

'Blue Light' May Impair Students' Sleep, Studies Say


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Schools may soon face an unintended consequence of more flexible technology and more energy-efficient buildings: sleepier students.

That's because evidence is mounting that use of artificial light from energy-efficient lamps and computer and mobile-electronics screens later and later in the day can lead to significant sleep problems for adults and, particularly, children.

While lights and electronic devices that mimic daylight can improve students' attention and alertness if used during normal daytime hours, Dr. Charles A. Czeisler, a professor of sleep medicine at Harvard Medical School, has found exposure in the late afternoon and evening can disrupt sleep cycles as much as six to eight hours—the same amount of "jet lag" caused by a flight from New York City to Honolulu.

"Technology has disconnected us from the natural 24-hour day," Dr. Czeisler said in a keynote lecture at the Society for Neuroscience meeting held here last month.

That could lead to headaches for school districts across the country that are rolling out take-home electronic devices in an effort to boost student achievement.

Two connected systems determine how people of all ages sleep. The first is pretty straightforward: The longer it's been since you've slept, the sleepier you get. The second system, called the circadian cycle, is more complex and can easily come into conflict with a person's basic sleep drive.

Human brains regulate circadian sleep through exposure to short-wavelength "blue" light, which makes up the bulk of bright daylight. Short-wavelength light increases cortisol in the brain, which regulates alertness. As blue light during the day fades to the longer-wavelength, redder light of dusk, the brain's timekeeper, the hypothalamus, suppresses cortisol and releases the sleep-promoting chemical melatonin.

One study released this month in the *Journal of Cognitive Neuroscience* showed that even those who are functionally blind **become more alert and have increased brain activity** in response to blue light, suggesting it can have effects even when it can't be seen.

'Biologically Potent'

In several studies, Dr. Czeisler has found that light-emitting diodes, or LEDs, which contain a large proportion of blue light, are more "biologically potent"—twice as effective

at resetting the brain's circadian clock as incandescent light. College students exposed to even brief periods of blue light late in the day showed delayed release in melatonin and up to a two-hour delay in sleep time.

Blue light is becoming ubiquitous in any device that uses LEDs—including tablet and laptop computers, energy-efficient lamps, and some televisions. The Arlington, Va.-based National Sleep Foundation found this year that more than half of Americans **use a computer, laptop, or tablet device in the hour before sleep** every night or nearly every night. More than seven in 10 also have televisions in their bedrooms.

In real life, that can create an unhealthy cycle: Students exposed to blue light late in the day feel less sleepy and continue to do homework or play online until very late, exposing themselves to more light and making it harder to feel sleepy, even as their need for sleep grows. In the past 50 years, Americans' average sleep time has dropped from 8.5 hours a day to only 6.9 hours, Harvard's Dr. Czeisler said. An analysis of nearly 700,000 school-age children in 20 countries found that they slept on average **75 minutes less a night** in 2008 than in 1905, with American children's sleep shrinking more rapidly than for those in most other countries.

As anyone who has had to wake a teenager for a 7 a.m. bus or deal with a toddler who missed his nap knows from experience, research finds children and adolescents are particularly affected by disruptions to their sleep cycles.

For example, a 2012 study by the University of California, Los Angeles, suggested the costs of losing sleep outweighed the academic benefits of more study time for high school students staying up late before a test. Even small sleep deficits have been found to not only hinder students' learning and memory, but also to increase their risks of depression, obesity, and getting into car accidents.

"I think there's huge misunderstanding about the use of these devices" and their effects on sleep, said Amy R. Wolfson, a clinical psychologist and sleep researcher at the College of the Holy Cross in Worcester, Mass. She found high school students who got poor

grades slept on average 25 minutes less and went to bed 40 minutes later than those who got A's and B's.

Ms. Wolfson, who is now studying the sleep effects of blue-light-emitting electronics in the bedrooms of college students, said sleep researchers have been trying, mostly in vain, to get educators to take sleep into consideration in their technology plans.

Raising the Question

"The Los Angeles school district purchased iPads for all their students, but did they educate parents on how to regulate the use of them in their homes? They thought about security, but [not sleep]. ... it's very hard for people to see it as a priority," Ms. Wolfson said. "I think that you've got to get a school district like L.A. to raise the question before they make a rollout."

Omar M. Del Cueto, the director of change management for Los Angeles public schools, said that staff members did not consider sleep issues when planning to distribute some 30,000 iPads this year, but trainers do talk to parents about setting "family rules" governing the use of the devices outside of school.

"We give the parent or guardian full authority over the use of the device in the home, to the same degree that they would limit a Play Station or a cellphone or a home computer or any other device," Mr. Del Cueto said. "I talk about the importance of sitting down with the students and saying, 'Look, I don't want this in your bedroom. ...You're going to be using the device here in the family room or the dining room, and you've got to get everything done before, say, the arbitrary time of 9:30 p.m.' "

Likewise, the Mooresville, N.C., schools, which have provided laptop computers for each student for several years, give general training on home use, but Scott S. Smith, the chief technology officer, said it does not cover sleep concerns.

Shannon Haber, a spokeswoman for Los Angeles, said her school system is conducting

internal studies next month and seeking feedback from teachers, principals, and parents on how mobile devices are being used and affecting students.

Education sales of tablet computers alone are expected to pass 3.5 million by the end of the year, but Sarah Landers, the communications manager for the Washington-based Consortium for School Networking, said that group, like many of the school districts using the new devices, has not looked at light issues associated with them.

Building in Daylight

Research on the effects of light on attention and health is hardly new, and school facilities planners have been considering how best to use light in school design for years, said Jeffrey K. Platenberg, the assistant superintendent and a facilities-planning expert for Fairfax County, Va., public schools.

With energy-efficiency and other improvements, Mr. Platenberg said, "it just makes sense to provide natural light into educational facility design."

Research by Dr. Czeisler and others has suggested exposing students to blue light in the mornings—through school windows and skylights, or even LED tablets—can strengthen the normal circadian cycle.

For example, Smith Middle School in Chapel Hill, N.C., installed skylights and reflectors throughout its building, which Principal Philip J. Holmes said have improved both energy efficiency and "mood" in the building. The school has since been used in a National Institutes of Health [study on the effects of light](#) on students' circadian cycles, since bright daylight is heavy in blue light.

"Before this, I was a principal in an elementary school with no windows at all," Mr. Holmes said. "I can't speak to the circadian rhythms, but you can definitely feel the difference [in Smith Middle School], even on cloudier days. We've had conversations about what it does to the mood—it brings a real positive energy."

Mr. Del Cueto of the Los Angeles district said he thinks it should be up to companies that make lights or electronic devices to ensure their products don't cause sleep problems.

Developers are starting to look for ways to correct lighting problems in both electronic devices and ambient light. The Philips lighting company's SchoolVision project has been testing adjustable classroom lights that allow teachers to provide different light intensity and color ranges for "focus," "energy," and "calm"—though so far there have only been small in-house case studies on the system's effects on students in Europe.

Similarly, the free software program f.lux, developed by Michael Herf, the co-founder of the Picasa digital-image organizer, attempts to adjust light from computer screens in line with the natural lighting for that time of day. There is no research yet on whether it improves users' sleep cycles, however, and it cannot be used legally on many tablets or mobile devices.

Still, Ms. Wolfson of the College of the Holy Cross argued that educators and parents should take a deeper look at how school policies—from class start-times to evening homework and extracurricular activities—influence students' light exposure and sleep habits. "We've understood about light and circadian rhythms for decades," she said, "but understanding in this more-nuanced way may shift the conversation and behavior more."

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