechanism (Solms, 2000)[16] proposes that dreaming is driven by dopaminergic activity in the forebrain, independent of brainstem processes. He contends that REM sleep and dreaming rely on distinct brain mechanisms, challenging the traditional view of their interconnectedness. According to Solms, dream generation is shaped by emotional drives, echoing Freudian ideas of instinctual desires. Ultimately, Solms emphasizes the essential role of forebrain dopamine in producing the motivational and emotional elements commonly found in dreams.

Reward Activation Model-RAM (Perogamvros et al., 2012, 2013)[17] posits that activation of the mesolimbic dopaminergic system during REM sleep enhances memory and emotional regulation, linking dream generation to emotional memories and motivational states. Perogamvros's RAM suggests that dopamine supports emotional adaptation by processing emotionally significant memories, contributing to psychological resilience. It suggests that dreaming might help reinforce rewarding experiences, impacting memory consolidation.

Solms' observations suggest that the mesocortical–mesolimbic dopamine system plays a vital role in the phenomenology of dreams. Furthermore, evidence indicating the influence of medial prefrontal cortex (mPFC) activity and dopamine levels on the qualitative aspects of dreaming supports the neurophysiological continuity hypothesis. This is consistent with Perogamvros and Schwartz's findings on the mesolimbic-dopaminergic system's role in regulating reward and motivational behaviors[18].

Offline Memory Consolidation **(**Stickgold et al., 2001)[19] provides insights into the relationship between sleep, dreams, and cognitive processes like learning and memory, emphasizing. This concept highlights sleep's role in memory formation but focuses more on sleep's general functions than on dreams' unique contributions, particularly during REM. Additionally, Tsunematsu[6]'s work examines physiological functions of dreaming, such as offline memory consolidation, suggesting that dreams help reprocess and strengthen memories from waking experiences.

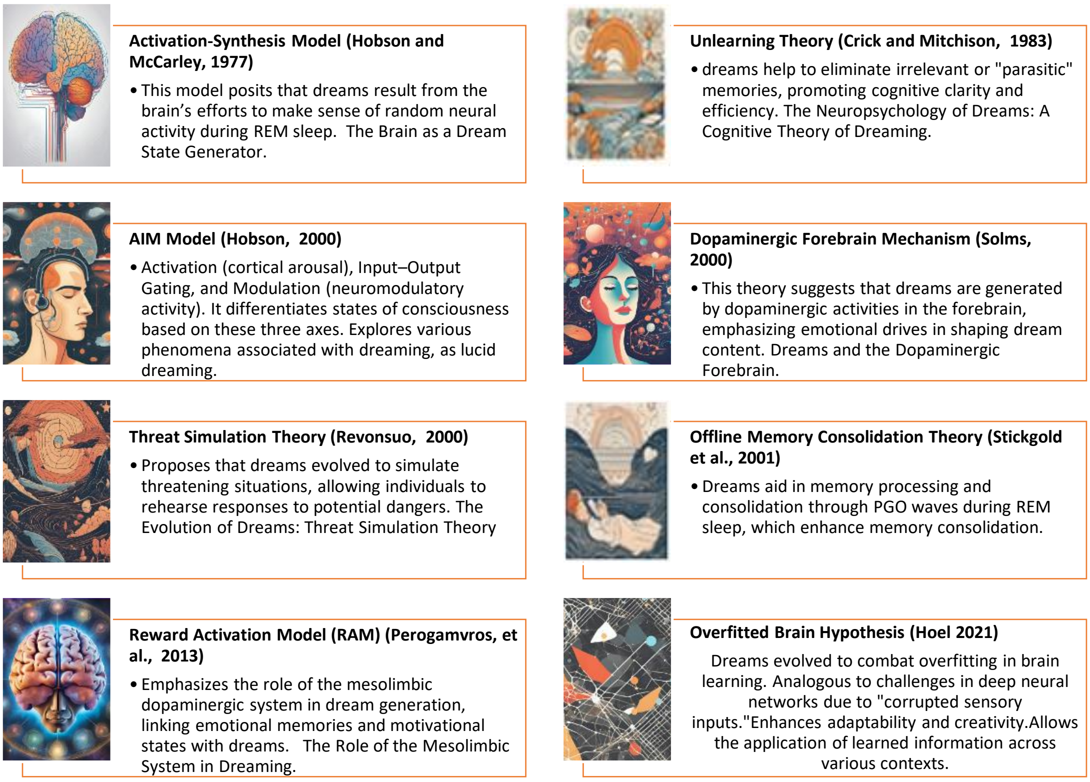
Defensive Activation Theory (Eagleman and Vaughn, 2021)[20] posits that REM sleep prevents sensory overload in the visual cortex by maintaining high neural activity, thus supporting brain plasticity.

Overfitted Brain Hypothesis (OBH) (Hoel, 2021)[7] posits that dreams introduce "noise" during REM sleep to prevent overfitting, a challenge also encountered by deep neural networks. This hypothesis suggests that dreams create random, distorted experiences that refine learning, enhancing cognitive flexibility and adaptation to novel situations. Hoel[7] suggests that dreams' hallucinatory and narrative aspects are essential for improving generalization, asserting that they play a fundamental role in enhancing cognitive adaptability.

Tsunematsu[6] also presents other theories, such as the *Role of Dreams in Development* (Roffwarg et al., 1966), which highlights the developmental function of dreams, particularly their contribution to neurological growth during infancy. Additionally, Tsunematsu[6] discusses the *Role of Dreams in Creativity*, as explored by Walker et al. (2002) and Cai et al. (2009), which will be further examined in the following section.

These major theories collectively highlight mainly a dual approach in dream research, with one emphasizing the neural mechanisms that generate dreams and the other exploring their possible physiological functions and the cognitive and adaptive functions of dreaming, from memory processing to evolutionary survival strategies, and underscore dreams' multifaceted nature within human experience. Together, they reflect ongoing advancements in understanding dreaming's role in neural activity, cognitive processes, and emotional regulation, with additional perspectives available in further literature.

Figure 2 - Summary of Major Theories on Neural Mechanisms and Physiological Functions of Dreaming**.**



The primary neural circuits proposed are dopamine-driven forebrain activation and brainstem signaling to the cortex [Tsunematsu6 , Hoel]. Artwork created in Canva, concept by MMG.

COMPLEX BRAIN INTERACTIONS: DREAMS AND CREATIVITY

There are several well-established examples of how dreams foster creativity. Dreams play a vital role in problem-solving and creative thinking, as shown by various anecdotes and studies.

Tsunematsu[6] discusses the role of dreams in enhancing creativity and problem-solving, noting numerous anecdotes from artists and scientists. Research by Walker et al. (2002) and Cai et al. (2009) demonstrates that REM sleep, compared to NREM sleep, improves creative problem-solving and facilitates the integration of uncorrelated information. The dopaminergic system, which is activated during REM sleep, plays a key role in fostering creativity. Dreams, particularly during REM sleep, help generate innovative, out-of-the-box solutions, often providing answers to problems that remain unresolved in waking life.

In this issue of the Journal, da Mota Gomes[21] further explores this connection, citing notable instances like Kekulé's discovery of the benzene ring structure, Mendeleev's development of the periodic table, and Loewi's breakthrough in understanding chemical neurotransmission. Beyond individual case reports, empirical studies have also examined how dreams contribute to creativity, defined here as receiving an idea in a dream that influences waking life behavior. Kuiken and Sikora (1993) and Schredl (2000), as cited by Roesler[9], found that 20-28% of students reported receiving creative inspiration from dreams at least twice a year. Additionally, Barrett (2015), also referenced by Roesner[9], conducted laboratory studies to examine the conditions under which waking-life problems are creatively resolved in dreams.

The intricate relationship between brains, dreams, and creativity is a fascinating area of research that brings together insights from psychology, neuroscience, and the arts. Recent studies have shed light on how the brain networks involved in creative thinking are interconnected and how dream states may influence them.

The dopaminergic system's role in promoting flexible, divergent thinking aligns with research suggesting that REM sleep enhances creativity by synthesizing seemingly irrelevant information what can provide "out-of-the-box" solutions to complex problems[6].

The default mode network (DMN) and other brain areas involved in appraisal and cognitive control combine to produce creativity, according to Beaty et al.'s[22] study on the network neuroscience of creative cognition. This interaction makes it easier to generate and control new concepts. These author review highlights three key cognitive processes associated with creative tasks: goal-directed memory retrieval, prepotent-response inhibition, and internally-focused attention. They find that functional connectivity between the executive control and default networks can predict individual creative abilities. The paper calls for future research to focus on mapping specific cognitive processes and using brain stimulation techniques to investigate causal relationships between network connectivity and creativity. Additionally, it suggests expanding research to domain-specific creative performances beyond general creativity.

Similarly, research led by Beaty et al.[23] investigates the brain networks supporting scientific creative thinking, specifically hypothesis generation, in STEM students (science, technology, engineering, and mathematics) using fMRI. Their study, involving 47 undergraduate STEM majors, identifies key networks including the default (posterior cingulate cortex), salience (right anterior insula), and semantic control (left inferior frontal gyrus) networks. The results show increased connectivity among these networks during hypothesis generation, reflecting enhanced cooperation between spontaneous and controlled cognitive processes. Stronger connections were observed between the semantic control network and default regions, and between the salience and default networks, indicating a networked approach to generating and evaluating novel scientific ideas. The study suggests that scientific creativity utilizes similar brain systems as general creative thinking, but further research is needed to explore the specific functions of these networks in maintaining creativity goals and inhibiting non-original ideas.

The role of the DMN extends beyond wakeful creative thought; it is also influential during dreaming. Figure 3 shows its main structures. The study by Vallat et al.[24] found that individuals with high dream recall have increased DMN connectivity and higher creativity scores compared to those with low dream recall. However, no direct correlation between DMN connectivity and creativity was observed. The results support the idea that dreaming and creativity are linked through the DMN but suggest further research is needed to clarify their relationship and explore methods to enhance both.

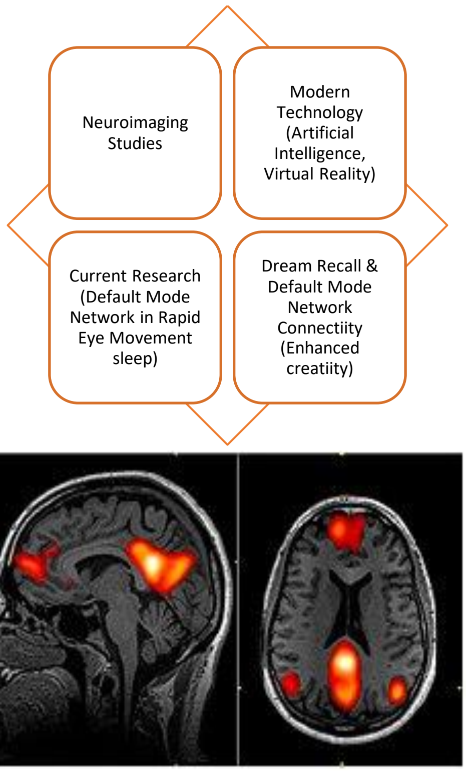
Moreover, aesthetic appreciation, another dimension of creativity, involves complex brain dynamics. Cela-Conde et al.[25] explored the neural mechanisms of aesthetic appreciation, demonstrating that engaging with art activates multiple brain networks, which integrate perceptual, cognitive, and emotional processes. Their interdisciplinary study employed magnetoencephalography (MEG) to identify two important networks involved in aesthetic appreciation: an initial network that is activated shortly after viewing stimuli and a delayed network that emerges later, primarily associated with the DMN. The findings indicate that aesthetic evaluation entails distinct neural processes over time, highlighting differences in connectivity when responding to beautiful versus non-beautiful stimuli across various temporal windows. This research provides deeper insights into the complex brain dynamics underlying aesthetic experiences and suggests that creativity extends beyond artistic expression to fundamental cognitive functions and neural interactions.

The work of Nadal and Chatterjee[26] further emphasizes the diversity and universality of art through the lens of neuroaesthetics. They argue that the brain's response to art is shaped by both individual experiences and universal patterns in human perception, suggesting that creativity thrives on both personal insights and shared cultural experiences.

Besides, Scarpelli et al.[18] conclude that studies on the neurobiological bases of dreaming have identified several key factors influencing dream experiences. Notably, trait-like factors such as personality play a significant role in dream recall, while EEG patterns prior to awakening are crucial for subsequent recall. In addition, the continuity hypothesis posits that dreams are closely linked to waking experiences, with sensory stimuli capable of modulating dream content. Moreover, parasomnia events may offer direct insight into dreaming by reflecting ongoing mental activity during sleep. The review also explores the potential therapeutic value of nightmares, highlighting their possible role in psychological treatment.

In conclusion, the intricate relationships between the brain networks implicated in creativity and dreaming offer a nuanced understanding of how humans produce and value original ideas. The necessity of investigating these neural connections in order to gain a deeper understanding of the nature of human creativity is highlighted by the synergistic interaction between the DMN and different cognitive processes as well as the inspiration-gathering function of dreams. Future studies could improve our knowledge of both creativity and its significant influence on the human experience as they continue to solve the puzzles surrounding the brain's capacity for creativity.

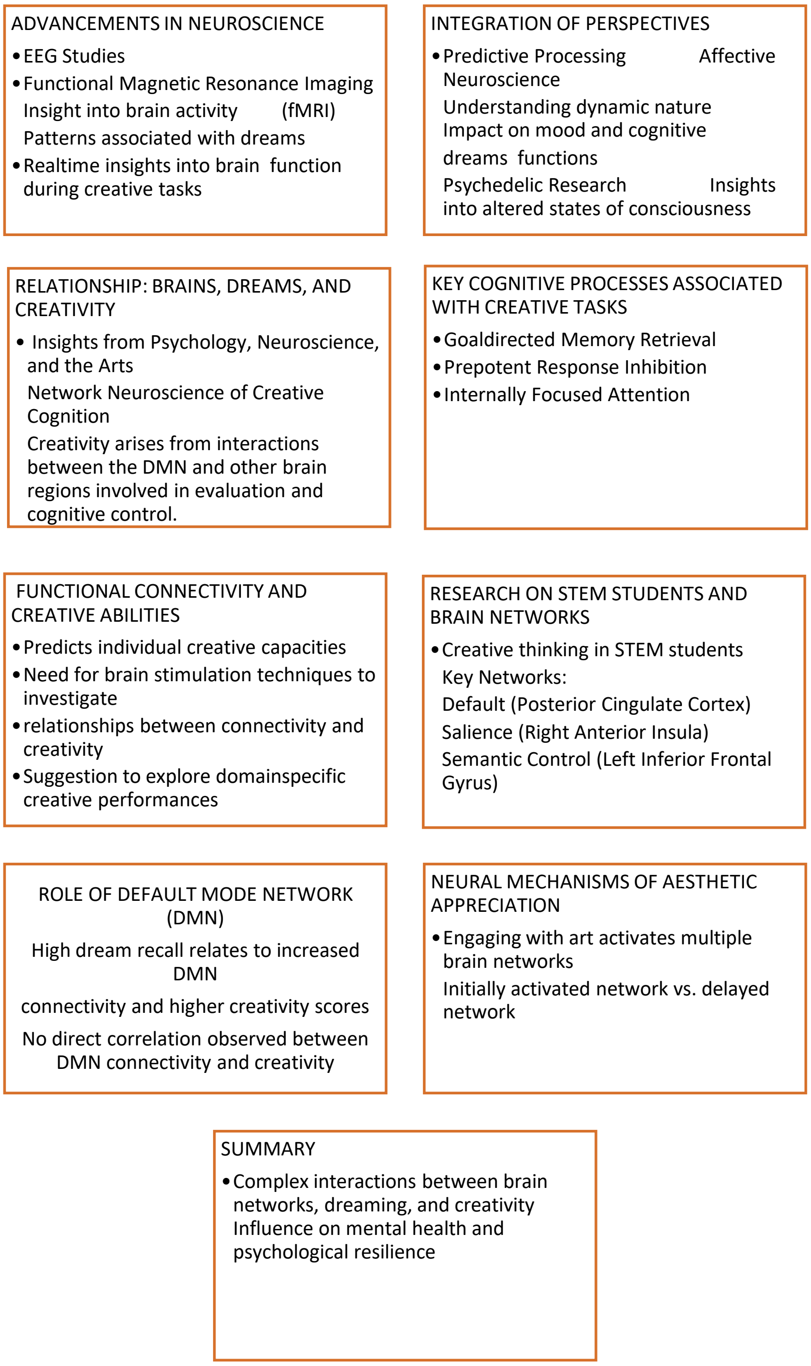
Figure 3 - Brain Networks and Dreaming: fMRI Visualization of the Default Mode Network (DMN), and Its Relevance to Creativity and Modern Research



fMRI scan reveals the regions of the DMN, including the dorsal medial prefrontal cortex, the posterior cingulate cortex, the precuneus, and the angular gyrus. This DMN image is sourced from Wikipedia.

Figure 4 summarizes the content of this section.

Figure 4 - Current Trends and Insights in Dream Research: Advancements, Perspectives, and Interdisciplinary Integration



DMN= Default mode network.

CONCLUSION

The exploration of dreams and creativity unveils a complex framework that interweaves historical insights with contemporary neurobiological research. From the divine interpretations in ancient Greek culture to empirical investigations in modern neuroscience, our understanding of how dreams influence creativity has undergone significant evolution. Historical perspectives have laid the groundwork for contemporary theories that emphasize the pivotal role of neural networks, particularly the DMN, in facilitating the creative potential of dreams.

By integrating insights from historical, psychological, and neuroscientific domains, a comprehensive understanding emerges regarding how dreams continue to shape and enhance creativity. These theories, while not systematically organized and revealing the often-overlooked phenomena of dreaming, provide a valuable perspective on this subject. They highlight the interconnection between psychological, biological, and cognitive processes, underscoring the profound significance of dreams in the human experience.

Looking ahead, future research should delve deeper into the intricate mechanisms through which dreams contribute to creative processes. This exploration will not only expand our knowledge of the multifaceted relationship between dreams and creativity but also illuminate the pathways through which our unconscious experiences can enrich our conscious lives.

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