

# The theoretical review of lucid dreaming research

**Jianhongjing Ou**

The College of Arts and Sciences, Indiana University Bloomington, Bloomington, IN 47405, United States

oujian@iu.edu

**Abstract.** Lucid dreaming, a rare state in which the dreamer realizes that he or she is dreaming, has captured the interest of scholars and sparked extensive research. This article explores the historical trajectory of lucid dreaming research, tracing its roots to the early writings of Frederick van Eeden and highlighting the key scientific contributions of Stephen LaBerge. Through a rigorous methodology, LaBerge pushed lucid dream research into the scientific realm. Technological advances, particularly in brain imaging, have deepened our understanding of the neural processes behind dreams and waking. Using a literature review approach, this article synthesizes research milestones, neurobiological insights, and practical applications of lucid dreaming. The therapeutic potential to address anxiety and promote personal growth emerged as a remarkable result. However, challenges including experimental reliability and limited research methods have surfaced. This paper also recognizes the lack of diversity among researchers and participants in the field and advocates for a broader range of perspectives and voices.

**Keywords:** Lucid Dreaming, Dreams, Sleep, Consciousness.

## 1. Introduction

Throughout human history, dreams have captured our imaginations, arousing wonder and curiosity about their mystical nature and meaning. Among the countless dream experiences, one phenomenon stands out as a rare and remarkable state of consciousness: lucid dreaming. According to LaBerge, lucid dreaming occurs when the dreamer is aware that he is dreaming, but remains immersed in the dream state [1]. This fascinating and mysterious phenomenon has captivated scholars, scientists, and dream lovers, leading to a wealth of research exploring lucid dreaming.

Understanding lucid dreaming has far-reaching implications because it provides insight into the nature of reality perception, improves mental health by addressing anxieties and anxiety, and offers potential avenues for creative problem-solving and personal development. In addition, the historical and cultural significance of lucid dreaming throughout human history has improved our understanding of faith and spirituality. In light of these factors, the purpose of this paper is to examine the history of lucid dreaming research in depth. By tracing its historical origins, examining key scientific milestones, exploring neurobiological mechanisms, evaluating practical applications, and identifying current gaps, the author hope to gain a deeper understanding of this extraordinary state of consciousness and identify potential research avenues.

## 2. Introduction of lucid dreaming

### 2.1. *Early explorations of lucid dreaming*

The term lucid dreaming first appeared in 1913, when it was created by Dutch psychiatrist Frederik van Eeden. Van Eeden believes lucid dreaming is a unique state of consciousness. He defines lucid dreaming as a dream in which the dreamer is fully aware that they are dreaming at the time the dream occurs. In other words, the dreamer becomes conscious during the dream, allowing them to consciously control the content of the dream and interact with the dream environment [2]. However, various religions have noticed this special state of consciousness far before Van Eeden did. In Hinduism, dreams hold sacred and prophetic significance and are regarded as a trustworthy source of insight. This notion aligns with the concept of lucid dreaming, where the dreamer becomes aware of being in a dream and gains control over it, leading to a deeper understanding of its symbolism and message. In contemporary texts, Hinduism considers Yoga Nidra a form of lucid dreaming. During Yoga Nidra, the practitioner witnesses dream imagery while maintaining a detached and objective observer's stance, akin to the lucid dreaming experience, where the dreamer gains awareness and control over the dream content. Moving to Tibetan Buddhism, a branch of Mahayana Buddhism, dream yoga is practiced as a meditative technique aimed at cultivating awareness during the dream state. The ultimate goal of dream yoga is to achieve lucidity in dreams as a pathway to self-actualization and enlightenment. This practice aligns with the concept of lucid dreaming, wherein the dreamer is conscious of the dream's unfolding and has the ability to manipulate its content. Interestingly, even in early Christian theology, lucid dreaming was recognized and acknowledged by figures like Augustine of Hippo. Augustine associated lucid dreaming with the afterlife, perceiving it as a complete separation of the soul from the body. In this context, lucid dreaming served as a glimpse into the afterlife, reinforcing Christian beliefs regarding the continuity of life after death [3].

### 2.2. *Pioneering studies and discoveries*

While dreams have held sacred and prophetic significance in various cultures and lucid dreaming has been explored in spiritual and philosophical contexts, the study of the phenomenon has undergone a major shift with the seminal work of Stephen LaBerge. Stephen LaBerge's groundbreaking work in the field of lucid dreaming research has been instrumental in bringing this phenomenon into the scientific spotlight. One of Stephen LaBerge's most important contributions to lucid dream research was the breakthrough development of the Mnemonic Induction of Lucid Dreams (MILD) techniques [4]. MILD was released in 1980 to increase the likelihood of lucid dreaming through a systematic, structured approach to prospective memory training. The method involves instructing participants to repeat specific phrases before falling asleep, such as "Next time I have a dream, I will remember that I was dreaming." By doing this, LaBerge attempted to prepare the dreamer's mind to recognize the dream state and gain lucidity while dreaming. During the initial stages of implementing the MILD technique, LaBerge conducted controlled experiments with different groups of participants. These studies use a randomized, double-blind design to ensure the validity and reliability of the results. Participants were divided into an experimental group, which was instructed to practice MILD techniques on a regular basis, and a control group, which received tasks unrelated to lucid dreaming. LaBerge's meticulous research methods allowed him to carefully measure the effectiveness of the MILD technique in promoting lucid dreaming. Through trial and error and objective data collection, he observed a significant increase in the frequency of lucid dreams in people who practiced the MILD technique compared to a control group. This finding provides empirical evidence supporting the viability of the MILD technique as a reliable method for inducing lucid dreams.

In addition to the pioneering work of the MILD technique, LaBerge performed another critical experiment using eye movement signals to verify the occurrence of lucid dreams [5]. LaBerge hypothesized that eye movements during lucid dreaming differ significantly from those observed while awake. To investigate this hypothesis, LaBerge used advanced polysomnography equipment to monitor the participants' eye movements during REM sleep. He recruited experienced lucid dreamers

as participants and instructed them to execute specific eye movement patterns during lucid dreams. These eye movement patterns were predetermined and communicated to the participants before they entered the sleep laboratory. LaBerge's experimental results provide convincing evidence in support of the existence of lucid dreaming. Analysis of the eye movement data revealed unique and recognizable patterns during REM sleep that corresponded to lucid dreams reported by the participants. By successfully instructing lucid dreamers to perform pre-defined eye-movement patterns in their goals, Laberge demonstrated the feasibility of using eye-movement signals as a means of communication between the dreamer and the outside world. This breakthrough not only validates that lucid dreaming occurs but also provides a potential avenue for studying the nature of consciousness during the dream state.

### **3. Advancements in understanding lucid dreaming**

The advent of neuroscience research techniques has revolutionized our understanding of brain activity in various states of consciousness, including sleep and lucid dreaming. Electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) have helped reveal the neural correlates of lucid dreaming. EEG studies have not only uncovered unique brainwave patterns during lucid dreaming but have also revealed intriguing findings related to the neural oscillations that exist during this unique state. For example, a study conducted by Voss et al. studied the EEG patterns of participants during lucid dreaming and compared them to non-awake REM sleep and waking states [6]. The study found a combination of alpha, beta, and gamma oscillations in the brain during lucid dreaming, indicating a unique neural state distinct from REM sleep and waking consciousness. This finding points to the possibility of specific neural signatures underlying lucid dreaming, which further underscores its importance as a distinct state of consciousness. Additionally, fMRI studies have provided valuable insights into brain regions associated with self-awareness during lucid dreaming. In a joint EEG/fMRI case study conducted by Dresler et al., participants were prompted to signal when they entered a lucid dream state while undergoing an fMRI scan [7]. The results showed increased activity in brain regions such as the prefrontal cortex and anterior cingulate cortex, areas associated with self-awareness and awareness. Increased activity in these regions during lucid dreaming further validates the notion of lucidity, highlighting its unique cognitive and neural basis. Furthermore, the integration of EEG and fMRI allowed the researchers to explore patterns of functional connectivity during lucid dreaming. By examining synchronized activity between different brain regions, scientists have gained a deeper understanding of the network dynamics that support waking consciousness during dreams. Early results from these studies suggest that lucid dreaming may involve better communication between parts of the brain that handle sensory processing, executive control, and self-referential processing. This could mean that lucid dreams involve a more complete and coherent state of consciousness.

In addition to EEG-fMRI, transcranial magnetic stimulation (TMS) has emerged as an innovative technique to investigate the causality of lucid dream induction. Researchers have applied TMS to specific brain regions, such as the dorsolateral prefrontal cortex (DLPFC) and the temporoparietal junction (TPJ), known to be involved in self-awareness and conscious processing. A study by Voss et al. [8] demonstrated that targeted TMS stimulation of the DLPFC increased the frequency of lucid dreams in participants who used LaBerge's MILD technique. This remarkable finding suggests that TMS can modulate brain activity to enhance self-reflective processes during sleep, facilitating the occurrence of lucid dreams.

Moreover, wearable devices and mobile applications have emerged as valuable tools in the hands of both researchers and lucid dream enthusiasts. These technologies enable real-time monitoring and detection of rapid eye movement (REM) sleep patterns, a stage closely associated with dreaming, including lucid dreaming. By leveraging these devices, individuals practicing lucid dream induction techniques, such as LaBerge's MILD method, receive immediate feedback on their sleep cycles and can optimize their efforts to achieve lucidity. This integration of technology and dream exploration holds great promise for improving the success rate of inducing lucid dreams and enhancing our understanding of the factors influencing dream lucidity.

#### **4. Applications and benefits of lucid dreaming**

The diverse applications and benefits of lucid dreaming have been extensively explored through numerous scientific studies and experiments. Lucid dreaming has been effectively employed in nightmare alleviation. By achieving lucidity during distressing dreams, individuals can consciously alter the dream narrative, transforming nightmares into more positive or neutral experiences. A meta-analysis conducted by Spoomaker and van den Bout supported the effectiveness of lucid dream interventions in reducing nightmare frequency and improving sleep quality in patients with nightmare disorders [9]. This indicates the practicality of lucid dreaming techniques in promoting better mental well-being and restful sleep for those struggling with nightmares. Moreover, lucid dreaming requires an increased level of cognitive control and critical thinking during the dream state, which may positively impact cognitive functions in waking life. Research by Baird, B., Mota-Rolim, S. A., and Dresler, M. suggested that practicing lucid dreaming could potentially enhance problem-solving abilities and working memory, opening up intriguing possibilities for cognitive enhancement through lucid dream training [10]. Furthermore, engaging in lucid dreaming may have some positive effects on one's well-being. In a study by Konkoly, K., and Burke, C. T., Longitudinal assessments of mental health and personal growth were performed between participants who had received lucid dreaming training versus those who had only learned dream journaling and mindfulness exercises [11], and a third group had no skills. The results showed that overall, there was no significant difference in personal growth between the groups. However, successful lucid dreamers reported higher life satisfaction and self-esteem and experienced lower levels of stress the day after lucid dreaming than those who attempted but did not achieve lucid dreaming. This suggests that while the overall personal growth benefits may not be uniquely attributable to lucid dreaming, successful induction of lucid dreaming may have specific positive effects on some aspects of well-being.

#### **5. Challenges and criticisms in lucid dream research**

The elusive nature of lucid dreaming poses a significant challenge for researchers in the field. Unlike regular dreams, which may follow patterns and occur frequently, lucid dreams happen sporadically and unpredictably. As a result, studying them in a controlled laboratory setting becomes difficult. To conduct rigorous experiments and draw reliable conclusions, researchers need standardized protocols, but the variability in lucid dreaming occurrences hampers the establishment of such protocols. For example, a study conducted by LaBerge and DeGracia attempted to induce lucid dreaming through specific techniques, but the success rates varied among participants, highlighting the elusive nature of this phenomenon [12].

Another issue researchers encounter is the reliability and validity of self-reports from individuals who experience lucid dreams. Inaccuracies in memory, incorrect interpretations of dreams, or other cognitive biases can all have an impact on participants' subjective accounts, which are the main source of lucid dream reports. This may lead to skewed data and hinder the accuracy of research findings. For instance, in a study by Voss et al., participants were asked to recall their lucid dreams upon waking up, but discrepancies were observed between their self-reports and objective measures, raising concerns about the reliability of self-reported data [13].

Assessing and analyzing dream content presents further challenges in lucid dream research. Dreams are intangible experiences that occur within the mind, and researchers heavily rely on dream journals and self-reports to gain insights into these experiences. While these methods provide valuable information, they may not capture the entirety of dream content. This limitation prevents researchers from fully understanding the neural correlates and cognitive processes involved in lucid dreaming. For example, a study by Nir and Tononi utilized functional magnetic resonance imaging (fMRI) to analyze brain activity during lucid dreaming, but the inability to directly access dream content limited the interpretation of their results [14].

In conclusion, the elusive nature of lucid dreams, reliance on self-reports, and limited access to dream content present significant hurdles in lucid dream research. Overcoming these challenges will require innovative research methods and technologies that can better capture and analyze the

intricacies of this fascinating phenomenon. Researchers must continue to refine their approaches to gain a deeper understanding of lucid dreaming and its potential implications for psychology and neuroscience.

## **6. Future directions and ethical considerations**

In the realm of lucid dream research, there are several exciting directions that researchers can pursue to deepen our understanding of this unique state of consciousness. One promising area of exploration involves investigating the neurobiological correlates of lucid dreaming. With advancements in neuroimaging technologies such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), researchers can delve deeper into the brain's activity during lucid dreams. Identifying specific brain regions and neural activity patterns associated with lucid dreaming could shed light on the underlying mechanisms of this phenomenon, potentially revealing valuable insights into consciousness and dream control. As technology continues to advance, there are emerging tools and methodologies that can revolutionize lucid dream research. Virtual Reality (VR) and Augmented Reality (AR) applications offer immersive dream simulations, allowing researchers to manipulate dream scenarios and induce lucidity in controlled virtual environments. This integration of VR and AR technologies can open up new possibilities for studying dream behavior and subjective experiences. Moreover, the development of more sophisticated sleep monitoring devices, such as wearable sensors and smartphone applications, can significantly enhance data collection during lucid dream studies. These advanced sleep monitoring devices can provide real-time data on sleep patterns and physiological markers, enabling researchers to better understand the relationship between sleep stages and lucid dreaming.

However, as researchers delve deeper into the study of lucid dreams, ethical considerations must not be overlooked. Participant well-being and safety should be at the forefront of every lucid dream study. Lucid dream experiences can be intense and emotionally charged, potentially leading to unintended psychological effects. Providing appropriate psychological support and counseling resources to participants during and after the study can help mitigate any adverse effects, ensuring the overall well-being of those involved.

## **7. Conclusion**

In short, the exploration of lucid dream research unveils a fascinating journey through the intricacies of history, science, and human consciousness. By delving into its historical origins, we trace lucid dreaming back to the early writings of Frederick van Eeden and discover its importance from a variety of religious perspectives in different societies. Stephen Rabbage's pioneering work becomes a key turning point, elevating lucid dreaming research into the scientific spotlight by establishing rigorous methodologies and conducting groundbreaking research. Furthermore, the combination of brain imaging and technological advances has deepened our understanding of the neural basis of wakefulness, revealing fascinating interactions between the brain and dreams. This then creates intriguing opportunities for further research and discovery in the field. The therapeutic and self-improvement applications of lucid dreaming are already producing encouraging results. Despite this, the voyage of lucid dreaming research has not been devoid of obstacles. The study of this enigmatic phenomenon has encountered obstacles, and there have been debates over methodology and interpretation. In order to ensure the validity and dependability of future investigations, it is essential to address these challenges. The promise of lucid dream research contains exciting potential for further exploration and technological advancements as we move forward. Emerging technologies and methodologies provide new opportunities for unraveling the enigma of dreams and advancing our understanding of consciousness. In this endeavor, it is essential to adhere to ethical principles that prioritize the well-being of participants and respect their research experiences. In the field of lucid dream research, responsible and empathetic methods will foster credibility and honesty. While the examination of lucid dream research within this paper yields a captivating narrative, it is incumbent upon us to acknowledge the apparent dearth of diversity characterizing both researchers and

participants in this domain. This homogeneity raises concerns about potential limitations in representation and the introduction of biases. To rectify this limitation, future endeavors in research could be enriched by the integration of a more expansive array of voices, perspectives, and socio-cultural contexts. By soliciting insights from researchers hailing from heterogeneous backgrounds and by delving into the intricate interplay between lucid dreaming and various cultural paradigms, this paper could ascend to the status of a more comprehensive exposition of the complexities inherent to the field. Notwithstanding the predominantly sanguine disposition of this paper towards lucid dream research, its scholarly merit could be further elevated by affording equitable attention to counterbalancing viewpoints and plausible critiques. By addressing contentions, lingering queries, and conceivable lacunae, this article stands poised to furnish a more equitable and all-encompassing evaluation of the multifaceted tapestry characterizing research into lucid dreaming.

### References

- [1] LaBerge, S., Levitan, L., & Dement, W. C. (1986). Lucid dreaming: Physiological correlates of consciousness during REM sleep. *The journal of mind and behavior*, 251-258.
- [2] Van Eeden, F. (1913, July). A study of dreams. In *Proceedings of the society for psychical research* (Vol. 26, No. Part 47, pp. 431-461).
- [3] Mota-Rolim, S. A., Bulkeley, K., Campanelli, S., Lobão-Soares, B., De Araujo, D. B., & Ribeiro, S. (2020). The dream of god: how do religion and science see lucid dreaming and other conscious states during sleep?. *Frontiers in Psychology*, 11, 555731.
- [4] LaBerge, S. P. (1980). *Lucid dreaming: An exploratory study of consciousness during sleep*. Stanford University.
- [5] LaBerge, S., Levitan, L., & Dement, W. C. (1986). Lucid dreaming: Physiological correlates of consciousness during REM sleep. *The journal of mind and behavior*, 251-258.
- [6] Voss, U., Holzmann, R., Tuin, I., & Hobson, A. J. (2009). Lucid dreaming: a state of consciousness with features of both waking and non-lucid dreaming. *Sleep*, 32(9), 1191-1200.
- [7] Dresler, M., Wehrle, R., Spoormaker, V. I., Koch, S. P., Holsboer, F., Steiger, A., ... & Czeisler, M. (2012). Neural correlates of dream lucidity obtained from contrasting lucid versus non-lucid REM sleep: a combined EEG/fMRI case study. *Sleep*, 35(7), 1017-1020.
- [8] Voss, U., Schermelleh-Engel, K., Windt, J., Frenzel, C., & Hobson, A. (2013). Measuring consciousness in dreams: the lucidity and consciousness in dreams scale. *Consciousness and Cognition*, 22(1), 8-21.
- [9] Spoormaker, V. I., & Van Den Bout, J. (2006). Lucid dreaming treatment for nightmares: a pilot study. *Psychotherapy and psychosomatics*, 75(6), 389-394.
- [10] Baird, B., Mota-Rolim, S. A., & Dresler, M. (2019). The cognitive neuroscience of lucid dreaming. *Neuroscience & Biobehavioral Reviews*, 100, 305-323.
- [11] Konkoly, K., & Burke, C. T. (2019). Can learning to lucid dream promote personal growth?. *Dreaming*, 29(2), 113.
- [12] LaBerge, S., & DeGracia, D. J. (2000). Varieties of lucid dreaming experience. *Individual differences in conscious experience*, 20, 269.
- [13] Voss, U., Holzmann, R., Hobson, A., Paulus, W., Koppehele-Gossel, J., Klimke, A., & Nitsche, M. A. (2014). Induction of self-awareness in dreams through frontal low current stimulation of gamma activity. *Nature neuroscience*, 17(6), 810-812.
- [14] Nir, Y., & Tononi, G. (2010). Dreaming and the brain: from phenomenology to neurophysiology. *Trends in cognitive sciences*, 14(2), 88-100.