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EDITORIAL

Sleep dreaming: the neuroscientific mapping of brain networks

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ABSTRACT

Current concepts in neurosciences view the generation of dreams during sleep as being the result of memory formation in a conscious state. Dreams are the interpretation of feelings and emotions that one encounters when awake. The increased neural activity lights up certain parts of the brain which work similar to the conscious state, hence the dreamer feels it real. Healthy people are able to tell the difference between real world and dreams, but psychotic patients have a stronger control over the neural networking of their brain, hence cannot come out of the dream state when awake.

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INTRODUCTION

Dreaming is the other name of altered state of consciousness related to mind activity during sleep. Dreams are organized in a form of story which is generated by sensory, perceptual and emotional life experiences. Dreams depict the mental state of the person.[1]

The neuroscience behind the formation of dreams is as early as the concept of Rapid Eye Movement (REM), which was discovered by Eugene Askerinsky (a research student) and Nathaniel Kleitman (his dissertation supervisor) at the University of Chicago back in 1995.[2] The body shows similar breathing rate, heart rate, and blood pressure as of an awake person but the muscles are frozen in REM sleep. This phenomenon is characterized by slowing of brain waves.[3]

Sleep decodes the activity of neural connections that make memory, whereas memory encoding is done during the waking period. Some dreams are remembered while rest are forgotten. The neuroimaging has proven the role of amygdala that aids in recalling the dreams that are associated with intense emotional response.[4] Researchers also found that low theta waves in frontal lobes of the brain indicated that a dreamer would remember the dream.[5]

The pathological increase of REM sleep which occurs due to depression or anxiety results in negative memories, thus occurrence of bad dreams and nightmares. Therefore, the intake of antidepressants decreases REM sleep which supports more smooth sleep, hence positive mood and happy dreams.[6] Dreams show similarities with psychosis as both share common characteristics especially in case of schizophrenia. The inaccurate beliefs about reality or distorted sensory perceptions is only internally generated and has no obvious external source. Both the dreamers and psychotics are unable to distinguish the occurrence of events inside one's mind from the outside world. The only difference is that psychotic patients are in much better control of internal stimuli compared to healthy dreamers, so that they cannot eradicate the dream memories when awake and continue to act out their dream roles in real life.[7,8]

The neural activity of brain accounts for dreaming which is not connected to external sources.[9] Several brain areas are responsible for various types of dreams characterized by different neural connections. The **vivid-visual dreams** are often generated by strong metabolic activity in occipital temporal visual areas. The **motor content** of dreams is held by hyperactivity of premotor cortices and the cerebellum of the brain.[10] The **intriguing emotional dreams** are controlled by the increased activity of pontine tegmentum, the thalamus, and the basal forebrain.[11] The **hyperactivity** during dreaming is also controlled by increased neural activity seen in medial prefrontal cortex, posterior cingulate cortex, and the medial temporal lobe region. The ignited network of all these brain regions are responsible for dreaming and mind wandering during sleep.[12] However some of the brain areas are involved in **hypoactivity** of the brain which deactivates dorsolateral prefrontal cortex, inferior parietal cortex, and the precuneus. This leads to impaired cognition during dreaming and may also contribute to dream amnesia.[13]

During sleep dreaming, the dreamer has a perception of being awake. This delusion is due to constant inactivation of parietal and frontal circuits responsible for wakeful memory and awareness. The feeling of consciousness during sleep is due to localized activity of parieto-occipital region.[14] Some dream experiences are similar to real wakeful experiences because the same neural activity pattern is observed during dreaming and wakefulness. For example, hand movements during dreaming activates same areas of motor cortex which are also active when executing hand movements in wakefulness.[15]

Future developments in neurosciences are likely to target molecular neurogenetics, to better understand the dream state and provide possible cures for psychoses.

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