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In Eyes, a Clock Calibrated by Wavelengths of Light

By LAURA BEIL
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Just as the ear has two purposes — hearing and telling you which way it is up — so does the eye. It receives the input necessary for vision, but the retina also houses a network of sensors that detect the rise and fall of daylight. With light, the body sets its internal clock to a 24-hour cycle regulating an estimated 10 percent of our genes.



Otto Steininger

The workhorse of this system is the light-sensitive hormone melatonin, which is produced by the body every evening and during the night. Melatonin promotes sleep and alerts a variety of biological processes to the approximate hour of the day.

Light hitting the retina suppresses the production of melatonin — and there lies the rub. In this modern world, our eyes are flooded with light well after dusk, contrary to our evolutionary programming. Scientists are just beginning to understand the potential health consequences.

The disruption of circadian cycles may not just be shortchanging our sleep, they have found, but also contributing to a host of diseases.

“Light works as if it’s a drug, except it’s not a drug at all,” said George Brainard, a neurologist at Thomas Jefferson University in Philadelphia and one of the first researchers to study light’s effects on the body’s hormones and circadian rhythms.

Any sort of light can suppress melatonin, but recent experiments have raised novel questions about one type in particular: the blue wavelengths produced by many kinds of energy-efficient light bulbs and electronic gadgets.

Dr. Brainard and other researchers have found that light composed of blue wavelengths slows the release of melatonin with particular effectiveness. Until recently, though, few studies had directly examined how blue-emitting electronics might affect the brain.

So scientists at the University of Basel in Switzerland tried a simple experiment: They asked 13 men to sit before a computer each evening for two weeks before going to bed.

During one week, for five hours every night, the volunteers sat before an old-style fluorescent monitor emitting light composed of several colors from the visible spectrum, though very little blue. Another week, the men sat at screens backlit by [light-emitting diodes](#), or LEDs. This screen was twice as blue.

“To our surprise, we saw huge differences,” said Christian Cajochen, who heads the Center for Chronobiology at the University of Basel. Melatonin levels in volunteers watching the LED screens took longer to rise at night, compared with when the participants were watching the fluorescent screens, and the deficit persisted throughout the evening.

The subjects also scored higher on tests of memory and cognition after exposure to blue light, Dr. Cajochen and his team reported in the May issue of The Journal of Applied Physiology. While men were able to recall pairs of words flashed across the fluorescent

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screen about half the time, some scores rose to almost 70 percent when they stared at the LED monitors.

The finding adds to a series of others suggesting, though certainly not proving, that exposure to blue light may keep us more awake and alert, partly by suppressing production of melatonin. An LED screen bright enough and big enough "could be giving you an alert stimulus at a time that will frustrate your body's ability to go to sleep later," said Dr. Brainard. "When you turn it off, it doesn't mean that instantly the alerting effects go away. There's an underlying biology that's stimulated."

Still, nobody is suggesting that we all turn off the lights at dusk and sit in the dark; research into this area is in its infancy. "We are only beginning to understand what really happens under natural conditions," said Mark Rea of the Lighting Research Center at Rensselaer Polytechnic Institute in New York.

Artificial light has been around for more than 120 years. But the light emitted by older sources, like incandescent bulbs, contains more red wavelengths. The problem now, Dr. Brainard and other researchers fear, is that our world is increasingly illuminated in blue. By one estimate, 1.6 billion new computers, televisions and cellphones were sold last year alone, and incandescent lights are being replaced by more energy-efficient, and often bluer, bulbs.

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