The scientific reason you don't like LED bulbs—and the simple way to fix them

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Credit: AI-generated image (disclaimer)

There's a handy trick for reading station signs that otherwise fly past in a blur as you travel in a high-speed train. Look at one side of the window and then immediately at the other side of the window. When you change your gaze, your eyes will automatically make a rapid jerking movement, known as a saccade. If the direction of the saccade is the same as that of

the train, your eyes will freeze the image for a split second, long enough to read the station name if you time things right.

Saccades are very fast movements of the eyes. Their exact speed depends on the size of the movement, but large saccades can move the eyes at the same rate as a high-speed train. The image of the station name becomes visible because it is travelling at the same speed as the eye, and the images before and after the saccade are blurred and so don't interfere with the image of the sign. This shows us that our vision is still working when our eyes move rapidly during saccades.

Scientists used to think we could see no more than about 90 flashes of light a second but now we know it's more like 2,000 because the eyes move so rapidly when we change gaze from one point to another. During the eye movement, the flicker of light creates a pattern that we can see. And this has some surprising consequences for our health thanks to the way some types of lighting can affect us. In particular, it could discourage people from using more energy-saving LED lightbulbs.

Most lighting is electric and powered by an alternating current supply, which makes the bulbs continually dim and then brighten again at a very fast rate. Unlike filament lamps and to a lesser extent fluorescent lamps, LEDs don't just dim but effectively turn on and off completely (unless the current is maintained in some way).

Health concerns

We know from earlier work on fluorescent lighting that even though the flicker is too fast to be visible, it remains a likely health hazard. In 1989, my colleagues and I compared fluorescent lighting that flickered 100 times a second with lights that appeared the same but didn't flicker. We found that office workers were half as likely on average to experience headaches under the non-flickering lights.

No similar study has yet been performed for LED lights. But because LED flickering is even more pronounced, with the light dimming by 100% rather than the roughly 35% of fluorescent lamps, there's a chance that LEDs could be even more likely to cause headaches. At best, it's likely to put some people off using LED bulbs because of the annoying, distracting effect of the flickering, which we know can be detected during saccades.

One obvious way of avoiding the flicker is to operate the lamps with a direct current so the light is constant, but this involves more expensive, shorter-lived components. Another solution is to design the lights so that the flicker can't be detected. But just how fast must the flicker be in order to be harmless?

To find out, my colleagues and I asked people to make a saccade across a flickering source of light and to report when they could see a pattern of multiple images of the light during the eye movement. When the light flickered 1,000 times a second the pattern could clearly be seen. At about 3,000 per second, the images became invisible.

In contrast, some LEDs flash only 400 times per second. This flicker is still far too rapid to be seen directly, but some people can see multiple images of the lamps every time they make a saccade, which is unpleasantly distracting. The flickering of these LEDs may limit the uptake of the bulbs, just as many people dislike energy-saving fluorescent lamps.

When you buy an LED bulb, you currently have no way of telling whether or not it will flicker. But there are already standards for LEDs that would limit flicker to acceptable levels. So ensuring these are met could make a big difference to our attempt to make our homes and workplaces more energy efficient.

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