John Cline Ph.D.
Sleepless in America

Blue Light: Friend or Foe?

Blue light has both healthy and unhealthy effects.

Posted Dec 30, 2019

Starry Night Over the Rhône (1888)
Source: Vincent van Gogh [Public domain]

We are in the holiday season, and colorful lights are everywhere inside and out and will be for a little while longer. It is a really beautiful time of year. We have recently had some serious icy weather in the Northeast, and the highways and byways, while difficult to navigate, are pathways through a true winter wonderland.

Seeing all the colored lights and the glistening ice on the trees helps lessen the sting of the bitter cold. Among all the colored lights, you will find some blue lights, and indeed, the modern home is full of blue light.

It is produced by, among other things, our energy-efficient indoor lighting, and is emitted by all the electronic devices we are using to consume information. Whether it is the tablet you use to read a book, the smartphone you use to keep in touch with family and friends, or the big screen TV in your den or living room, they all emit blue light. Even the energy-saving lightbulbs are emitting more blue light than the older, incandescent light bulbs.

It is likely that most people in the U.S. are using electronic devices after sunset, and so are exposed to never-before-experienced levels of this light—and at times that our bodies may not be able to deal effectively with it. Do we need to change our habits? Our lightbulbs? How important is this blue light situation?

Should we take a cue from NASA? NASA has switched to a new type of lighting for use during the night period on the space station. It exposes astronauts to a longer wavelength of light than that emitted by the old lighting system during times when they are getting ready for sleep.

Now, as you have been doing your holiday online or other shopping, you may have seen the ads for blue-light-blocking glasses that you can purchase to protect you from the negative effects of this ubiquitous blue light. The concern about blue light has increased, because exposure to this kind of light after sundown, and, indeed, to bright light in general, is a new development in human history. LEDs used in computers, smartphones, and TV screens produce significant amounts of blue light.

While humans have always been exposed to great quantities of blue light in regular sunlight, previous to the current era, our nights have been essentially free of it. Now our days are chock-full of blue light whether we are indoors or out, and our exposure continues long into the nighttime hours via computer, TV, and smartphone screens. So is blue light, bad light?

Just what is blue light? We know that a particular experience is evoked when we are exposed to the electromagnetic waves of its specific wavelength. It is impossible at this time to know if the experience of blue is the same for everyone, or if it is subjectively different in different people. But we do know the wavelength of light that causes the experience that we label as blue. This wavelength of light causes changes in the photopigment molecule, which results in changes in the membrane potential of photoreceptor cells in the retina of the eye, which sends a signal to the brain that is interpreted as the color blue.

The full spectrum of visible light extends from a wavelength of 380 to 720 nm, with wavelengths shorter than 380 nm falling into the ultraviolet range and those longer than 720 nm falling into the infrared range. Peak sensitivity to blue light is at a wavelength of about 420 nm. For more information on the various wavelengths and their corresponding colors, see Helmenstine (2019). Compact fluorescent lightbulbs and LED lights are more energy-efficient than older incandescent lightbulbs, but as a function of how they work, they produce more blue light.

It is hard to appreciate the degree and speed with which lighting technology has changed in recent years. Long-standing light sources, such as incandescent lights, have virtually disappeared, and TV screens that once used cathode-ray tube technology now use LEDs (Tosini, Ferguson, & Tsubota, 2016). This has allowed for thinner computer screens and smaller smartphones, has saved energy, and has changed the way people can read.

When reading from an electronic device, the light comes directly from the screen rather than from reflection, as happens when reading a printed source like a book or magazine. In order to make a modern white light LED, a bichromatic source is used with a blue light-emitting LED coupled with a yellow phosphor. While this looks white to the human eye, there is a greater level of blue light in it than in the white light emitted by an incandescent bulb (Tosini, Ferguson, & Tsubota, 2016).

People have studied the psychological effect of the color blue. It is often thought of as being calming. It can also evoke feelings of sadness. Blue reminds us of the natural world with its blue oceans and blue skies. This probably accounts for, at least in part, the positive feelings this color brings up.

reported to have had a negative effect on at least some of his guests' appetites.

Research has shown (see Czeisler& Buxton, 2017) that blue and short-wavelength green light (450-500 nm) is the most powerful type of light in shifting circadian phase and suppressing melatonin production. Exposure to blue light has been found to improve reaction time, decrease inattention, and increase alertness. These are all helpful for daytime activities. Under conditions of natural light, the circadian clock is synchronized by the release of melatonin around sunset and by decreased melatonin production around sunrise.

When we are exposed to blue-enriched visible light from a tablet in the evening, the release of melatonin is delayed, as is the timing of REM sleep. Alertness and sleep latency are increased, as is morning sleepiness. Longer exposure with brighter light intensifies these effects. Reading an old-fashioned paperback or hardcover before bedtime delivers enjoyment, and/or information, and with less effect on the circadian rhythm and sleep. It's good to have options when it comes to how we do our bedtime reading.

There is now evidence that a number of physiological and psychological processes in humans are affected by light and especially by blue light, including "hormone secretion, heart rate, alertness, sleep propensity, body temperature, and gene expression" (Holzman, 2010, p 5). Bright light is used to treat depression, especially when it has a seasonal pattern. Bright blue light, when properly timed, may have benefits in treating premenstrual depression, bulimia, and anxiety (Holzman, 2010).

The Earth, of course, has a blue sky, and it thus makes sense that we might be especially biologically sensitive to this wavelength of electromagnetic energy. But throughout history, exposure to blue light has been limited to the daytime hours, while now we are exposed to high levels of it in our offices, homes, and in the evening after the sun has set. Even the light sources of the past, such as fires and candles, emitted primarily in the red portion of the spectrum and at lower intensities so that their impact on the circadian rhythm was relatively limited.

Blue light clearly is important for the proper setting of the circadian rhythm, which historically has happened due to daily exposure to sunlight. The long winter months in the more northern and southern parts of our planet are often associated with depressed mood and seasonal depression.

Concerns about the health impact of blue light exposure beyond the known potential to shift the circadian rhythm have been raised. These include possible links to cancer, diabetes, heart disease, and obesity. A potential link between increased nighttime blue light exposure, such as could occur while working the night shift, and cancer, may be due to decreased melatonin levels caused by nighttime light exposure.

There is evidence that gradually shifting the circadian rhythm over time can increase blood sugar levels and decrease leptin, which is the hormone of satiety. This could increase hunger and potentially affect the development of diabetes. Some concern has been raised that either intense or prolonged blue light exposure could contribute to damage to the eye with such long-term consequences as an increased risk of age-related macular degeneration, although this is unproven (Tosini, Ferguson, & Tsubota, 2016). Tosini, Ferguson, & Tsubota (2016) did recommend that manufacturers of LEDs should consider switching to materials that generate longer wavelengths of blue light as the shorter wavelengths seem to pose a greater risk.

Humans have not evolved to deal with bright light in the evening and night hours. Clearly, exposure to bright light and especially to blue light in the evening and nighttime hours shifts the circadian rhythm with effects on sleep. These include taking longer to fall asleep, having altered times for dreaming, and waking feeling more sleepy. There is less evidence about additional health impacts of blue light, such as cancer or diabetes, but if there is a relationship, it could be mediated by the changes in hormone secretion associated with the circadian rhythm.

So what can we do to cope with our new electronic environment and its energy-efficient but potentially unhealthy effects? At a societal level, it would make sense to maximize blue light exposure during the day in order to promote alertness and brighter mood and to entrain the circadian rhythm properly while decreasing exposure in the evening and night hours in order to prevent negative health effects, such as difficulty falling asleep and increased daytime sleepiness and fatigue. This would involve efforts to improve the quality of daytime light sources in homes and businesses, encouraging getting outside more, and changes to nighttime light sources so that exposure to blue light is mitigated. It might also involve adopting a standard time throughout the year without the shift between daylight savings and standard time.

On a personal level, the first thing to do is to take charge of your environment. Strive to get most of your light exposure in the daytime and decrease light exposure after sundown, especially in the hour or so before bedtime. Open the windows or take a walk in the fresh air in the daylight hours. Obtain LED light bulbs that provide light with longer wavelengths, more to the red and orange end of the spectrum, and with less blue light production.

Turn down the brightness on the computer, smartphone, TV screen, and reading tablet in the evening. If you have to use screens later in the evening, use programs, such as the free f.lux app (which I have recommended to patients for years) and Night Shift, to automatically decrease brightness and blue light exposure on computers and phones. Switch to books or magazines or conversation as bedtime nears and stop the use of computers, TV, and smartphone screens. And you may find those blue-light-blocking glasses helpful. Still not a lot of evidence on this one, but anecdotally, many of my patients report finding them useful. For just dealing with the eye strain that many people experience from using their screens all day, the American Academy of Ophthalmology has some recommendations.

So enjoy the blue lights you may see at night among holiday decorations, and perhaps think about minimizing the blue light that shines into your eyes from screens. Happy New Year!

References

Czeisler, C.A., & Buxton, O.M. (2017). Human circadian timing system and sleep-wake regulation, 362 – 376, in Kryger, M, Roth, T, & Dement, W.C. (Eds.), (2017). Principles and Practice of Sleep Medicine sixth edition, Philadelphia: Elsevier, Inc.

A22–A27. doi:10.1289/ehp.118-a22

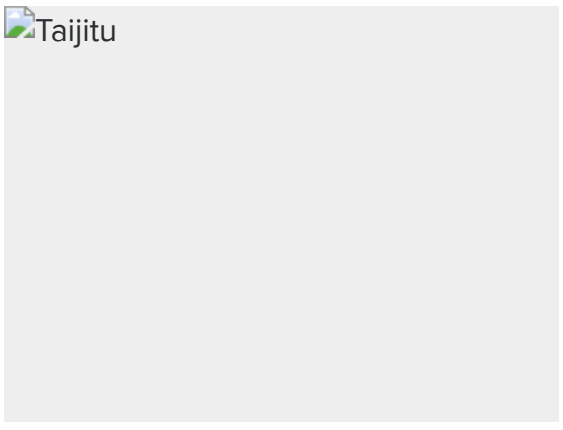
More

1

About the Author

John Cline, Ph.D., is a clinical psychologist, Diplomate of the the American Board of Sleep Medicine, a fellow of the American Academy of Sleep Medicine and a clinical professor at Yale University.

Read Next



Can Getting Too Little Sleep Hurt Your Heart?

I Just Watched a Whole Season of Breaking Bad and It Is 3 AM

Blocking Blue Light Helps Sleep?

Advertising of Untested, Deficient Sleep Aids: Puhleeze!

Blue Light Hazardous to Sleep, but Helpful While Awake

A More Sleep-Friendly iPhone on the Way? It's About Time!

Protect Yourself From Blue-Light Exposure

What's Really Keeping You From Getting a Good Night's Sleep

Most Popular

How Much Sleep Do You Really Need?

Borderline Personality Disorder: What It Is, Why It Matters

Find a Therapist

Get the help you need from a therapist near you–a FREE service from Psychology Today.

City or Zip

Cities:

Atlanta, GA
Austin, TX
Baltimore, MD
Boston, MA
Brooklyn, NY
Charlotte, NC
Chicago, IL
Columbus, OH
Dallas, TX
Denver, CO
Detroit, MI
Houston, TX
Indianapolis, IN
Jacksonville, FL
Las Vegas, NV
Los Angeles, CA
Louisville, KY
Memphis, TN
Miami, FL
Milwaukee, WI
Minneapolis, MN
Nashville, TN
New York, NY
Oakland, CA
Omaha, NE
Philadelphia, PA
Phoenix, AZ
Pittsburgh, PA
Portland, OR
Raleigh, NC
Sacramento, CA
Saint Louis, MO
San Antonio, TX
San Diego, CA
San Francisco, CA
San Jose, CA
Seattle, WA
Tucson, AZ
Washington, DC

Are you a Therapist?
Get Listed Today

Recent Issues