

Sleep Science

Sleep in the Real World

The internal mechanisms that regulate our almost ceaseless cycles of sleep and wakefulness make up a remarkable system. However, a variety of internal and external factors can dramatically influence the balance of this sleep-wake system.

Changes in the structure and function of the brain during development can have profound, if gradual, effects on sleep patterns. The amount of sleep we obtain generally decreases and becomes more fragmented throughout our lifespan. These and other variations associated with age are covered at length in the essay *Changes in Sleep with Age*.

Other factors that affect sleep include stress and many medical conditions, especially those that cause chronic pain or other discomfort. External factors, such as what we eat and drink, the medications we take, and the environment in which we sleep can also greatly affect the quantity and quality of our sleep. In general, all of these factors tend to increase the number of awakenings and limit the depth of sleep.

Light's Effect

Light exposure can cause our biological clock to advance or delay, which affects our sleep and wake cycle.

Light is one of the most important external factors that can affect sleep. It does so both directly, by making it difficult for people to fall asleep, and indirectly, by influencing the timing of our internal clock and thereby affecting our preferred time to sleep.

Light influences our internal clock through specialized "light sensitive" cells in the retina of our eyes. These cells, which occupy the same space as the rods and cones that make vision possible, tell the brain whether it is daytime or nighttime, and our sleep patterns are set accordingly.

Due to the invention of the electric lightbulb in the late 19th century, we are now exposed to much more light at night than we had been exposed to throughout our evolution. This relatively new pattern of light exposure is almost certain to have affected our patterns of sleep. Exposure to light in the late evening tends to delay the phase of our internal clock and lead us to prefer later sleep times. Exposure to light in the middle of the night can have more unpredictable effects, but can certainly be enough to cause our internal clock to be reset, and may make it difficult to return to sleep.

Jet Lag and Shift Work

Normally, light serves to set our internal clock to the appropriate time. However, problems can occur when our exposure to light changes due to a shift in work schedule or travel across time zones. Under normal conditions, our internal

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clock strongly influences our ability to sleep at various times over the course of a 24-hour period, as well as which sleep stages we experience when we do sleep.

Long-distance travelers experience "jet lag" as their internal clock adjusts to the new day-night cycle.

Individuals who travel across time zones or work the night shift typically have two symptoms. One is insomnia when they are trying to sleep outside of their internal phase, and the other is excessive sleepiness during the time when their internal clock says that they should be asleep. Half of all night shift workers regularly report nodding off and falling asleep when they are at work. This should be seen as an important concern both for individuals and society, given that airline pilots, air traffic controllers, physicians, nurses, police, and other public safety workers are all employed in professions in which peak functioning during a night shift may be critical.

The effects of shift work and jet lag on sleep are covered in much greater detail in *Jet Lag and Shift Work and You and Your Biological Clock*.

Pain, Anxiety, and Other Medical Conditions

A wide range of medical and psychological conditions can have an impact on the structure and distribution of sleep. These conditions include chronic pain from arthritis and other medical conditions, discomfort caused by gastroesophageal reflux disease, pre-menstrual syndrome, and many others. Like many other sleep disruptions, pain and discomfort tend to limit the depth of sleep and allow only brief episodes of sleep between awakenings.

Individuals of all ages who experience stress, anxiety, and depression tend to find it more difficult to fall asleep, and when they do, sleep tends to be light and includes more REM sleep and less deep sleep. This is likely because our bodies are programmed to respond to stressful and potentially dangerous situations by waking up. Stress, even that caused by daily concerns, can stimulate this arousal response and make restful sleep more difficult to achieve.

Medications and Other Substances

Many common chemicals affect both quantity and quality of sleep. These include caffeine, alcohol, nicotine, and

antihistamines, as well as prescription medications including beta blockers, alpha blockers, and antidepressants.

Smoking and Sleep (0:56) Dr. Lawrence Epstein describes how nicotine in cigarettes can prevent or disrupt sleep. watch video

The pressure to sleep builds with every hour that you are awake. During daylight hours, your internal clock generally counteracts this sleep drive by producing an alerting signal that keeps you awake. The longer you are awake, the stronger the sleep drive becomes. Eventually the alerting signal decreases and the drive to sleep wins out. When it does, you fall asleep.

Caffeinated products decrease a person's quality of sleep.

A chemical called adenosine, which builds up in the brain during wakefulness, may be at least partly responsible for sleep drive. As adenosine levels increase, scientists think that the chemical begins to inhibit the brain cells that promote alertness. This gives rise to the sleepiness we experience when we have been awake for many hours. Interestingly, caffeine, the world's most widely used stimulant, works by temporarily blocking the adenosine receptors in these specific parts of the brain. Because these nerve cells cannot sense adenosine in the presence of caffeine, they maintain their activity and we stay alert.

Caffeine and Sleep (0:43) Dr. Lawrence Epstein describes how caffeine works to promote alertness, but can also inhibit restful sleep. watch video

If sleep does occur following the intake of caffeine, the stimulant's effects may persist for some time and can influence the patterns of sleep. For instance, caffeine generally decreases the quantity of slow-wave sleep and REM sleep and tends to increase the number of awakenings. The duration of its effect depends on the amount of caffeine ingested, the amount of time before sleep that the person ingests the caffeine, the individual's tolerance level, the degree of ongoing sleep debt, and the phase of the individual's internal clock.

Alcohol is commonly used as a sleep aid. However, although alcohol can help a person fall asleep more quickly, the quality of that individual's sleep under the influence of alcohol will be compromised. Ingesting more than one or two drinks shortly before bedtime has been shown to cause increased awakenings and in some cases insomnia due to the

arousal effect the alcohol has as it is metabolized later in the night. Alcohol also tends to worsen the symptoms of sleep apnea, which will further disrupt sleep in people with this breathing disorder.

Alcohol and Sleep (0:26) Dr. Stephen Amira describes how alcohol consumption can lead to disrupted sleep. watch video

Dozens of prescription drugs that are used to help control common disease symptoms may have varying effects on sleep. Beta blockers, which are used to treat high blood pressure, congestive heart failure, glaucoma, and migraines, often cause decreases in the amount of REM and slow-wave sleep, and are also associated with increased daytime sleepiness. Alpha blockers, which are also used to treat high blood pressure and prostate conditions, are linked to decreased REM and increased daytime sleepiness. Finally, antidepressants, which can decrease the duration of periods of REM sleep, have unknown long-term effects on sleep as a whole. Some antidepressants, from the class of drugs known as SSRIs, have been found to promote insomnia in some individuals.

The Sleep Environment

Light and temperature effect the quality and restfulness of your sleep.

The bedroom environment can have a significant influence on sleep quality and quantity. Several variables combine to make up the sleep environment, including light, noise, and temperature. By being attuned to factors in your sleep environment that put you at ease, and eliminating those that may cause stress or distraction, you can set yourself up for the best possible sleep.

We've already noted that too much light at night can shift our internal clock and makes restful sleep difficult to achieve. To minimize this effect, nightlights in hallways and bathrooms can be used. As for noise, although background sounds may relax some people, the volume level must be low. Otherwise, increased frequency of awakenings may prevent transitions to the deeper stages of sleep. Research shows that the ideal temperature range for sleeping varies widely among individuals, so much so that there is no prescribed best room temperature to produce optimal sleep patterns. People simply sleep best at the temperature that feels most comfortable. That said, extreme temperatures in sleeping environments tend to disrupt sleep. REM sleep is commonly more sensitive to temperature-related disruption. For example, in very cold temperatures, we may be deprived entirely of REM sleep. Lastly, it is worth mentioning that the preferences of a spouse or bedmate may have a significant effect on sleep, especially when a partner's sleep and wake

times vary, or if he or she snores or suffers from sleep-disordered breathing.

For tips on how to improve your sleep despite all of these factors, see the section [Overcoming Factors That Interfere with Sleep](#).

You will find more about typical sleep patterns in [Natural Patterns of Sleep](#).

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Reference

[The Norton Psychology Reader](#)

[Publishing Your Psychology Research](#)