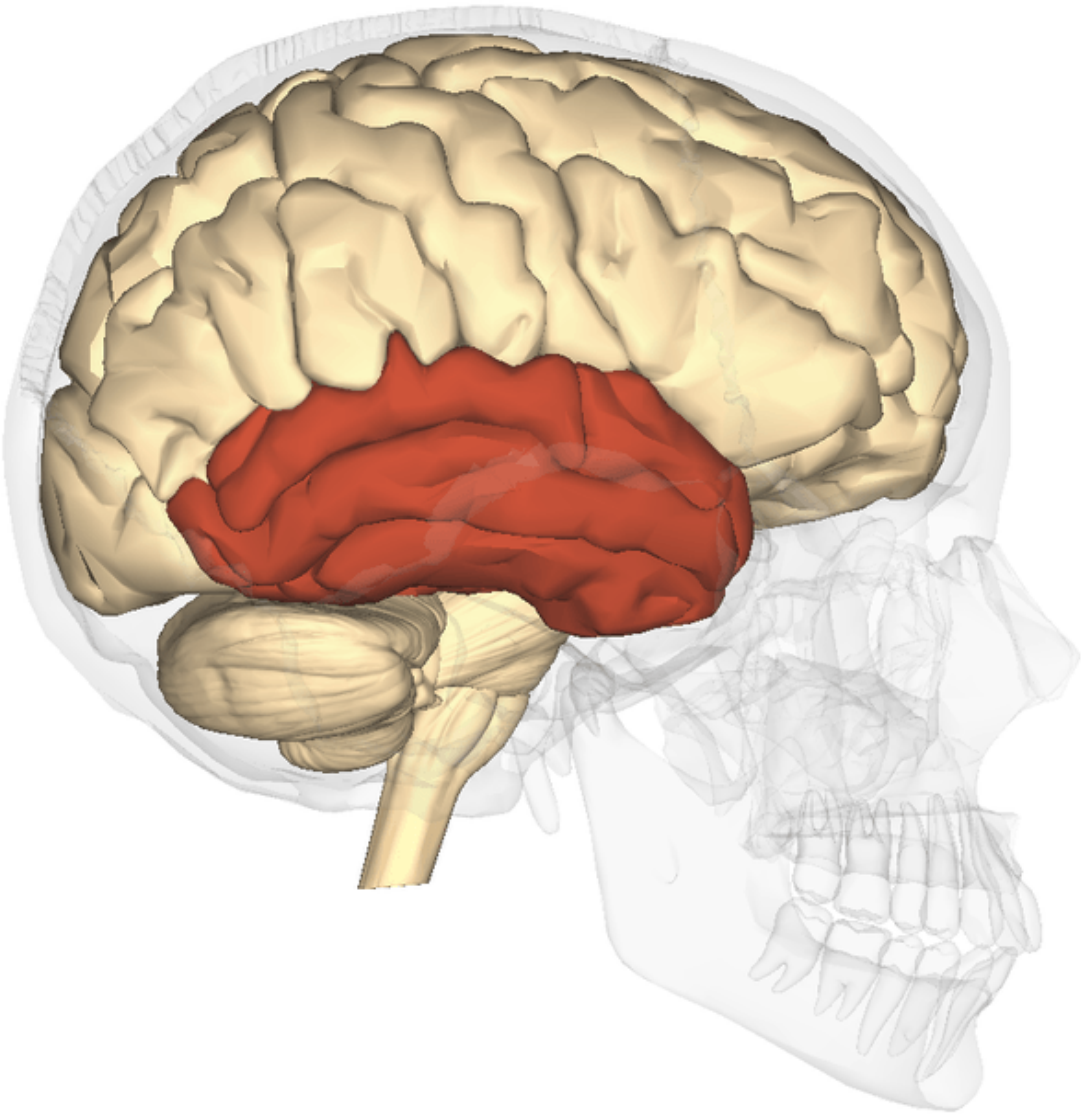
Medical Xpress

Forget Freud, research on dream imagery may help us understand consciousness

August 13 2015, by Uma Shahani



Temporal lobe lateral view. Credit: BodyParts3D/Anatomography via wikimedia, CC BY-SA

Rapid eye movements (REMs) during sleep may contribute to the visual part of our dreams by acting as a switch from image to image, researchers have found. The study, which measured the activity of individual cells in the brain in both awake and sleeping participants, is important because it is the first of its kind and provides a great starting point for uncovering the deeper secrets of human consciousness.

Consciousness can roughly be summed up as our awareness of the environment and our ability to respond to it. However, Sigmund Freud and his followers have described dreams as deep-seated, unconscious psychic desires. Today, many instead see them as an interpretation of images of the environment stored in certain parts of the brain. These images are thought to be projected onto the visual cortex so we can "see them" in our dreams.

Physiologists and experimental psychologists refer to mental images of 3D scenes as "visuospatial imagery", which is similar to what we see when we dream. In humans, we know that direct stimulation of certain areas in the brain in epileptic patients induces dream-like images. However, combining the interpretations of dreams according to Freud with the physiological basis of dreaming into a single study is a challenging task.

The new study is based on measurement from electrodes implanted in the brains of humans for the first time, giving firsthand information about how single neurons behave in dreaming humans.

REMs happen when we are completely awake as well as when we are

sleeping. The aim of the study was to compare the two in human participants to establish whether the brain activity when we sleep is similar to when we are awake. The particular brain region the researchers looked at was the medial temporal lobe – a region linked to areas that process visual awareness.

The team recorded sleep and wakefulness cycles in 19 volunteering patients with a type of epilepsy that cannot be controlled with medication. Such patients therefore have electrodes implanted in the brain that can record information so as to delineate the area responsible for the starting of epileptic seizures in order for that area to eventually be taken out surgically.

The researchers used these electrodes to record REM sleep. To look at how the brain processes visual information, they monitored REM when the patients were awake – either when they were watching a DVD or interacting with people in a well-lit room. They also monitored the participants when they were awake in a dark room – meaning they did not process any visual information. As a control in which eye movements were suppressed, participants were asked to fixate on images for a short period of time.

They found that the neurons increased their firing rate in a similar way after REM sleep as they did when the participants were awake and processing visual information. There was less of a similarity, however, when the patients were in the dark. This indicates that REM during sleep or wakefulness is closely linked to the processing of visual information.

The finding could potentially mean that REMs are important units of integration that tie sleep and wakefulness – and therefore consciousness – together. Given that activity in the medial temporal lobe is closely linked with visual awareness, these results may indicate that REM during sleep could be a reflection of a switch from image to image in dreams.

The findings might lead to research that combines neural, vascular and behavioural insights that help us understand human consciousness.

Neurons require energy and oxygen to function and this is brought to them by blood. Vascular data can be recorded using a type of brain-imaging technique known as functional near infrared spectroscopy which can provide an index of brain oxygenation during REM neurovascular coupling – the relationship between local neural activity and changes in cerebral blood flow that occur as a result of it.

We can combine neurovascular data during REM with behavioural data that are obtained by measuring how the brain selectively blocks visual processing during eye movements to avoid blurry images on the retina. These blurred images are useless, which is why we don't actually see them but instead see individual frames sharply. Of course we don't notice this because we also have the gift of accommodation (changing the shape of our lens when we look close up or far away) for most of our lives. But when we hit middle age, however, that response disappears and we can become aware of this effect.

By combining electrical and vascular recordings from neurons during REM sleep, we may be able to figure out whether the same effect takes place when we dream. Will the neurons that are briefly inactive use less oxygen? It is this intricate relationship between the different types of data that we need to couple with psychology in order to shed more light on REM, dreams and the brain's ability to internalise the outside environment and visual space.

Source: The Conversation