BOOKS *et al.*

The bizarre and rambling nature of dreams may be key to their role in memory processing.

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NEUROSCIENCE

Dream interpretation meets modern science

Nighttime narratives could be critical to consolidating memories, argue two sleep researchers

By **Michelle Frazer**[1] *and* **Gina Poe**[2,3]

In *When Brains Dream*, sleep scientists Antonio Zadra and Robert Stickgold detail the latest research that seeks to understand what occurs in our brains when we dream, and they present theories about what purposes dreaming may serve. The book takes the reader from humanity's early religious understanding of dreams, through our initial attempts to study the psychology of dreaming, to current experiments on the neurophysiology of the sleeping brain, providing relatable and often humorous anecdotal evidence from the authors' own lives and work along the way.

Humans have contemplated the purpose of dreams throughout recorded history. Ancient texts including the Sumerian *Iškar Zaqīqu* and Artemidorus's *Oneirocritica* reveal a prevalent belief that dreams convey important and often supernatural messages, necessitating skilled interpretation. Even Aristotle weighed in on the nature and use of dreams, although he concluded that they were likely just the result of our organs shifting during sleep.

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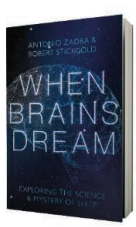
As the world became more secularized in the 19th century, psychologists began to focus on applying their efforts to understanding the sleeping brain. Early research explored the link between waking experiences and dream content, examined the abstract nature of symbols in dreams, and even began applying statistical principles to quantify data gathered in dream journals. By the time Freud published his seminal treatise on dreams in 1899, lesser-known scientists had already gathered evidence that remains remarkably relevant to sleep research today, including the observation that vivid dreams occur most frequently during early morning sleep and that physiological changes occur as sleep progresses.



When Brains Dream
Antonio Zadra and Robert Stickgold
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Since the discovery of rapid eye movement (REM) sleep in 1950, however, most studies have approached sleep from a biological perspective. We now know that sleep appears to play a crucial role in clearing waste from the brain, that it regulates hormone levels, and that it helps boost the immune system. There is also a large body of evidence linking sleep to learning and memory.

But are dreams necessary to these functions? Or are they a meaningless consequence of random neural firing? In the latter half of the book, the authors present the ambitious theory that dreams themselves, not just the dream sleep state, play a critical role in the consolidation of memories—a theory they refer to as network exploration to understand possibilities (NEXTUP).

On the surface, the idea that the infrequently remembered and often bizarre narratives we construct during sleep could contribute to memory consolidation seems unlikely. But Zadra and Stickgold argue that the disjointed nature of dreams is actually key to their role in memory processing. They maintain that dreams, rather than merely repeating the events of the day to cement them into long-term storage, allow our brains to freely explore memories that have been filed away over time, extracting information and developing a narrative based on associations.

According to the NEXTUP theory, dreams primarily feature weakly associated themes and memories, an idea supported by previous work in the Stickgold lab, which found that weakly associated word pairs are preferentially activated during REM sleep (*1*). Coactivation of weakly associated items could underlie the strange and often unexpected twists that unfold during dreaming.

But why do dreams take on a narrative structure at all? The authors suggest that the narrative allows the dreamer to explore and evaluate possible scenarios, providing a mechanism by which a verdict can be rendered. Dreams that elicit strong emotions, they argue, may cue the brain about the association's potential utility, which may in turn lead to a strengthening of that association.

The NEXTUP theory appears to be supported by animal studies. Rats trained on a maze later appear to dream about maze routes they had never taken (*2*). REM sleep also appears to be a crucial time for zebra finches to "write" their songs (*3*). The brain is highly plastic during REM sleep, allowing the erasure of erroneous and weak connections as well as the establishment of new ones (*4*). These lines of evidence suggest that dreams may allow the brain to explore potential results that would be dangerous or not possible during wakefulness. ■

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