

In Christopher Nolan’s film *Inception*, a movie that does to dreaming what *The Matrix* did for virtual reality, you may have been holding your breath as Ariadne, an architecture student, folded the streets of Paris over herself like a blanket. This stunning sequence, an homage to M. C. Escher, is testimony to the bizarre nature of dreams. Watching it made the neuroscientist in me reflect on what dreams are and how they relate to the brain.

The first question is easy to answer. Dreams are vivid, sensorimotor hallucinations with a narrative structure. We experience them consciously—seeing, hearing and touching within environments that appear completely real (though curiously, we do not smell in our dreams). Nor are we mere passive observers: we speak, fight, love and run.

Dream consciousness is not the same as wakfulness. We are for the most part unable to introspect—to wonder about our own uncanny ability to fly or to meet somebody long dead. Only rarely do we control our dreams; rather things happen, and we go along for the ride.

Everyone dreams, including dogs, cats and other mammals. But sleep lab data reveal that people consistently underreport how often and how much. The reason is that dreams are ephemeral. Memory for dreams is very limited and largely restricted to the period before awakening. The only way to remember a dream is to immediately recall it on waking and then write it down or describe it to another person. Only then does its content become encoded in memory.

Although we often have trouble remembering dreams, our dreaming selves have full access to our pasts. In dreams we recall earlier episodes from our lives, and we often experience intense feelings of sadness, fear, anxiety or joy. Perhaps it was this heightened emotionality that led Sigmund Freud to speculate that dreams are wish fulfillment. Regardless, the answer to my second question—how and why does the brain manufacture dreams?—remains a fundamental mystery. But psychologists and brain scientists have recently renewed their interest in this everyday surreal activity.

**Perchance to Dream**

In 1953 Nathaniel Kleitman of the University of Chicago and his graduate student Eugene Aserinsky discovered that slumber, which had been considered a single continuous period of down time, contains recurring periods in which the sleeper’s eyes move about, heartbeat and breathing become irregular, voluntary muscles are paralysed and brain activity (as measured by electrocorticography) is heightened. These fast, low-voltage brain waves resemble the ones that occur during wakefulness. This state became known as rapid eye movement (REM) sleep, to distinguish it from deep sleep.

When people are woken from REM sleep, they usually report vivid dreams. Such reports do not occur when people are rounded from non-REM sleep. Thus arose the close association between REM sleep and the oniric state. For many years experts associated dream consciousness with the distinct physiology of the brain during REM sleep. But in the past several decades that understanding has begun to slowly shift. When people who are woken from deep sleep are asked “What was passing through your mind just before you woke up?” rather than the more biased “Have you been dreaming?” a more nuance picture emerges.

In the early phases of deep sleep, and during the sleep stage naps, which consist of pure non-REM sleep, people report vivid hallucinations that are shorter, more static and more thoughtlike than the dreams that occur during REM sleep. These visions are typically more like snapshots than narratives and do not include a self. Yet a minority of these non-REM dream reports are indistinguishable from REM dreams.

It is also notable that sleep-walking and nightmares occur in deep, not REM, sleep. Thus scientists have had to revise the belief that the REM state is an external manifestation of the subjective dream state.

Further evidence comes from the study of stroke-damaged patients who have a retrograde amnesia; for example, people with memory deficiences do not report fewer dreams. Additionally, the length of dream reports correlates well with time elapsed in REM dreams. And more evidence comes from people with a pathology known as REM sleep behavior disorder, who lack the muscle paralysis (known as atonia) that is a hallmark of REM sleep. They act out their dreams, on occasion, causing damage to themselves or their bed partners.

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Dreams are of great interest to the student of the mind-body problem, because they bear witness that the brain alone is sufficient to generate consciousness. We dream with eyes that in the dark, disconnected from the outside world. The brain regions responsible for basic sensory perception are deactivated. Nor is behavior necessary, so we are motionless except for our breathing and eye movements. Thus, dreams support the old philosophical brain-in-the-vat idea that saw its modern renaissance in *The Matrix*.

Cognitive neuroscientists have recently learned to decode some simple mental states—in essence, a primitive form of mind reading. When scientists ask people to view one of two images—a portrait or a photograph of a horse—or to imagine either a face or a house, they can tell from brain analyses which of the two the person is seeing or imagining.

Once such techniques become more sophisticated, we can decode the content of dreams, perhaps even their meaning. Why am I so confident that I experience anything while dreaming? Maybe I am really unconscious while slumbering and merely confabulate my dreams when I wake up.

This is unlikely for many reasons. The bizarreness and vividness of dreams is distinct from normal experience and insouciance. Notice, for example, some people who have had a psychotic episode do not report fewer dreams. Additionally, the length of dream reports correlates well with time elapsed in REM dreams.

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**The Mind-Body Problem**

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**Further Reading**