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CLINICAL IMPLICATIONS OF LUCID DREAMING RESEARCH (FOR PSYCHOSIS, NIGHTMARES, PTSD)

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ABSTRACT

Both Kant and Schopenhauer drew attention to the fact that there is a connection between lucid dreaming and psychosis. Specifically, the two philosophers proposed that "a lunatic is a wakeful dreamer" and that "a dream is a short-lasting psychosis, and a psychosis is a long-lasting dream," respectively. Wundt said that "we may encounter in dreams all the phenomena we find in the reality," which agrees with both of these ideas. Sigmund Freud, who proposed that psychosis is an aberrant incursion of a dreaming activity into an awake state was inspired in various ways by all of these individuals. Emil Kraepelin, while being one of the most prominent critics of psychoanalysis, postulated the same thing.

Keyword: lunatic is a wakeful dreamer, aberrant incursion, Emil Kraepelin,

INTRODUCTION

According to Jung, "the clinical image of dementia praecox is what we would see if we could conceive a dreamer strolling about and performing his own dream as if he were awake." the latter word, which was first conceived of by Kraepelin, was afterwards termed schizophrenia by Bleuler. Bleuler also wrote that "the modalities of thinking of schizophrenic subjects are

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very similar to dreaming," and that dreaming "has its own rules," and that most of the characteristics of schizophrenic thinking (particularly delusional thinking) are explained by the differences between the dreaming way of thinking and the way of thinking that occurs during wakefulness. .

There is a lot of evidence to suggest that rapid eye movement sleep (REMS), which is the mental stage that is most closely associated with dreaming is a physiological experience that is comparable to the psychotic symptoms of schizophrenia. Following the discovery of antipsychotic medications, researchers came up with the theory that the positive symptoms of schizophrenia, such as psychosis, correspond with enhanced dopaminergic activity in certain neural circuits At the moment, pharmacological and/or genetic treatments that boost dopaminergic transmission may generate psychotic-like behaviours in animals. Because of this, these manipulations are helpful for understanding the processes that underlie psychosis. For instance, Dzirasa and colleagues were unable to differentiate the spectral content of REMS from that of the wake state in rats with psychotic-like behaviours; the strength of rapid and slow oscillations was found to be the same in both wakefulness and REMS. In light of this, it would seem that REMS and waking states are intertwined in animal models of psychosis. Activation of dopamine D2 receptors in the mesolimbic pathway, which is also important in the pathophysiology of psychosis occurs during REMS. This might be the reason why dreams are characterised by a multitude of mental experiences that are similar to hallucinations This suggests that dreaming would be an excellent model for psychosis In support of this idea, Dzirasa and colleagues shown that the suppression of REMS may also be achieved by lowering dopamine transmission, which is a medication that is often used to treat psychosis. Both REMS and schizophrenia are associated with decreased levels of noradrenaline and serotonin, as well as increased activity of cholinergic and glutamatergic systems These variations in the levels of noradrenaline, serotonin, acetylcholine, and glutamate can also be seen in patients with schizophrenia. Furthermore, hallucinogenic chemicals seem to point to a connection between psychosis and one's dreams Because LSD causes an increase in the frequency of ponto-geniculo-occipital waves, which are associated with the execution of brief ocular saccades during REMS, this phenomenon may represent a possible correlation between the visual experiences that are induced by LSD and those that occur during dreaming.

Studies using neuroimaging to examine the frontal brain provide more evidence that dreams and psychosis are closely related. Subjects who suffer from schizophrenia have a syndrome

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known as hypofrontality, which describes this region's extreme impairment The dorsolateral prefrontal cortex in particular is known to deactivate during physiological REMS Frontal regions deactivate as well. Both REMS and psychosis are characterised by a loss of logical judgement and delusional thinking, which may be induced by low frontal activity This can also lead to a reduction in self-awareness.

Lucid dreaming is a phenomenon that has been with mankind since the beginning of time, but it has been ignored by the scientific and academic community for a long time. Instead, it has been relegated to a more mystical or paranormal approach. This is true of many other types of dreaming and sleeping phenomena as well. Lucid dreaming is one of these (LaBerge & Rheingold, 1991). LaBerge and his colleagues (LaBerge, Nagel, Dement, & Zarcone, 1981) came up with a way to physiologically identify the exact moment lucid dreaming was happening inside the dreaming subject. During the late XIX and XX centuries, it suffered from being a nuisance to Freudian psychoanalysis (Tranquillo, 2014). It remained dormant to science until the work of LaBerge and his colleagues. With that point, there was an explosion of study and tests on the topic, perhaps mirroring what had occurred in the 1950s after the discovery of rapid-eye-movement (REM) sleep and its link to dreaming (Thompson, 2015b). The modern cognitive neuroscience of dreaming suggests that the cognitive limits encountered in non-lucid dreaming are caused by pre-frontal deactivations found during REM sleep. This theory is based on the observation that these deactivations occur. When compared to the waking state, it would appear that certain regions of the human brain, such as the dorso-lateral pre-frontal cortex (DLPFC) and the precuneus, become selectively deactivated, while other regions, such as the limbic and paralimbic systems, become more activated. Other regions, such as the hippocampus, appear to remain relatively unchanged (Hobson & Pace-Schott, 2002; Nir & Tononi, 2010; Schwartz & Maquet, 2002; Spoormaker, Czisch, & Dresler, 2010).

It is hypothesised that during lucid dreaming, the dorsolateral prefrontal cortex (DLPFC), which had been dormant, becomes active again. This is what makes it possible to be aware that one is experiencing a dream. In a similar vein, it has been hypothesised that lucid dreaming is associated with activations in the prefrontal cortex (Hobson, 2009a; Hobson, Pace-Schott, & Stickgold, 2000; Karim, 2010; Spoormaker et al., 2010; Tononi, 2009; Voss, Holzmann, Tuin, & Hobson, 2009). According to Hobson (2009a), lucid dreaming suggests that consciousness can be split into two parts: an actor, in the guise of the dreamer, and an observer, in the guise of the awake. Because of this, lucid dreaming has become, in the

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author's opinion, a very attractive phenomenon for scientific investigation in the field of consciousness studies. Because it is so alluring, some people believe that the human mind may exist in both the waking and dreaming phases at the same time. In turn, this ought to make it easy for the experimental scientist to test the physiological correlates of lucid dreaming in the laboratory. (Hobson, 2009a). Additionally, it has been hypothesised that in order to investigate consciousness, one would need to monitor changes in both their brain and their thoughts at the same time (Brylowsky, 2010; Hobson, 2005). In keeping with what has been discussed previously, the purpose of this thesis is to offer a conceptual and theoretical analysis of the field of lucid dreaming within cognitive neuroscience, with particular attention paid to the field of consciousness studies and the direct relationship that exists between the two.

The permanency of the lucid dreaming phenomena throughout recent human history, together with the upsurge in present cognitive neuroscience lucid dreaming study related with a specific feature of consciousness research, provides the explanation for this objective's rationale. For this reason, it is essential to determine, to begin with, the neurophysiological particulars of human sleep and dreaming that are pertinent to the purpose of the thesis. In particular, it is essential to determine how non-lucid dreams and lucid dreams differ from one another from a phenomenological and neurophysiological standpoint, as well as how the transition from non-lucid to lucid dreaming occurs. This purpose will be attempted to be fulfilled in the second part of this thesis, which is titled "Human Sleep and Dreaming." Following that, in Part III, an overview of the cognitive neuroscience of lucid dreaming is presented. The primary focus of this section is first on general guidelines for working with lucid dreams, and then the discussion shifts to an in-depth analysis of the most relevant experiments from contemporary research. The last part of the paper discusses the primary links that exist between lucid dreaming and consciousness, specifically in terms of the primary theories and hypotheses that link both of these research areas at the current time. In spite of this, it is essential to first have a short history of lucid dreaming and to identify a few key ideas that are crucial to this research before moving on. Regardless, the importance of this task cannot be overstated. In the next paragraph, this task will be completed.

MAIN CONCEPTS DEFINITION

Clarification of essential ideas is necessary in order to get a comprehensive comprehension of the nomenclature that has been used throughout this theoretical inquiry. In order to achieve

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this goal, condensed definitions in the form of citations will be provided, which will then be followed by brief analyses, with the exception of the concept of lucid dreaming, which will be discussed in a more in-depth way. To begin, one may begin by consulting the Stanford Encyclopedia of Philosophy and reading its article on the topic in order to attempt to get a better understanding of the aspect of the idea of consciousness that is pertinent to the aims of this manuscript: The phrases "conscious" and "consciousness" are umbrella concepts that may be used to refer to a broad range of mental events. Both are used with a variety of connotations, and the adjective "conscious" is used in a variety of contexts since it may refer to complete creatures (which are referred to as "creature consciousness") as well as specific mental states and processes (which are referred to as "state consciousness") (Van Gulick, 2014, section 2).

However, for the sake of this theoretical examination, the word "consciousness" will be employed as "state consciousness," much as it seems to be used in modern research on lucid dreaming. Although "consciousness" seems to be an umbrella term in and of itself, However, one can also refer to consciousness as "the subjective psychological reality that we experience" which may lead to interpreting it as the subjective experience of "I," as in interior presence. This is another way that consciousness may be described. These two definitions appear to complement one another, as state consciousness may be the subjective reality that is experienced as the brain moves back and forth through a continuum of states during the course of the sleep-wake cycle, as well as many other so-called normal and altered states of consciousness, during the course of the temporal frame of a human life. This idea will be brought up and debated at several points throughout the document. There are a few different types of consciousness that may be found if one looks under the general heading of "consciousness," including reflective consciousness and phenomenal consciousness. To put it more simply, phenomenal awareness may be defined as the existence of ongoing subjective experiences or the act of engaging in such experiences. If there is any kind of subjective experience that is now present for an organism, then that creature is said to possess phenomenal awareness.

According to some, the idea of phenomenal awareness is the single most important term in the field of research devoted to the study of consciousness. This is because it denotes the instantaneous existence of a certain kind of experience for a person (Revonsuo, 2006). A higher-order kind of consciousness, also known as reflective consciousness, "involves a

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cognitive activity that contributes something to and is apart from the perceptual material itself," according to one definition of this type of consciousness.

These two ideas are of such a basic character that they are necessary to understand in order to determine the heart of this theoretical research. Research on lucid dreaming is contemporaneously tied to research on consciousness, as will be made increasingly obvious throughout the work, culminating in Part IV: "Lucid Dreaming and Consciousness," and it is via these conceptualizations that the connection is established. Secondly, the idea of dreaming can be described in a nutshell as "complex, multimodal, dynamic, and progressive conscious experiences that occur during sleep and are organised in the form of a sensory-perceptual world or a world simulation." This definition captures the complexity, multimodality, progression, and progressiveness of dreaming This idea will be explored further in more depth over the whole of Part II, which is titled "Human Sleep and Dreaming." There is a phenomena known as lucid dreaming, which may be described as "a dream during which the dreamer is aware that the continuing experience is a dream." Lucid dreaming can be found within the realm of dreaming.

When this is taken into consideration, one can also say that lucid dreams are dreams in which the dreamer is aware that he is dreaming (Brown, 1934). This means that lucid dreams are dreams in which the dreamer is in a state of consciousness that is comparable in many ways to waking consciousness, but in which the subject is aware that he is still dreaming (LaBerge et al., 1981). Lucid dreamers report being in possession of all of their cognitive faculties, including the ability to reason clearly, the ability to remember conditions of waking life, and the ability to act within the dream upon reflection or according to a plan decided upon prior to going to sleep. Lucid dreamers report being in possession of all of their cognitive faculties (Holzinger, LaBerge, & Levitan, 2006). The persistent knowledge that one is dreaming and that one is not really awake is thought to be the hallmark of lucid dreaming. According to this criterion, it is even feasible to regard lucid dreaming to be paradoxical since it seems to incorporate aspects from both the waking and dreaming states of consciousness (Hobson, 2009a). In one's day-to-day life, a person does not reflect on whether or not they are awake when they are, and in a similar vein, a person is not conscious that they are dreaming while they are dreaming (LaBerge & Gackenbach, 2000).

LITERATURE REVIEW

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Sérgio A (2013) There is a growing body of research that supports the concept that rapid eye movement sleep, often known as REMS, serves as an effective model for advancing our knowledge of psychosis. Both REMS and psychosis are characterised by an absence of logical judgement and the generation of one's own impressions from inside, which can be explained by a hyperlimbic activity that coexists with a hypofrontality. It is interesting to note that some people are able to become aware that they are dreaming while undergoing REMS. This unique experience is known as lucid dreaming (LD), and its neurological foundation is still up for debate. We hypothesise that learning disabilities are related with higher frontal activity during REMS because the frontal lobe is involved in processes such as self-consciousness, working memory, and attention. The use of transcranial magnetic or electric stimulation of the frontal area during REMS might be one approach to test this idea. This would include observing whether or not this stimulation causes LD. Further, we propose that psychosis and LD are two distinct types of experiences: LD can be thought of as a physiological awakening that occurs during dreaming as a result of frontal activity, whereas psychosis can be thought of as a pathological intrusion of dream features during wake state that is caused by hypofrontality. In addition, we hypothesise that the study of LD may have three primary consequences for therapeutic practise. To begin, it has been suggested that LD might be significant to the field of research into consciousness, particularly its diseases and other altered states. Second, LD has the potential to be utilised as a treatment for repeated nightmares, which are a typical sign of both depression and post-traumatic stress disorder (PTSD). In conclusion, LD may make it feasible to engage in motor imagery while dreaming, which may aid in the process of physical recovery. Overall, we are of the opinion that study into LD may elucidate numerous facets of the functioning of the brain in its physiological, disturbed, and diseased stages.

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RESEARCH MATALOGY

INTRODUCTION

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There are a few different types of consciousness that may be found if one looks under the general heading of "consciousness," including reflective consciousness and phenomenal consciousness. To put it more simply, phenomenal awareness can be defined as the presence of ongoing subjective experiences or the act of engaging in such experiences. If there is any kind of subjective experience that is now present for an organism, then that creature is said to possess phenomenal awareness According to some, the idea of phenomenal awareness is the single most important term in the field of research devoted to the study of consciousness. This is because it denotes the instantaneous existence of a certain type of experience for a person (Revonsuo, 2006). A higher-order kind of consciousness, also known as reflective consciousness, "involves a cognitive activity that contributes something to and is apart from the perceptual material itself," according to one definition of this type of consciousness.

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DATA ANALEYSIS

INTRODUCTION

Studies conducted in the 1960s and 1970s found evidence of lucid dreaming in the form of repeated brief awakenings that occurred during REM sleep. It was hypothesised that these micro-awakenings constituted the physiological foundation for lucid dreaming (LaBerge, 1990; LaBerge & Gackenbach, 2000). Despite this, it appears that a single researcher proposed the idea that lucid dreams occurred during the paradoxical stage of sleep, often known as REM, just like any other dreams (Green, 1968; LaBerge & Gackenbach, 2000). These hypotheses were not supported by any empirical data, and there was a need for a physiological method that could pinpoint the precise moment when the lucid dream was occurring (LaBerge & Gackenbach, 2000). Already in the 1960s, it had been established that, in many dream reports, the eye movements recorded during REM coincided to the direction the patients had described going in their dreams. This was a discovery that was made (LaBerge & Gackenbach, 2000; Roffwarg, Dement, Muzio, & Fisher, 1962). In light of this information, it is likely that it would be possible to harness the dreamer's volitional capacities while they are dreaming in order to generate a pre-arranged eye movement signal that would identify the precise moment when the dreamer became lucid (LaBerge & Gackenbach, 2000).

THE USE OF LUCID DREAMS IN COGNITIVE NEUROSCIENCE RESEARCH

As was noted before, when a person is having lucid dreams, it seems as though the dreamer possesses a consciousness that is equivalent to that of when they are awake, in terms of coherence, clarity, and cognitive complexity. In the past, people questioned whether these experiences occurred during sleep or during brief intervals of waking known as hypnopompic (LaBerge, 1990). LaBerge and colleagues (1981) devised an experiment with the purpose of discovering the physiological parameters under which lucid dreaming can take place in an effort to provide an answer to this topic. The authors took into account the definition of lucid dreaming, reasoning that if dreamers became aware that they were dreaming, then maybe they could also signal in their dream, and that signal probably would have a physiological correlate. This led them to conclude that lucid dreaming occurs when dreamers become aware that they are dreaming (LaBerge & Gackenbach, 2000; LaBerge et al., 1981). In the experiment conducted by LaBerge and colleagues (1981), there were a total of five participants (N = 5). These participants were instructed in a cognitive technique known as Mnemonic Induction of Lucid Dreams (MILD), and they were chosen for their purported

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capacity to induce lucid dreams at will. The subjects spent anything from two to twenty non-consecutive nights being observed and tested in a sleep laboratory. Recordings of the standard PSG were carried out, which included EEG and EOG, as well as chin, left and right wrist EMG. The individuals created a pre-arranged signal with dreamt eye shifts to identify the beginning of a lucid dream. This signal comprised of excessive horizontal movements in the pattern left-right-left-right (L-R-L-R), which translated in the EOG register. After spontaneously waking up from different phases of sleep, a total of thirty-five people reported having lucid dreams. In thirty-two of the cases, the dream occurred during rapid eye movement (REM), whereas in two other cases, it occurred during the transition from non-REM to REM sleep.

Thirty of these lucid dreams were reportedly accompanied with signalling from the participants (LaBerge et al., 1981). According to the authors, the reports that alluded to signals and the related PSG were evaluated by a judge after each recording. However, the judge was uninformed of the times that the reports were reviewed. The judge's job was to decide if any of the PSG epochs had a correlation with the lucid dream signal that was being reported, or whether none of them did. In twenty-four of the previously stated thirty-five cases, the judge was able to pick the relevant thirty-second epochs out of almost a thousand per PSG by basing his decision on the consistency between the signals that were reported and those that were seen. It was believed that the possibility of this selection ratio occurring by chance was so low that it could not even be measured (LaBerge et al., 1981). Since then, investigations of the same nature have been carried out at a number of different research facilities, therefore lending credence to the theory that lucid dreaming is a phenomena that occurs during sleep (Armstrong-Hickey, 1988; Dresler et al., 2012; Fenwick, Schatzman, Worsley, Adams, Stone, & Baker, 1984; Ogilvie, Hunt, Kushniruk, & Newman, 1983; Voss et al., 2009). When all of this is taken into consideration, one would wonder how it is possible to be sure that the test subjects were in fact sleeping when the pre-arranged signal was detected in the EOG.

It would appear that the solution is rather simple: the subjective lucid dream accounts and the physiological sleep measures corresponded; more specifically, "all signals associated with lucid dream reports occurred during epochs of unambiguous REM sleep rated according to the conventional criteria" (LaBerge et al., 1981, p. 729). The two most important takeaways from the research carried out by LaBerge and his colleagues in 1981 were as follows: first, lucid dreaming appears to take place most frequently during REM sleep; and second, the

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study's findings point to the possibility of lucid dreamers intentionally signalling to the outside world from the dream world while they are dreaming. (LaBerge et al., 1981). These two deductions made it possible to take a fresh approach to the study of dreams; for example, it became feasible to conduct tests in which participants could note the precise moment at which particular lucid dreaming experiences took place in their dreams. In turn, this made it possible to derive psycho-physiological relationships and conduct methodical tests of hypotheses (LaBerge & Gackenbach, 2000; LaBerge et al., 1981).

The use of lucid dreams in cognitive neuroscience research, as stated by a number of writers (LaBerge & DeGracia, 2000; LaBerge & Gackenbach, 2000; LaBerge et al., 1986), necessitates the acquaintance or familiarity with a number of methodological concerns, such as the following:

1. Subjective reports and introspection are recognised to offer the most direct accounting of the contents of consciousness; but, it is impossible to validate subjective reports objectively, and introspection is a very long way from being an objective, direct, or error-free method of observation (LaBerge & Gackenbach, 2000). When conducting an experiment, it is of the highest significance that the participants have a solid grasp of the idea of lucid dreaming. One indicator of this is the presence of a recognition phrase in a sample report of lucid dreams (Snyder & Gackenbach, 1988).
2. The ability to remember one's dreams appears to be an effective predictor of lucid dreaming ability in those who have not been instructed to do so (Schredl & Erlacher, 2004; Snyder & Gackenbach, 1988).
3. When attempting to pinpoint lucid dreams, it would be important to take into consideration that they probably associate with phasic REM. It has been proposed that lucid segments of Signal-Verified Lucid Dreams (SVLDs) REM periods seem to be characterised by higher levels of physiological activation, when compared with the preceding segments of non-lucid REM from the same REM periods. This suggests that lucid dreams are associated with phasic REM. 4. It has been (Brylowsky et al., 1989; LaBerge & Gackenbach, 2000; Laberge et al., 1986).
4. The method of producing SVLDs that involves extreme horizontal eye movement (L-R-L-R) inside the dream may be problematic because it is difficult to carry out and may result in awakenings. This eye movement inside the dream is believed to affect what the subject is seeing in the dream, thereby disrupting the visual imagery (LaBerge & Gackenbach, 2000).

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5. It has been hypothesised that SVLDs can originate either from a continuing REM dream that is not lucid, which is known as a dream-initiated lucid dream (DILD), or straight from a brief waking, which is known as a wake-initiated lucid dream (WILD) (WILD). It is believed that approximately two-thirds of lucid dreams are of the DILD variety, while the remaining one-third are of the WILD variety (LaBerge & Gackenbach, 2000; Laberge et al. 1986). However, this is only a preliminary figure that needs to be expanded upon through the conduct of additional research.
6. There are four possible outcomes for lucid dreams: waking, transitioning into a non-lucid dream, entering non-rapid eye movement (NREM) sleep, or experiencing a false awakening (LaBerge & DeGracia, 2000). It has been demonstrated that lucid dreaming is a talent that can be acquired via practise (LaBerge, 1980), and several methods for the induction of lucid dreams have been created. Stumbrys and colleagues (Studrys, Erlacher, Schadlich, & Schredl, 2012) presented a taxonomy of lucid dream induction methods taken from thirty-five studies, evaluated for their methodological quality, and systematically reviewed the evidence for the effectiveness of induction techniques. This work was based on Stumbrys's previous work (Studrys, Erlacher, Schadlich, & Schredl, 2012). According to the approach that was used for the meta-analysis, the authors came to the conclusion that none of the strategies appear to reliably and consistently create lucid dreams. However, several of the techniques showed potential. The term "lucid dream induction" refers to any method that aims to enhance the frequency of lucid dreams, and the authors identified three broad categories in an attempt to give an experimentally based taxonomy of the many strategies for inducing lucid dreams:

According to Stumbrys and colleagues (2012), within the realm of cognitive techniques, one promising induction method seems to be Tholey's combined technique. This technique has already been tested in two studies with high methodological quality (Paulsson & Parker, 2006; Zadra, Donderi, & Pihl, 1992) and incorporates elements of reflection, as in developing a reflective frame of mind, intention, as in imagining being in a dream and recognising it, and autosuggestion, as When compared with controls, this method appears to significantly increase the frequency of lucid dreaming, particularly for individuals who have prior experience with lucid dreams; however, it also appears to increase the frequency of lucid dreaming for participants who have never had any prior experience with lucid dreams (Paulsson & Parker, 2006; Stumbrys et al., 2012; Zadra et al., 1992). Regarding the methods

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of external stimulation, Stumbrys and colleagues (2012) point out that certain stimuli, such as a light flashing on the eyes of a dreamer or an electrical impulse applied on the wrist during REM sleep, might be effective for the induction of lucid dreams. Examples of these stimuli include These findings, however, should be regarded with some degree of care, as the authors of the study stress, because the results were published before the examined devices were made available on the market (DreamLight, DreamLink, NovaDreamer, Dreamachine). There hasn't been a lot of study done on the topic of drug application techniques, despite the fact that they appear to be exciting.

As a result, further in-depth investigations are required (Sergio, 1988; Stumbrys et al., 2012). When looking at studies on lucid dream induction in general, one of the most important things that has to be addressed is identifying the legitimate criteria that characterise a successful induction. In sleep laboratory studies, the valid criteria should be unambiguous predefined eye signals in the EOG register during REM sleep. Additionally, a dream report received immediately after awakening following signalling should also be considered, as this would confirm lucidity and volitional eye signals (Stumbrys et al., 2012). It is possible that the timing of the dream report is extremely important in order to prevent cognitive function from being hindered by sleep inertia. Sleep inertia is a transitional stage between sleep and awake in which it has been shown that cognitive performance is impaired (Tassi & Muzet, 2000). Because the estimated time in dream report matches well with the time passed in REM sleep before the awakening, these first-person subjective reports may be believed when it comes to properly expressing the sensations that occur internally during sleep (Windt, 2013). The situation that is described by RBD, in which muscle atonia is interrupted, and the observed motions match the reported dream, is an extremely instructive example of this phenomenon (Nir & Tononi, 2010). In relation to the investigation of the neurobiology of dreaming, the use of trans-cranial direct current stimulation (tDCS) has been suggested. This idea is supported by the rationale that neuroimaging studies can only allow for correlational statements regarding the brain regions that are involved in a particular behaviour (Karim, 2010; Noreika et al., 2010). TDCS makes it possible to do both cathodal stimulation, which hyperpolarizes neurons and reduces the excitability of the cerebral cortex, and anodal stimulation, which increases the excitability of the cortical regions (Nitsche & Paulus, 2000). Therefore, in regard to the prefrontal hypothesis of lucid dreaming (Hobson, 2009a), it may be possible to apply anodal transcranial direct current stimulation (tDCS) during REM sleep in order to activate the DLPFC and test whether or not this external modulation of cortical

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excitability induces lucidity or increases the frequency of lucid dreams on the subject (Noreika et al., 2010). On the other hand, this may also be employed in the opposite direction, that is, by suppressing the DLPFC of experienced lucid dreamers by the application of cathodal stimulation, in order to determine whether or not lucid dreaming would be eliminated or reduced (Noreika et al., 2010). It is probable that these findings will lend causal support to the correlational evidence collected from neuroimaging research, so demonstrating that the DLPFC plays a predominate role in lucid dreaming (Karim, 2010; Noreika et al., 2010). To summarise, researchers appear to have faith in trials that combine subjective accounts with objective measurements such as voluntary eye movements. This strategy appears to be a valid method for gaining insight into the phenomenology of the lucid dreaming brain. Meta-awareness is a subjective experience and an entirely internal percept, but lucid dreams seem to present researchers with a unique opportunity to combine introspection with a third person approach to the study of metaawareness in a state of known physiology, REM sleep dreaming. Meta-awareness is probably one of the most prominent characteristics of human consciousness. Lucid dreams seem to present researchers with a unique opportunity to combine introspection with a third person approach to the study of meta-a (Voss, 2010).

The study of lucid dreaming, which is currently being conducted by scientists, may offer the potential of bringing psychology back to its roots in introspection. This possibility is currently being protected by strong third-person instruments, such as quantitative rating scales, quantitative EEG, and fMRI (Voss, 2010). The next sub-section will discuss some of the most pertinent recent research in cognitive neuroscience that is pertinent for the purposes of this study. Specifically, this research will be important since it was conducted recently.

CONCLUSION

The idea that there seems to be limitations to the scientific method in coming to terms with the felt reality of first-person experience, in the sense of a self endowed with consciousness, is one that emerges out of all of the concepts, empirical experiments, and ideas that have been presented in the past. This is the conclusion that can be drawn from everything that has come before it (Thompson, 2015b). Despite this, the study on lucid dreaming that has been provided throughout this theoretical examination clearly indicates the possibility of practical experiments utilising the same methodology. These experiments, insofar as lucid dreaming is concerned, are constrained by the small number of participants who are accessible and who

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are capable of producing SVLDs while being subjected to a variety of procedures. Working with this phenomena presents a number of challenges, the first and greatest of which is this one. In addition, as is the case with everything else connected to the study and investigation of consciousness, the unavoidable problem is to come up with a theory that, in some way, can account for the phenomena. The main and secondary consciousness hypothesis, which is founded on a naturalistic perspective of human development, is supported by the most recent empirical study into the phenomenon of lucid dreaming. Another factor, which is important in all areas of scientific study, is replication. It is imperative that the most recent results in the realm of lucid dreams be verified through additional research as soon as possible. The LuCid scale is a good illustration of this, since it is now being tested out in modified and condensed forms, as well as in a manner that is extremely adaptable and possibly quite a bit so. The manner in which it was utilised to measure tACS results (Voss et al., 2014), for instance, as to demonstrate clarity in the 40 Hz gamma band, elucidates clearly the necessity for experimental consolidation in this field of study.

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