

Module 24

Sleep Deprivation, Sleep Disorders, and Dreams

Module Learning Objectives

- 24-1** Describe the effects of sleep loss, and identify the major sleep disorders.
- 24-2** Describe the most common content of dreams.
- 24-3** Identify proposed explanations for why we dream.



Sleep Deprivation and Sleep Disorders

- 24-1** How does sleep loss affect us, and what are the major sleep disorders?

When our body yearns for sleep but does not get it, we begin to feel terrible. Trying to stay awake, we will eventually lose. It's easy to spot students who have stayed up late to study for a test or finish a term paper: They are often fighting the "nods" (their heads bobbing downward in seconds-long "microsleeps") as they fight to stay awake.

In the tiredness battle, sleep always wins. In 1989, Michael Doucette was named America's Safest Driving Teen. In 1990, while driving home from college, he fell asleep at the wheel and collided with an oncoming car, killing both himself and the other driver. Michael's driving instructor later acknowledged never having mentioned sleep deprivation and drowsy driving (Dement, 1999).

Effects of Sleep Loss

Today, more than ever, our sleep patterns leave us not only sleepy but drained of energy and feelings of well-being. After a succession of 5-hour nights, we accumulate a sleep debt that need not be entirely repaid but cannot be satisfied by one long sleep. "The brain keeps an accurate count of sleep debt for at least two weeks," reported sleep researcher William Dement (1999, p. 64).

Obviously, then, we need sleep. Sleep commands roughly one-third of our lives—some 25 years, on average. But why?

Allowed to sleep unhindered, most adults will sleep at least 9 hours a night (Coren, 1996). With that much sleep, we awake refreshed, sustain better moods, and perform more efficient and accurate work. The U.S. Navy and the National Institutes of Health have demonstrated the benefits of unrestricted sleep in experiments in which volunteers spent 14 hours daily in bed for at least a week. For the first few days, the volunteers averaged 12 hours of sleep a day or more, apparently paying off a sleep debt that averaged 25 to 30 hours.

That accomplished, they then settled back to 7.5 to 9 hours nightly and felt energized and happier (Dement, 1999). In one Gallup survey (Mason, 2005), 63 percent of adults who reported getting the sleep they needed also reported being "very satisfied" with their personal life (as did only 36 percent of those needing more sleep). And when 909 working women reported on their daily moods, the researchers were struck by what mattered little (such as money, so long as the person was not battling poverty), and what mattered a lot: less time pressure at work and a good night's sleep (Kahneman et al., 2004). Perhaps it's not surprising, then, that when asked if they had felt well rested on the previous day, 3 in 10 Americans said they had not (Pelham, 2010).

College and university students are especially sleep deprived; 69 percent in one national survey reported "feeling tired" or "having little energy" on several or more days in the last two weeks (AP, 2009). In another survey, 28 percent of high school students acknowledged falling asleep in class at least once a week (Sleep Foundation, 2006). The going needn't get boring before students start snoring. (To test whether you are one of the many sleep-deprived students, see **TABLE 24.1**.)

Sleep loss is a predictor of depression. Researchers who studied 15,500 young people, 12 to 18 years old, found that those who slept 5 or fewer hours a night had a 71 percent higher risk of depression than their peers who slept 8 hours or more (Gangwisch et al., 2010). This link does not appear to reflect sleep difficulties caused by depression. When children and youth are followed through time, sleep loss predicts depression rather than



Sleepless and suffering These fatigued, sleep-deprived earthquake rescue workers in China may experience a depressed immune system, impaired concentration, and greater vulnerability to accidents.

FYI

In a 2001 Gallup poll, 61 percent of men, but only 47 percent of women, said they got enough sleep.

Table 24.1

Cornell University psychologist James Maas has reported that most students suffer the consequences of sleeping less than they should. To see if you are in that group, answer the following true-false questions:

True	False	
<input type="checkbox"/>	<input type="checkbox"/>	1. I need an alarm clock in order to wake up at the appropriate time.
<input type="checkbox"/>	<input type="checkbox"/>	2. It's a struggle for me to get out of bed in the morning.
<input type="checkbox"/>	<input type="checkbox"/>	3. Weekday mornings I hit snooze several times to get more sleep.
<input type="checkbox"/>	<input type="checkbox"/>	4. I feel tired, irritable, and stressed out during the week.
<input type="checkbox"/>	<input type="checkbox"/>	5. I have trouble concentrating and remembering.
<input type="checkbox"/>	<input type="checkbox"/>	6. I feel slow with critical thinking, problem solving, and being creative.
<input type="checkbox"/>	<input type="checkbox"/>	7. I often fall asleep watching TV.
<input type="checkbox"/>	<input type="checkbox"/>	8. I often fall asleep in boring meetings or lectures or in warm rooms.
<input type="checkbox"/>	<input type="checkbox"/>	9. I often fall asleep after heavy meals.
<input type="checkbox"/>	<input type="checkbox"/>	10. I often fall asleep while relaxing after dinner.
<input type="checkbox"/>	<input type="checkbox"/>	11. I often fall asleep within five minutes of getting into bed.
<input type="checkbox"/>	<input type="checkbox"/>	12. I often feel drowsy while driving.
<input type="checkbox"/>	<input type="checkbox"/>	13. I often sleep extra hours on weekend mornings.
<input type="checkbox"/>	<input type="checkbox"/>	14. I often need a nap to get through the day.
<input type="checkbox"/>	<input type="checkbox"/>	15. I have dark circles around my eyes.

If you answered "true" to three or more items, you probably are not getting enough sleep. To determine your sleep needs, Maas recommends that you "go to bed 15 minutes earlier than usual every night for the next week—and continue this practice by adding 15 more minutes each week—until you wake without an alarm clock and feel alert all day." (Sleep Quiz reprinted with permission from James B. Maas, "Sleep to Win!" (Bloomington, IN: AuthorHouse, 2013).)

vice versa (Gregory et al., 2009). Moreover, REM sleep's processing of emotional experiences helps protect against depression (Walker & van der Helm, 2009). After a good night's sleep, we often do feel better the next day. And that may help to explain why parentally enforced bedtimes predict less depression, and why pushing back school start time leads to improved adolescent sleep, alertness, and mood (Gregory et al., 2009; Owens et al., 2010).

Even when awake, students often function below their peak. And they know it: Four in five teens and three in five 18- to 29-year-olds wish they could get more sleep on weekdays (Mason, 2003, 2005). Yet that teen who staggers glumly out of bed in response to an unwelcome alarm, yawns through morning classes, and feels half-depressed much of the day may be energized at 11:00 P.M. and mindless of the next day's looming sleepiness (Carskadon, 2002). "Sleep deprivation has consequences—difficulty studying, diminished productivity, tendency to make mistakes, irritability, fatigue," noted Dement (1999, p. 231). A large sleep debt "makes you stupid."

It can also make you fatter. Sleep deprivation increases *ghrelin*, a hunger-arousing hormone, and decreases its hunger-suppressing partner, *leptin* (more on these in Module 38). It also increases cortisol, a stress hormone that stimulates the body to make fat. Sure enough, children and adults who sleep less than normal are fatter than those who sleep more (Chen et al., 2008; Knutson et al., 2007; Schoenborn & Adams, 2008). And experimental sleep deprivation of adults increases appetite and eating (Nixon et al., 2008; Patel et al., 2006; Spiegel et al., 2004; Van Cauter et al., 2007). This may help explain the common weight gain among sleep-deprived students (although a review of 11 studies reveals that the mythical college student's "freshman 15" is, on average, closer to a "first-year 4" [Hull et al., 2007]).

In addition to making us more vulnerable to obesity, sleep deprivation can suppress immune cells that fight off viral infections and cancer (Motivala & Irwin, 2007). One experiment exposed volunteers to a cold virus. Those who had been averaging less than 7 hours sleep a night were 3 times more likely to develop a cold than were those sleeping 8 or more hours a night (Cohen et al., 2009). Sleep's protective effect may help explain why people who sleep 7 to 8 hours a night tend to outlive those who are chronically sleep deprived, and why older adults who have no difficulty falling or staying asleep tend to live longer than their sleep-deprived agemates (Dement, 1999; Dew et al., 2003). When infections do set in, we typically sleep more, boosting our immune cells.

Sleep deprivation slows reactions and increases errors on visual attention tasks similar to those involved in screening airport baggage, performing surgery, and reading X-rays (Lim & Dinges, 2010). Similarly, the result can be devastating for driving, piloting, and equipment operating. Driver fatigue has contributed to an estimated 20 percent of American traffic accidents (Brody, 2002) and to some 30 percent of Australian highway deaths (Maas, 1999). One two-year study examined the driving accident rates of more than 20,000 Virginia 16- to 18-year-olds in two major cities. In one city, the high schools started 75 to 80 minutes later than in the other. The late starters had about 25 percent fewer crashes (Vorona et al., 2011). Consider, too, the timing of four industrial disasters—the 1989 *Exxon Valdez* tanker hitting rocks and spilling millions of gallons of oil on the shores of Alaska; Union Carbide's 1984 release of toxic gas that killed thousands in Bhopal, India; and the 1979 Three Mile Island and 1986 Chernobyl nuclear accidents. All occurred after midnight, when operators in charge were likely to be drowsiest and unresponsive to signals requiring an alert response. Likewise, the 2013 Asiana Airlines crash landing at San Francisco Airport happened at 3:30 A.M. Korea time, after a 10-hour flight from Seoul. When sleepy frontal lobes confront an unexpected situation, misfortune often results.

Stanley Coren capitalized on what is, for many North Americans, a semi-annual sleep-manipulation experiment—the "spring forward" to "daylight savings" time and "fall backward" to "standard" time. Searching millions of records, Coren found that in both Canada and the United States, accidents increased immediately after the time change that shortens sleep (FIGURE 24.1).

AP® Exam Tip

Many students try to get by on less and less sleep to try to fit everything in. The irony is that if you stay up too late studying, it can be counterproductive. Sleep deprivation makes it difficult to concentrate and increases the likelihood you will make silly mistakes on tests. The impact on your immune system means you are more likely to get sick. To be the best student you can be, make sleep a priority.

"So shut your eyes
Kiss me goodbye
And sleep
Just sleep."
—SONG BY MY CHEMICAL ROMANCE

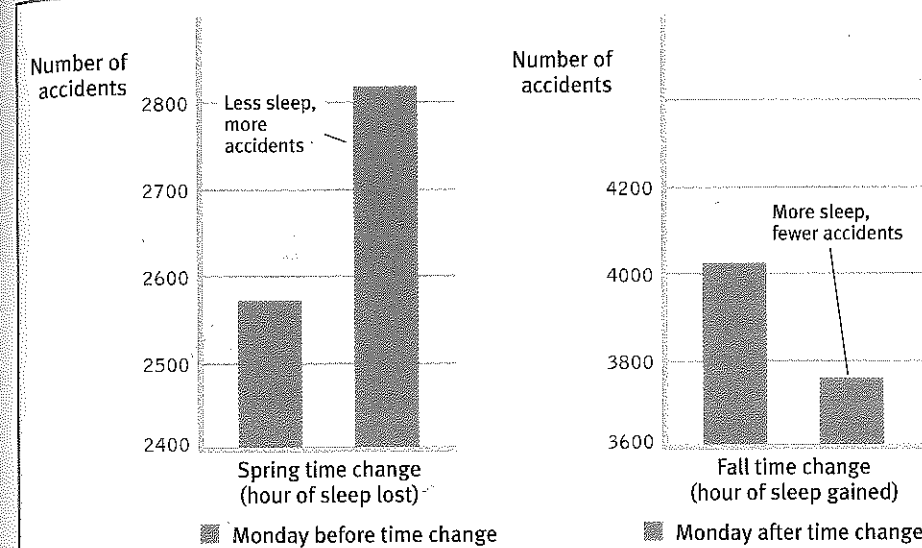


Figure 24.1

Canadian traffic accidents On the Monday after the spring time change, when people lose one hour of sleep, accidents increased, as compared with the Monday before. In the fall, traffic accidents normally increase because of greater snow, ice, and darkness, but they diminished after the time change. (Adapted from Coren, 1996.)

FIGURE 24.2 summarizes the effects of sleep deprivation. But there is good news! Psychologists have discovered a treatment that strengthens memory, increases concentration, boosts mood, moderates hunger and obesity, fortifies the disease-fighting immune system, and lessens the risk of fatal accidents. Even better news: The treatment feels good, it can be self-administered, the supplies are limitless, and it's available free! If you are a typical high school student, often going to bed near midnight and dragged out of bed six or seven hours later by the dreaded alarm, the treatment is simple: Each night just add 15 minutes to your sleep. Ignore that last text, resist the urge to check in with friends online, and succumb to sleep, "the gentle tyrant."

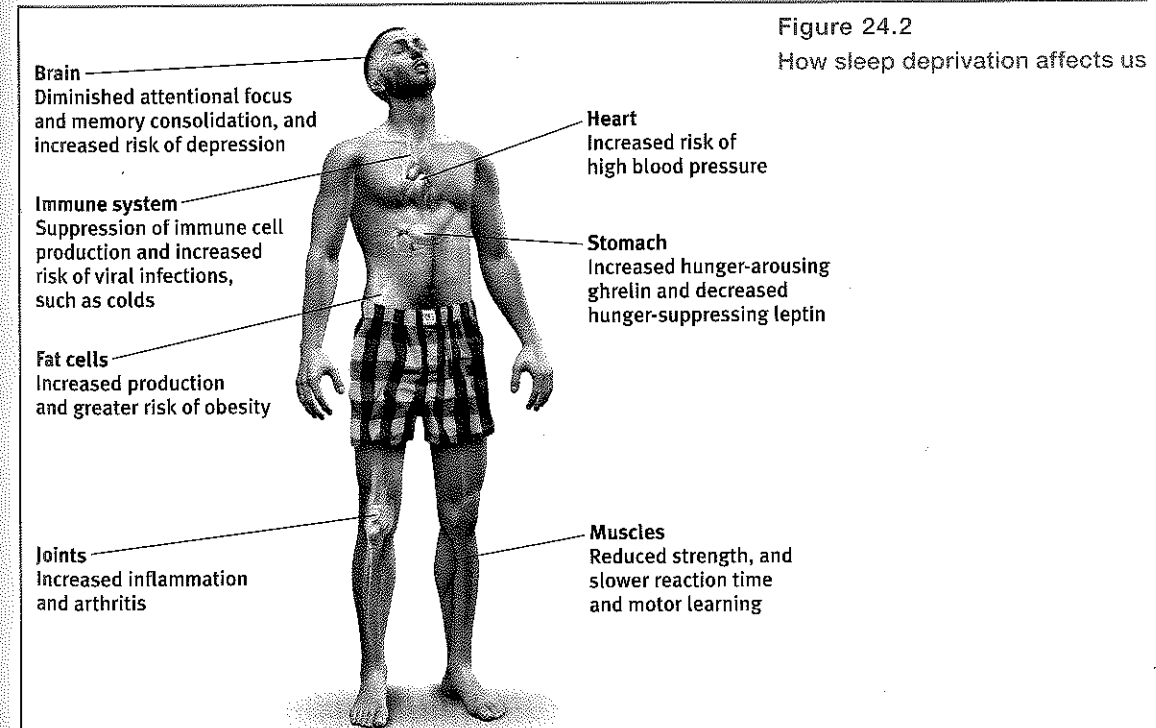


Figure 24.2

How sleep deprivation affects us

off the mark.com by Mark Parisi



"The lion and the lamb shall lie down together, but the lamb will not be very sleepy." -Woody Allen, IN THE MOVIE *LOVE AND DEATH*, 1975

"Sleep is like love or happiness. If you pursue it too ardently it will elude you." -WILSE WEBB, *SLEEP*: *THE GENTLE TYRANT*, 1992

insomnia recurring problems in falling or staying asleep.

narcolepsy a sleep disorder characterized by uncontrollable sleep attacks. The sufferer may lapse directly into REM sleep, often at inopportune times.

MAJOR SLEEP DISORDERS

No matter what their normal need for sleep, 1 in 10 adults, and 1 in 4 older adults, complain of **insomnia**—not an occasional inability to sleep when anxious or excited, but persistent problems in falling or staying asleep (Irwin et al., 2006).

From middle age on, awakening occasionally during the night becomes the norm, not something to fret over or treat with medication (Vitiello, 2009). Ironically, insomnia is worsened by fretting about one's insomnia. In laboratory studies, insomnia complainers do sleep less than others, but they typically overestimate—by about double—how long it takes them to fall asleep. They also underestimate by nearly half how long they actually have slept. Even if we have been awake only an hour or two, we may *think* we have had very little sleep because it's the waking part we remember.

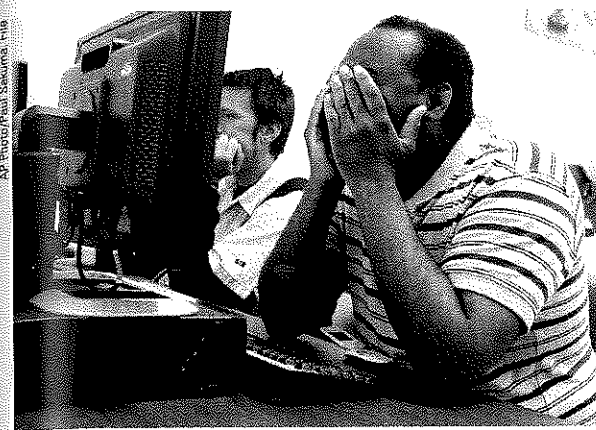
The most common quick fixes for true insomnia—sleeping pills and alcohol—can aggravate the problem, reducing REM sleep and leaving the person with next-day blahs. Such aids can also lead to *tolerance*—a state in which increasing doses are needed to produce an effect. An ideal sleep aid would mimic the natural chemicals that are abundant during sleep, without side effects. Until scientists can supply this magic pill, sleep experts have offered some tips for getting better quality sleep (TABLE 24.2).

Falling asleep is not the problem for people with **narcolepsy** (from *narco*, "numbness," and *lepsy*, "seizure"), who have sudden attacks of overwhelming sleepiness, usually lasting less than 5 minutes. Narcolepsy attacks can occur at the most inopportune times, perhaps just after taking a terrific swing at a softball or when laughing loudly, shouting angrily, or having sex (Dement, 1978, 1999). In severe cases, the person collapses directly into a brief period of REM sleep, with loss of muscular tension. People with narcolepsy—1 in 2000 of us, estimated the Stanford University Center for Narcolepsy (2002)—must therefore live with extra caution. As a traffic menace, "snoozing is second only to boozing," says the American Sleep Disorders Association, and those with narcolepsy are especially at risk (Aldrich, 1989).

Researchers have discovered genes that cause narcolepsy in dogs and humans (Miyagawa et al., 2008; Taheri, 2004). Genes help sculpt the brain, and neuroscientists are searching the brain for narcolepsy-linked abnormalities. One team discovered a relative absence of a hypothalamic neural center that produces *orexin* (also called hypocretin), a neurotransmitter linked to alertness (Taheri et al., 2002; Thannickal et al., 2000). (That discovery has led to the clinical testing of a new sleeping pill that works by blocking orexin's arousing activity.)

Table 24.2 Some Natural Sleep Aids

- Exercise regularly but not in the late evening. (Late afternoon is best.)
- Avoid caffeine after early afternoon, and avoid food and drink near bedtime. The exception would be a glass of milk, which provides raw materials for the manufacture of serotonin, a neurotransmitter that facilitates sleep.
- Relax before bedtime, using dimmer light.
- Sleep on a regular schedule (rise at the same time even after a restless night) and avoid naps.
- Hide the clock face so you aren't tempted to check it repeatedly.
- Reassure yourself that temporary sleep loss causes no great harm.
- Realize that for any stressed organism, being vigilant is natural and adaptive. A personal conflict during the day often means a fitful sleep that night (Åkerstedt et al., 2007; Brissette & Cohen, 2002). And a traumatic stressful event can take a lingering toll on sleep (Babson & Feldner, 2010). Managing your stress levels will enable more restful sleeping. (See Modules 43, 44, and 84 for more on stress.)
- If all else fails, settle for less sleep, either by going to bed later or getting up earlier.



Economic recession and stress can rob sleep. A National Sleep Foundation (2009) survey found 27 percent of people reporting sleeplessness related to the economy, their personal finances, and employment, as seems evident in this man looking for work.

sleep apnea a sleep disorder characterized by temporary cessations of breathing during sleep and repeated momentary awakenings.

night terrors a sleep disorder characterized by high arousal and an appearance of being terrified; unlike nightmares, night terrors occur during NREM-3 sleep, within two or three hours of falling asleep, and are seldom remembered.

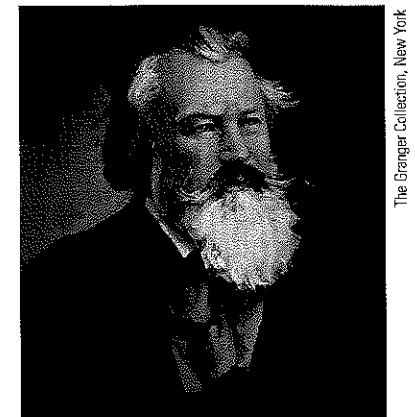
Narcolepsy, it is now clear, is a brain disease; it is not just "in your mind." And this gives hope that narcolepsy might be effectively relieved by a drug that mimics the missing orexin and can sneak through the blood-brain barrier (Fujiki et al., 2003; Siegel, 2000). In the meantime, physicians are prescribing other drugs to relieve narcolepsy's sleepiness in humans.

Although 1 in 20 of us have **sleep apnea**, it was unknown before modern sleep research. *Apnea* means "with no breath," and people with this condition intermittently stop breathing during sleep. After an airless minute or so, decreased blood oxygen arouses them and they wake up enough to snort in air for a few seconds, in a process that repeats hundreds of times each night, depriving them of slow-wave sleep. Apnea sufferers don't recall these episodes the next day. So, despite feeling fatigued and depressed—and hearing their mate's complaints about their loud "snoring"—many are unaware of their disorder (Peppard et al., 2006).

Sleep apnea is associated with obesity, and as the number of obese Americans has increased, so has this disorder, particularly among overweight men, including some football players (Keller, 2007). Other warning signs are loud snoring, daytime sleepiness and irritability, and (possibly) high blood pressure, which increases the risk of a stroke or heart attack (Dement, 1999). If one doesn't mind looking a little goofy in the dark (imagine a snorkeler at a slumber party), the treatment—a mask-like device with an air pump that keeps the sleeper's airway open—can effectively relieve apnea symptoms.

Unlike sleep apnea, **night terrors** target mostly children, who may sit up or walk around, talk incoherently, experience doubled heart and breathing rates, and appear terrified (Hartmann, 1981). They seldom wake up fully during an episode and recall little or nothing the next morning—at most, a fleeting, frightening image. Night terrors are not nightmares (which, like other dreams, typically occur during early morning REM sleep); night terrors usually occur during the first few hours of NREM-3.

Sleepwalking—another NREM-3 sleep disorder—and *sleep talking* are usually childhood disorders, and like narcolepsy, they run in families. (Sleep talking—usually garbled or nonsensical—can occur during any sleep stage [Mahowald & Ettinger, 1990].) Occasional childhood sleepwalking occurs for about one-third of those with a sleepwalking fraternal twin and half of those with a sleepwalking identical twin. The same is true for sleep talking (Hublin et al., 1997, 1998). Sleepwalking is usually harmless. After returning to bed on their own or with the help of a family member, few sleepwalkers recall their trip the next morning. About 20 percent of 3- to 12-year-olds have at least one episode of sleepwalking,



Did Brahms need his own lullabies? Cranky, overweight, and nap-prone, Johannes Brahms exhibited common symptoms of sleep apnea (Margolis, 2000).



Now I lay me down to sleep
For many with sleep apnea, a continuous positive airway pressure (CPAP) machine makes for sounder sleeping and better quality of life.

usually lasting 2 to 10 minutes; some 5 percent have repeated episodes (Giles et al., 1994). Young children, who have the deepest and longest NREM-3 sleep, are the most likely to experience both night terrors and sleepwalking. As we grow older and deep NREM-3 sleep diminishes, so do night terrors and sleepwalking. After being sleep deprived, we sleep more deeply, which increases any tendency to sleepwalk (Zadra et al., 2008).

A dreamy take on dreamland The 2010 movie *Inception* creatively played off our interest in finding meaning in our dreams, and in understanding the layers of our consciousness. It further explored the idea of creating false memories through the power of suggestion—an idea we will explore in Module 33.

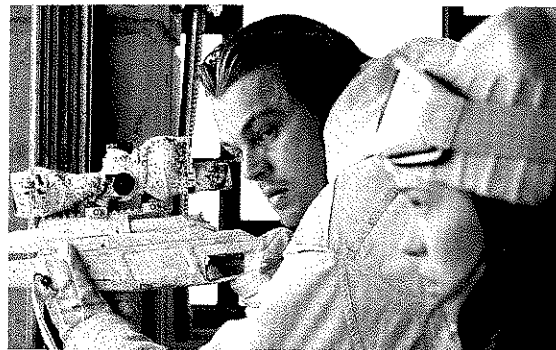


Photo: Warner Bros. Pictures

Dreams

Now playing at an inner theater near you: the premiere showing of a sleeping person's vivid dream. This never-before-seen mental movie features captivating characters wrapped in a plot so original and unlikely, yet so intricate and so seemingly real, that the viewer later marvels at its creation.

Waking from a troubling dream, wrenched by its emotions, who among us has not wondered about this weird state of consciousness? How can our brain so creatively, colorfully, and completely construct this alternative world? In the shadowland between our dreaming and waking consciousness, we may even wonder for a moment which is real.

Discovering the link between REM sleep and dreaming opened a new era in dream research. Instead of relying on someone's hazy recall hours or days after having a dream, researchers could catch dreams as they happened. They could awaken people during or within 3 minutes after a REM sleep period and hear a vivid account.

What We Dream

24-2 What do we dream?

Daydreams tend to involve the familiar details of our life—perhaps picturing ourselves explaining to a teacher why a paper will be late, or replaying in our minds personal encounters we relish or regret. REM dreams—“hallucinations of the sleeping mind” (Loftus & Ketcham, 1994, p. 67)—are vivid, emotional, and bizarre—so vivid we may confuse them with reality. Awakening from a nightmare, a 4-year-old may be sure there is a bear in the house.

We spend six years of our life in dreams, many of which are anything but sweet. For both women and men, 8 in 10 dreams are marked by at least one negative event or emotion (Domhoff, 2007). Common themes are repeatedly failing in an attempt to do something; of being attacked, pursued, or rejected; or of experiencing misfortune (Hall et al., 1982). Dreams with sexual imagery occur less often than you might think. In one study, only 1 in 10 dreams among young men and 1 in 30 among young women had sexual content (Domhoff, 1996). More commonly, the story line of our dreams incorporates traces of previous days' nonsexual experiences and preoccupations (De Koninck, 2000):

- After suffering a trauma, people commonly report nightmares, which help extinguish daytime fears (Levin & Nielsen, 2007, 2009). One sample of Americans recording their dreams during September 2001 reported an increase in threatening dreams following the 9/11 terrorist attacks (Propper et al., 2007).
- After playing the computer game *Tetris* for 7 hours and then being awakened repeatedly during their first hour of sleep, 3 in 4 people reported experiencing images of the game's falling blocks (Stickgold et al., 2000).
- Compared with city-dwellers, people in hunter-gatherer societies more often dream of animals (Mestel, 1997). Compared with nonmusicians, musicians report twice as many dreams of music (Uga et al., 2006).

dream a sequence of images, emotions, and thoughts passing through a sleeping person's mind. Dreams are notable for their hallucinatory imagery, discontinuities, and incongruities, and for the dreamer's delusional acceptance of the content and later difficulties remembering it.

“I do not believe that I am now dreaming, but I cannot prove that I am not.” —PHILOSOPHER BERTRAND RUSSELL (1872–1970)

FYI Would you suppose that people dream if blind from birth? Studies in France, Hungary, Egypt, and the United States all found blind people dreaming of using their nonvisual senses—hearing, touching, smelling, tasting (Buquet, 1988; Taha, 1972; Vekassy, 1977).

“For what one has dwelt on by day, these things are seen in visions of the night.” —MENANDER OF ATHENS (342–292 B.C.E.), *THE PRINCIPAL FRAGMENTS*

Our two-track mind is also monitoring our environment while we sleep. Sensory stimuli—a particular odor or a phone's ringing—may be instantly and ingeniously woven into the dream story. In a classic experiment, researchers lightly sprayed cold water on dreamers' faces (Dement & Wolpert, 1958). Compared with sleepers who did not get the cold-water treatment, these people were more likely to dream about a waterfall, a leaky roof, or even about being sprayed by someone.

So, could we learn a foreign language by hearing it played while we sleep? If only it were so easy. While sleeping we can learn to associate a sound with a mild electric shock (and to react to the sound accordingly). But we do not remember recorded information played while we are soundly asleep (Eich, 1990; Wyatt & Bootzin, 1994). In fact, anything that happens during the 5 minutes just before we fall asleep is typically lost from memory (Roth et al., 1988). This explains why sleep apnea patients, who repeatedly awaken with a gasp and then immediately fall back to sleep, do not recall the episodes. It also explains why dreams that momentarily awaken us are mostly forgotten by morning. To remember a dream, get up and stay awake for a few minutes.

Why We Dream

24-3 What are the functions of dreams?

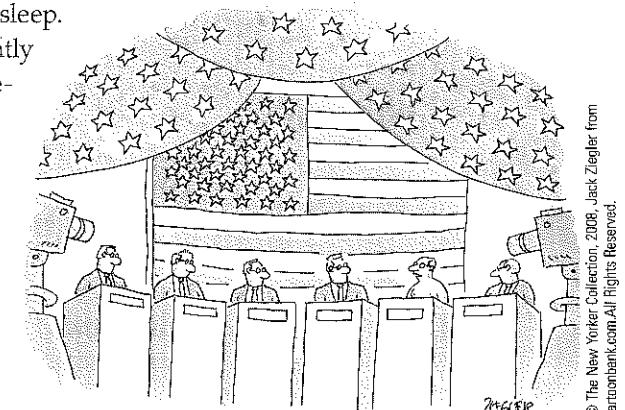
Dream theorists have proposed several explanations of why we dream, including these:

To satisfy our own wishes. In 1900, in his landmark book *The Interpretation of Dreams*, Sigmund Freud offered what he thought was “the most valuable of all the discoveries it has been my good fortune to make.” He proposed that dreams provide a psychic safety valve that discharges otherwise unacceptable feelings. He viewed a dream's **manifest content** (the apparent and remembered story line) as a censored, symbolic version of its **latent content**, the unconscious drives and wishes that would be threatening if expressed directly. Although most dreams have no overt sexual imagery, Freud nevertheless believed that most adult dreams could be “traced back by analysis to erotic wishes.” Thus, a gun might be a disguised representation of a penis.

Freud considered dreams the key to understanding our inner conflicts. However, his critics say it is time to wake up from Freud's dream theory, which is a scientific nightmare. Based on the accumulated science, “there is no reason to believe any of Freud's specific claims about dreams and their purposes,” observed dream researcher William Domhoff (2003). Some contend that even if dreams are symbolic, they could be interpreted any way one wished. Others maintain that dreams hide nothing. A dream about a gun is a dream about a gun. Legend has it that even Freud, who loved to smoke cigars, acknowledged that “sometimes, a cigar is just a cigar.” Freud's wish-fulfillment theory of dreams has in large part given way to other theories.

To file away memories. The *information-processing* perspective proposes that dreams may help sift, sort, and fix the day's experiences in our memory. Some studies support this view. When tested the next day after learning a task, those deprived of both slow-wave and REM sleep did not do as well on their new learning as those who slept undisturbed (Stickgold et al., 2000, 2001). People who hear unusual phrases or learn to find hidden visual images before bedtime remember less the next morning if awakened every time they begin REM sleep than they do if awakened during other sleep stages (Empson & Clarke, 1970; Karni & Sagi, 1994).

Brain scans confirm the link between REM sleep and memory. The brain regions that buzz as rats learn to navigate a maze, or as people learn to perform a visual-discrimination



“Uh-oh. I think I'm having one of those dreams again.”

“Follow your dreams, except for that one where you're naked at work.” —ATTRIBUTED TO COMEDIAN HENRY YOUNGMAN

FYI

A popular sleep myth: If you dream you are falling and hit the ground (or if you dream of dying), you die. (Unfortunately, those who could confirm these ideas are not around to do so. Some people, however, have had such dreams and are alive to report them.)

“When people interpret [a dream] as if it were meaningful and then sell those interpretations, it's quackery.” —SLEEP RESEARCHER J. ALLAN HOBSON (1995)

manifest content according to Freud, the remembered story line of a dream (as distinct from its latent, or hidden, content).

latent content according to Freud, the underlying meaning of a dream (as distinct from its manifest content).

task, buzz again during later REM sleep (Louie & Wilson, 2001; Maquet, 2001). So precise are these activity patterns that scientists can tell where in the maze the rat would be if awake. Others, unpersuaded by these studies, note that memory consolidation may also occur during non-REM sleep (Siegel, 2001; Vertes & Siegel, 2005). This much seems true: A night of solid sleep (and dreaming) has an important place in our lives. To sleep, perchance to remember.

This is important news for students, many of whom, observed researcher Robert Stickgold (2000), suffer from a kind of sleep bulimia—binge-sleeping on the weekend. “If you don’t get good sleep and enough sleep after you learn new stuff, you won’t integrate it effectively into your memories,” he warned. That helps explain why high school students with high grades have averaged 25 minutes more sleep a night than their lower-achieving classmates (Wolfson & Carskadon, 1998).

FYI

Rapid eye movements also stir the liquid behind the cornea; this delivers fresh oxygen to corneal cells, preventing their suffocation.

To develop and preserve neural pathways. Perhaps dreams, or the brain activity associated with REM sleep, serve a *physiological* function, providing the sleeping brain with periodic stimulation. This theory makes developmental sense. As you will see in Unit IX, stimulating experiences preserve and expand the brain’s neural pathways. Infants, whose neural networks are fast developing, spend much of their abundant sleep time in REM sleep (FIGURE 24.3).

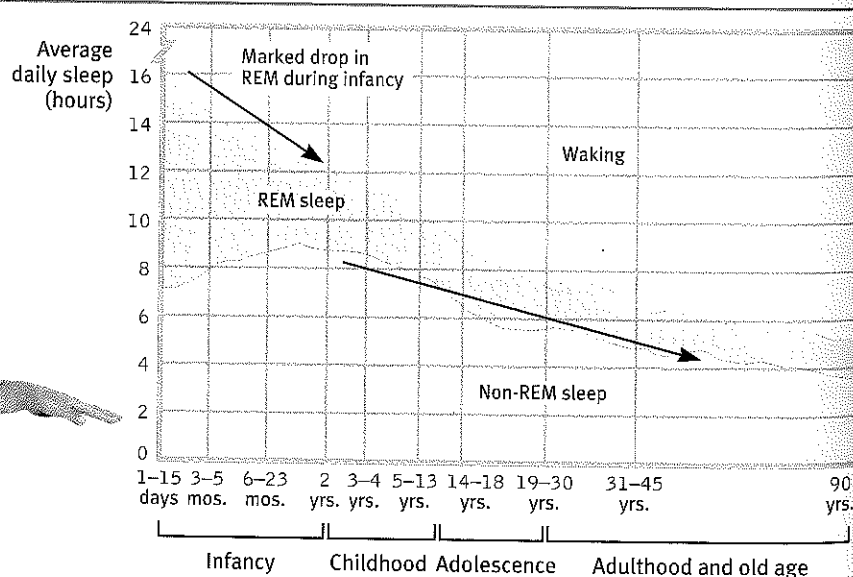
To make sense of neural static. Other theories propose that dreams erupt from *neural activation* spreading upward from the brainstem (Antrobus, 1991; Hobson, 2003, 2004, 2009). According to one version, dreams are the brain’s attempt to make sense of random neural activity. Much as a neurosurgeon can produce hallucinations by stimulating different parts of a patient’s cortex, so can stimulation originating within the brain. These internal stimuli activate brain areas that process visual images, but not the visual cortex area, which receives raw input from the eyes. As Freud might have expected, PET scans of sleeping people also reveal increased activity in the emotion-related limbic system (in the amygdala) during REM sleep. In contrast, frontal lobe regions responsible for inhibition and logical thinking seem to idle, which may explain why we are less inhibited in our dreams than when awake (Maquet et al., 1996). Add the limbic system’s emotional tone to the brain’s visual bursts and—voilà!—we dream. Damage either the limbic system or the visual centers active during dreaming, and dreaming itself may be impaired (Domhoff, 2003).

FYI

Question: Does eating spicy foods cause one to dream more?
Answer: Any food that causes you to awaken more increases your chance of recalling a dream (Moorcroft, 2003).

Figure 24.3

Sleep across the life span As we age, our sleep patterns change. During our first few months, we spend progressively less time in REM sleep. During our first 20 years, we spend progressively less time asleep. (Adapted from Snyder & Scott, 1972.)



To reflect cognitive development. Some dream researchers dispute both the Freudian and neural activation theories, preferring instead to see dreams as part of brain maturation and cognitive development (Domhoff, 2010, 2011; Foulkes, 1999). For example, prior to age 9, children’s dreams seem more like a slide show and less like an active story in which the dreamer is an actor. Dreams overlap with waking cognition and feature coherent speech. They simulate reality by drawing on our concepts and knowledge. They engage brain networks that also are active during daydreaming. Unlike the idea that dreams arise from bottom-up brain activation, the cognitive perspective emphasizes our mind’s top-down control of our dream content (Nir & Tononi, 2010).

TABLE 24.2 compares major dream theories. Although today’s sleep researchers debate dreams’ function—and some are skeptical that dreams serve any function—there is one thing they agree on: We need REM sleep. Deprived of it by repeatedly being awakened, people return more and more quickly to the REM stage after falling back to sleep. When finally allowed to sleep undisturbed, they literally sleep like babies—with increased REM sleep, a phenomenon called **REM rebound**. Withdrawing REM-suppressing sleeping medications also increases REM sleep, but with accompanying nightmares.

Most other mammals also experience REM rebound, suggesting that the causes and functions of REM sleep are deeply biological. That REM sleep occurs in mammals—and not in animals such as fish, whose behavior is less influenced by learning—also fits the information-processing theory of dreams.

So does this mean that because dreams serve physiological functions and extend normal cognition, they are psychologically meaningless? Not necessarily. Every psychologically meaningful experience involves an active brain. We are once again reminded of a basic principle: *Biological and psychological explanations of behavior are partners, not competitors.*

REM rebound the tendency for REM sleep to increase following REM sleep deprivation (created by repeated awakenings during REM sleep).

Table 24.2 Dream Theories

Theory	Explanation	Critical Considerations
<i>Freud’s wish-fulfillment</i>	Dreams provide a “psychic safety valve”—expressing otherwise unacceptable feelings; contain manifest (remembered) content and a deeper layer of latent content—a hidden meaning.	Lacks any scientific support; dreams may be interpreted in many different ways.
<i>Information-processing</i>	Dreams help us sort out the day’s events and consolidate our memories.	But why do we sometimes dream about things we have not experienced?
<i>Physiological function</i>	Regular brain stimulation from REM sleep may help develop and preserve neural pathways.	This does not explain why we experience meaningful dreams.
<i>Neural activation</i>	REM sleep triggers neural activity that evokes random visual memories, which our sleeping brain weaves into stories.	The individual’s brain is weaving the stories, which still tells us something about the dreamer.
<i>Cognitive development</i>	Dream content reflects dreamers’ cognitive development—their knowledge and understanding.	Does not address the neuroscience of dreams.