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Mechanics of Dreaming

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ABSTRACT

This study provides an introduction to the science of dreams. Various neuroscientific processes that create lucid imagery in the human mind are used to explain dreaming. Scientists propose that neurological non-rapid and rapid eye movement cycles aid in sleeping, but these cycles explain little of the dream experience. Thus, scholars propose multiple theories to explain the act of dreaming and the content of dreams, but no universally accepted theory exists. To address this research gap, the merging of neuroscientific and philosophical theories of dreaming has been presented to organize them for the benefit of the literature.

Definitions of Dreaming

Rechtschaffen's Theory: Dreaming to Simulate Alternate Realities

Although dreams can be viewed as universal in the sense that nearly all humans experience them, the theory of Rechtschaffen's was the first to emphasize their solitary nature. According to Rechtschaffen, dreaming entailed a "complete absorption in an alternate reality that is unique to the individual" (Pace-Schott & Picchioni, 2005). Interestingly, however, this absorption generally occurs without conscious awareness: the majority of people do not realize they are dreaming until they wake up. Furthermore, many people recall little, if any, of the content of their dreams. However, Rechtschaffen's theory points out that a rare exception occurs to this lapse in awareness, that is, lucid dreaming.

During lucid dreaming, individuals are aware of the fact that they are in a metacognitive realm. According to Rechtschaffen (Pace-Schott & Picchioni, 2005), this surreal level of self-awareness can enable individuals to learn to control the content of their dreams. In other words, lucid dreamers are capable of simulating novel situations that they may or may not have experienced in real life such as flying, time travel, or teleportation. Instead of shaping a new reality via lucid dreaming, individuals may wake up from a dream with a sense of déjà vu, which occurs when they feel like the experience of their dream is not novel. Instead, they have experienced such events in the past. However, the situation that individuals experience may be different from any lived experiences due to the nature of the fact that they are dreaming. These two unique features of sleep, namely, lucid dreaming and déjà vu, led Rechtschaffen to conclude that the function of dreaming is to "simulate novel realities and to learn to distinguish them from real life" (Rechtschaffen, 1998).

The Freudian Era: Dreams as a Window into the Mind and Preparation for the Future

Similar to Rechtschaffen, Sigmund Freud emphasized the importance of the subjective nature of dreaming. Dreams are unique to individuals; thus, Freud believed dreams can "provide us with information about the dreamer's cognitive state, such as their beliefs, desires, and motivations" in the conscious and unconscious senses (Franklin & Zyphur, 2005). Moreover, Freud posited that dreams may serve an evolutionary function. He believed that dreams could serve as a low-stake arena to process and prepare for future events, because the content of dreams is indistin-

guishable from reality. By enabling individuals to simulate potential threats, dreaming may increase an individual's chances of survival in the future (Franklin & Zyphur, 2005).

Elaborating on the Definition of Dreaming

The conjectures related to the definition of dreams do not end there, however; a few scientists claim that dreaming is composed of three definite aspects, namely, not only cognitive synthesis but also the weave of emotion along with periodic, visual bursts, which merge into one major component of the dream experience (Seligman & Yellen, 1987).

Reasons for Dreaming

Aristotelian Theories

One of the first philosophers to ponder on the reasons why individuals dream was the Greek philosopher Plato, who connected the concept of dreaming to the innate psychological "underpinnings" of the dreamer (Shaw, 2016). According to Plato, the formation of dreams required "harmony" within the person, thus, proposing the argument that to gain "positive dreams" as well, one must nourish oneself with the thoughtfulness of good thinking and joyful "precepts" (Shaw, 2016). He believed that if one acquired good health, then violent dreams (or nightmares) would be avoided by remaining well-nourished and hydrated (Shaw, 2016). The next philosopher is Aristotle, who proposed that dreaming heavily emphasized the analysis of living humans as a compound of matter (Gregoric & Fink, 2022). Aristotle proposed three angular theories as follows.

De somno et vigilia (the state of sleep)

Aristotle explains that sleep belongs to the same soul (Gregoric & Fink, 2022) and is the natural occurrence of a bodily function before one must awaken from slumber. For the reason that sleep is a relevant part of the human body, it is considered to be "perceptual" and, eventually, a "common sense." According to Aristotle, entering a state of common sense and having it incapacitated leads the rest of the senses to function in a passive manner. The heart is considered the most valuable organ, which monitors the pathway between sleeping and waking (Figure 1).

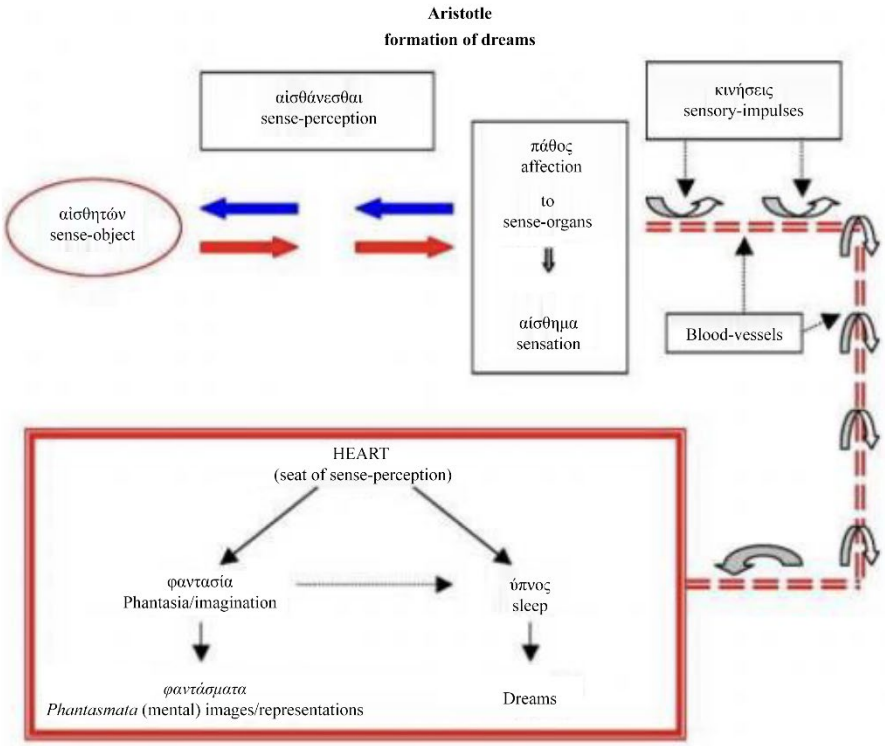

Figure 1. Flow chart of Aristotle's first angular theory of the formation of dreams. The image depicts the pathway in which the cardiac system conveys the process of sleep and dreams and visually depicts the anatomical methodology of the creation of a dream. (Papachristou N.D)

De insomniis (the occurrence of dreams)

Further elaborating on the physiological nature of sleep, Aristotle proposed that the work of dreaming can form from the perceptual angle or the intuitive side of the soul. Moreover, these angles are the only two that individuals cognitively acquire (Gregoric & Fink, 2022). Although Aristotle acknowledges that no conscious perception exists in the mind during asleep, he addresses a parallel concept called phantasmata or the ability or occurrence of vivid images. He emphasizes that the only means through which images or appearances can pave the way into one's mind during slumber is when they precognitively occur before a state of sleep.

De divinatione per somnum (the probability and predictability of dreams)

On the basis of *de insomniis*, Aristotle deduced that the probability of a dream holding any form of religious entrance or upbringing is highly unlikely. In contrast, modern times popularized this unrealistic, fantastical theorem of dreams as a *godly* native implementation in the mind (Gregoric & Fink, 2022). However, Aristotle agreed that a probable exists that dreams align with reality but cited that a physical event must occur to make it true. Aristotle believed that dreams neither a negative manifesto nor a supernatural sequence of events; instead, he argued that if dreams were true, then the intrusive abilities of dreams to influence actions in daily life would be real. The same was considered true of dreams that illustrate predictions of future events. Although these two aspects express dreams, the concept of dreams became much narrower. As a result, the focus was centered on the actions and status of the physiological parts of the body. Aristotle also clarified that no possible methods can enable humans to see future events, such that the angle of predicting events through a dream is highly unusual and formidably redundant. Nevertheless, this notion did not de-amplify that dreams are not worth considering for application to real life. Aristotle encourages this action and even modestly admits that, in fact, dreams possess something remarkably unusual as they are diverse

among human beings. This only continues to be a mystery as more discoveries, which are marked in the literature, are made.

The "Illusion" of Dreaming

Aristotle, who was well known for the three angular theories, became the first philosopher to examine the nature of dreams. As these theories progressed, scientists concluded that dreams, if present in humans and animals, must be an evolutionary advantage. Although raising many questions and debates about his beliefs, these theories were in no line of interest of the great philosopher. In terms of curiosity, Aristotle presented the most number of questions about the manner in which one could cognitively experience such vivid imagery with eyes closed, which contradicts all principles of physiology and visual studies. He and his contemporaries clamored that dreams were merely an "illusion" (Shaw, 2016) and asked why dreams were similar to putting two fingers on the nose and only seeing one (Shaw, 2016). Aristotle concluded that if visual sensory systems were tricked into viewing a false image, then the same must occur in a dream, where reality is confused for metacognition. With this examination, Aristotle proposed that if the physiological state of humans were consciously unaware, then the only conclusion is that humans dream internally.

The Contradictions of Descartes

Rene Descartes primarily focused on whether or not a dream was present in one's mind during slumber. Responding to Aristotle, Descartes explained how he also encountered similar illusions (Shaw, 2016) and how it is nearly frightening when no known indicative activity exists that can be used to differentiate reality from dreams. Although the explorations of Plato and Aristotle remained important in contributing to the knowledge of dreams, these thoughts were now challenged (Shaw, 2016) by the delusions of Descartes. This scenario resulted in the pioneers questioning whether or not dreams were real or another fathomable false concept. Regardless, proposing to hallmark the importance of dreaming was remarkable for early studies. Without these newfound ideas, the idea of dreams would eventually lead to more scientists proposing other theories on this mind-puzzling topic.

Neo-Freudian Perspective

In the 1950s, Neo-Freudians, those who followed the beliefs and psychoanalytic thoughts and discourse of Sigmund Freud, boldly suggested from the psychodynamic perspective that dreaming enables individuals to sort, process, and store in memory accumulated stimuli and information to promote a better adaptation to reality. Earlier studies suggested that dreams functioned "paradoxically" (Siegel, 2011) and dove into the in-depth infidelities of the construction of dreams. Throughout frequent experiments and observations in feline studies (Hess et al., 1953), the "sequencing" of dreams perplexed scientists from the phase of falling asleep to deep sleep. Scientists also questioned the perfect synchronization (Mancia, 2005) of circadian rhythms monitored via electroencephalography. Initially, this concept contradicted the atypical psychoanalytical Freudian perspective. It was considered promiscuous when exemplified within the book of Sigmund Freud entitled *Die Traumdeutung* (Schredl, 2010), which narrates the telltale depiction and art of dreaming and its contextualization of the expression of human life. In the novel, Freud expressed that the interpretation of dreams is "the royal road to knowledge of the unconscious activities of the mind" (*Die Traumdeutung, Freud 1899,* (Schredl, 2010)). Freud lavished on the detailed interconnection that, although skeptically challenging, acknowledging the view of the psychoanalytical perspective on the function of dreaming is undeniably fascinating.

The Current Status of Dream Studies

Rapid Eye Movement Sleep and Neuroprocessing

Although mental processes were partially recovered, further experiments were conducted on the tell-tale behavior of feline animals during rapid eye movement (REM) sleep, which targeted the brain structure. The results indicated that their previously aloof behavior transformed into fear and vigilance due to threat-like appearances that were seemingly invisible to the naked eye (Franklin & Zyphur, 2005). Electrophysical experiments indicated that in certain cases, REM sleep enhances visual activity and, therefore, amplifies the presence of dreams within the mind. However, scientists wonder whether or not mammals or organisms were a matter-of-fact experience and shared the same spatial lucency that one experiences through the unconscious. Although dreaming is considered formed through REM sleep, other extraneous studies demonstrated that dreaming can also occur external to REM, because of the high activity occurring in the brain when asleep. However, this claim led to contradictions toward previous hypotheses (Franklin & Zyphur, 2005). To settle, scientists created theories based on these studies and discovered that frequent flashes of imagery, cognitive activity, and amplified emotional processing occur during Rapid eye movement (REM) and Non-rapid eye movement (NREM) sleep states (Pace-Schott & Picchioni, 2005). The meaning and essence of why humans dream remain to be determined from previously existing theories of dreams. The most likely scenario is that through scientific evidence and early studies from Freud, the process of dreams depicts (Shaw, 2016) neural network systems being rearranged, refreshed, and reorganized. As a result, the unconscious mind delivers and oscillates material to be brought to one's self-awareness and processes new information and experiences with increased precision.

Technology

As science becomes increasingly modern, the questions about dreams and their purposes also increase. In addition, the notion that the function of dreaming could have been determined with the assistance of technical methodology is equally negotiable. Although multiple scientific discoveries point to multiple functions, REM activity (Figure 2) aids other researchers in examining the dreamlike stature that humans and mammals experience (Schredl, 2010). This notion would eventually lead to neuropsychologic approaches that do not align with modern-day interpretations of dream phenology data despite their efforts (Schredl, 2010). Interestingly, the introduction of REM activity influenced dreams to lead to more prophecies and ideas, such that certain discoveries even made the conjecture and proof that a handful of individuals are incapable of dreaming (Franklin & Zyphur, 2005), which led to a wide range of momentum regarding the concept. While others may feel fluttering emotions and dreamscape-like imageries within their unconscious, others may lack any presence of hyperactivity related to REM and do not remember or recall a dream (Hall & Van de Castle, 1966, Spadafora & Hunt, 1990). This notion led to the diversity of dreams and its content, which contradicts the thoughts of the phenomena of lucidity (referenced above). Undoubtedly, a huge, vast differentiation of dream experience exists. However, how and why certain individuals exhibit different symptoms and behaviors after dreams and surreal events remains a mystery. The use of REM activity relatively distinguished these behavioristic traits among the dreamers and provided sufficient explanation. Nevertheless, further insights are required.

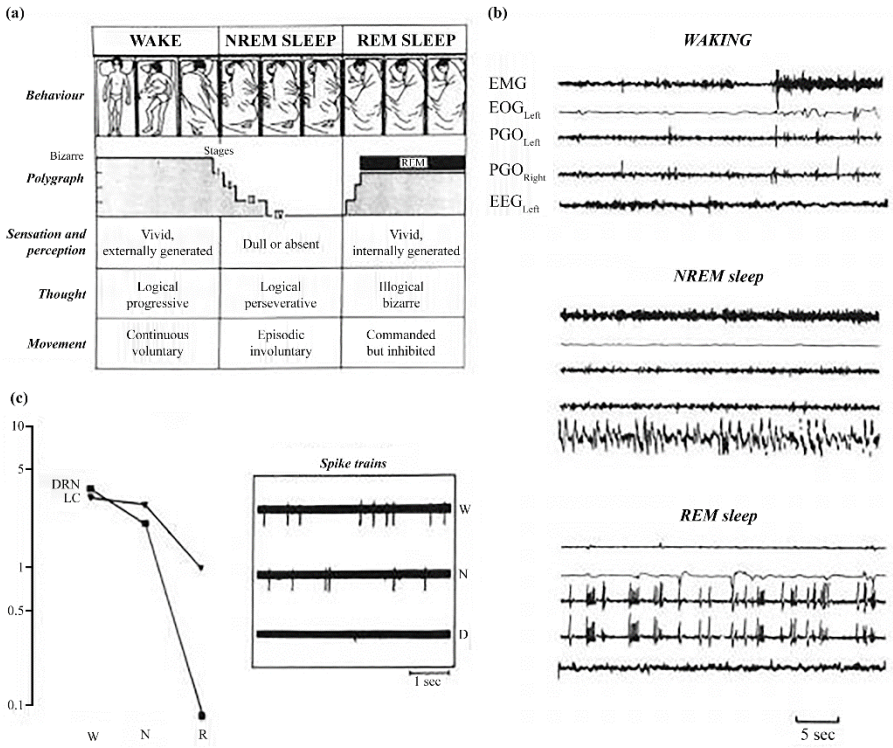

Figure 2. Non-rapid eye movement (NREM) and rapid eye movement (REM) sleep along with behavioral and neuronal changes during sleep. (2a) Differences in posture between waking, NREM, and REM. (2b) Observations illustrate that REM exhibits little to no movement. (2c) NREM features frequent tossing and turning. (Hobson, 1990)

Neurotechnology

The use of many neurotechnological types of equipment such as electroencephalography (EEG), electrooculography (EOG), and electromyography (EMG; Franklin & Zyphur, 2005; Figure 2) well explains the arousal states and physical activities one exhibits during slumber (Franklin & Zyphur, 2005). A study finds that nREM states produce fewer probabilities of dream activities compared with those of REM states (Hobson, 1988). Moreover, patients report that through REM sleep, a high activity of vivacity can occur and correspond to dreams to prewaking and post-waking actions (Sforza et al., 1997; Franklin & Zyphyr, 2005). During this stage, the brain is more active, and the EEG's alpha and beta wave activity mimic the waking stage. There are three characteristics that describe this imitation: (1) the brain is active while in other stages in which the alpha and beta waves graphics monitor this motion, (2) the muscle activity is reduced within the central nervous system to imitate subconscious physioparalysis, and (3) eye movement is present because the muscle activity has zero relevance with the eye muscles (Franklin & Zyphur, 2005). The brain activity is slow yet vivid, and it produces high interest of dreams after one awakens from slumber. The knowledge of nREM sleeping being vastly inactive in comparison to REM sleep can be used to apply to certain neuromal functions that have occurred within the lesions in the brain. Certain neurological errors or maladaptive problems in the brain can impact these traditional imitations (Sforza et al., 1997). Considering this evidence, humans are now able to give cognitive retellings of these dreams because of the neurological effects and physiology of the brain that technology is able to provide.

The Importance of Negative Dreams

Brief Context

Acknowledging nightmares is important. Throughout multiple studies on this troubling phenomenon, a lack of relevance and logical understanding have been noted on not only dreams but also the cause of nightmares. Specifically, the reason for why nightmares occur remains unknown; moreover, the connection between nightmares and the oscillating brain prominently remain obscure (Cheung, 2012). Throughout multiple human experiences, nightmares reflect negative emotions and habits and influences mental processing, which can evidently deteriorate mental processing. To this day, the question continues on the existence of these troubling consequences, which interfere with daily life. As previously explained, scholars examine the expression of nightmares, who inform that they are directly linked to mental disorders such as post-traumatic stress syndrome (Belicki, 1992). As a result, it generated physiological and cognitive responses (Franklin & Zyphur, 2005).

Commonalities and Differences Between Dreams and Nightmares

Other ideas propose and enlighten science with the fact that scientists continue to strongly adhere to the belief that nightmares could be addressed and eliminated through the desensitization of a phobia or an irrational fear. The irrationality of the futility of the imagination of one's mind amplify and become more bewildering to one's understanding, as if dreaming could not get complex enough. Dreaming was already a complex concept which only proved such a trait as science evolved. Moreover, theories are conducted on middlemen, where it could be narrowed down to a series of major dream theories (Chamorro, 2015) and where dreams and nightmares are conjoined into biological epiphenomena and associated with even more theories, such as mood regulation, to further amplify this subject. The same theories suggest that they are products of mechanisms that underlie sleep (Chamorro, 2015). As previously stated, the theory also persuasively expresses the importance of nightmares and acknowledges their maladaptive nature, which references its evolutionary pathway and results in the modern appearance of nightmares as a "rehearsal" of negative, threatening events to prepare oneself for a life or death challenging situation. The theory that scientists probe into scientific inquiry may prove that nightmares, by themselves, may play more than a negative role in one's mind (Chamorro, 2015) and may lead to the remarkable discovery of a positive outcome that continues to baffle scientists.

Freudian Knowledge

Although dreams are heavily emphasized as a mental reflection of the human mind, acknowledgment is important that nightmare, which is an antagonistic, malevolent form of the normal human unconsciousness, may amplify into a role that dates back to a primitive survivorship skill. In connection to imaginative contextualization and according to Freudian knowledge, scholars state that the execution of perception within physiology does not interfere with the stimuli that influence and activate the oscillation pathways in the brain to configure a nightmare. This effect leaves many people with the lingering feeling and confusion of whether or not dreams are a real concept. In this manner, a person is disoriented from determining the difference between reality and a figment of one's unconscious, which is a terrifying experience. The physical effects consist of an elevated heartbeat with increased levels of fear and fight or flight sequences occurring in the amygdala (Mellman et al., 1995) (see Figure 3)

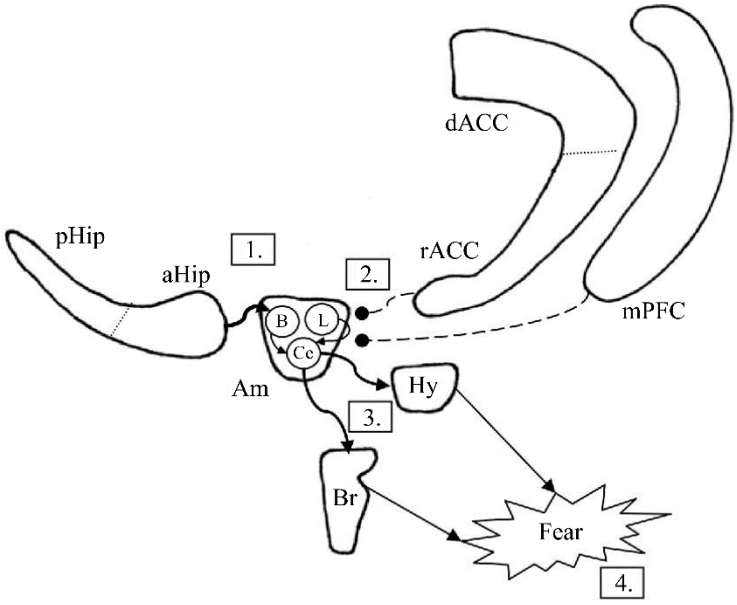

Figure 3. Neuronetwork model representative of Freudian theories on nightmares. The image depicts an amygdala and proposes the likely regions and types of areas in which dreaming ceases and begins to produce maladaptive dreams. (1) Relayed within the hippocampus to the basal nucleus (B) and modeled the nucleus of the amygdala in center (Ce). (2) Medial prefrontal cortex and the dorsal and rostral anterior cingulate cortices (dACC, rACC), which regulate the amygdala for the production of neurons in the nucleus and exhibit fear and signaling to indicate distress. (3) The amygdalian nucleus signals the limbic system to produce levels of fear when amplified; exemplified in the autonomic nervous system. (4) Autonomical relationship with behaviors as result of nightmare. Red denotes active signals, and green represent an inhibitor (Levin & Nielsen, 2007).

Evolutionary Advantages

With reference to the REM mode of sleep, previous studies exemplified the function of nightmare among marsupials (Franklin & Zyphur, 2005). Form the evolutionary perspective, the activation of certain episodic events within nightmares to trigger certain negative feedback may enhance the survival of a species. The reason is that it could acquire better fitness. From the stimulation of certain brain areas, the commands of synapses will enable the mind to perceive certain things as not only real but also sufficiently realistic in which the brain amplifies this response through the nervous system and enables an individual to address with certain challenges within an environment that benefits the survival of a species.

Revonsuo's Theory

Surprisingly, the theory of Revonsuo aligns with evolutionary theory, but it is more of a torturous debate of whether or not one should consider an antagonistic dream or a nightmare as good, or bad. In other words, it is an all-or-nothing game. Revonsuo's theory dictates that nightmares are a "prototype dream," which is a vague title, but opens to more questions and, perhaps, helpful information. By itself, the theory also explains that emphasizing its importance, whether negative or positive, results in stronger, empirical data that could be used to further not rid and to understand this metacognitive phenomenon (Levin & Nielsen, 2007). With this data and collection of events, the necessity relies into the simulation of various experiences to be encoded and replayed in one's mind for the maintenance of evolutionary survival. A multitude of various dreams has been collected that has valiantly proven that

dream production mechanisms do impact the conscious mind during the midst of trouble and supports Revonsuo's theory on dream mechanics and their relationship to human survival. These dreams are ordinary events shared almost daily, such as children's dreams, recurrent dreams, nightmares, post-traumatic dreams, and the dreams of hunter-gatherers (Revonsuo, 2000).

Revonsuo's Theory (Part Two) and its Connection to Survival Theory by Charles Darwin

In the year 2000, Revonsuo proposed that threat simulation theory (Franklin & Zyphur, 2005) posits that the objective of not only nightmares but also dreams present a difficult meaning, that is, serving the unconscious mind with relays of events to prepare individuals for potential life events. This notion predicts and proves that dreaming has not only evolved (Revonsuo, 2000) but has sufficiently amplified for the continuation of the human species to enhance their capabilities for future events. Overlooked and uncategorized, the role of nightmare and its function executes an evolutionary advantage. Scholars mainly deduce that nightmares express a strong role in preparing the individual for dangerous events that are unlikely but possible. In a certain way, the surrealistic, hallucinogenic environment of the unconscious may provide an ironically large advantage in dangerous events, because it is a nightmare that which users acknowledge, enhancing humans even more chronologically.

Conclusion

From early philosophers, such as Aristotle and Plato, to the modern-day propositions by Revonsuo and many other scientists, the concept of dreaming is worth acknowledging and considering for the future of neuroscience. Lucid, diverse images illustrated within the universally shared concept of slumber can help enhance the understanding of how dreams, whether negative or positive, deserve to be elucidated and examined for further knowledge. Through the work of neurotechnology and the help of previously existing theories, studies, and analyses, humans seemingly obtained a better understanding of the surrealistic phenomenon that we not only share as a species but are connected through unity. The extraordinary momentum that one experiences, which reflects a thought or meaning lacking of certainty, remains to be discovered. However, knowledge about why such an innate experience occurs remains scarce. We suggest that keeping a worthy journey is best.

Limitations

The studies and ideas proposed above are only mere examinations that have been proven significant throughout the history of dream phenomenology. Primarily, the information gathered by scientists are susceptible to change, since majority of these sources are from decades ago. These studies, however, can be elaborated through further research by more exemplifications of dream causes which will hopefully be brought into consideration as science experiments progress in the near future. We will never know the true theoretical, direct sources of Greek philosophical responses to dreams, as they have been outdated in time. This is also accountable on behalf of the studies we currently have, but we are yet to understand the complete meaning. Perhaps, with time, scientists will become more wary of the significance of dreams and develop further studies, as the topic of dreaming is urged to be talked about.

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