No blue light, please, I'm tired—light color determines sleepiness versus arousal in mice

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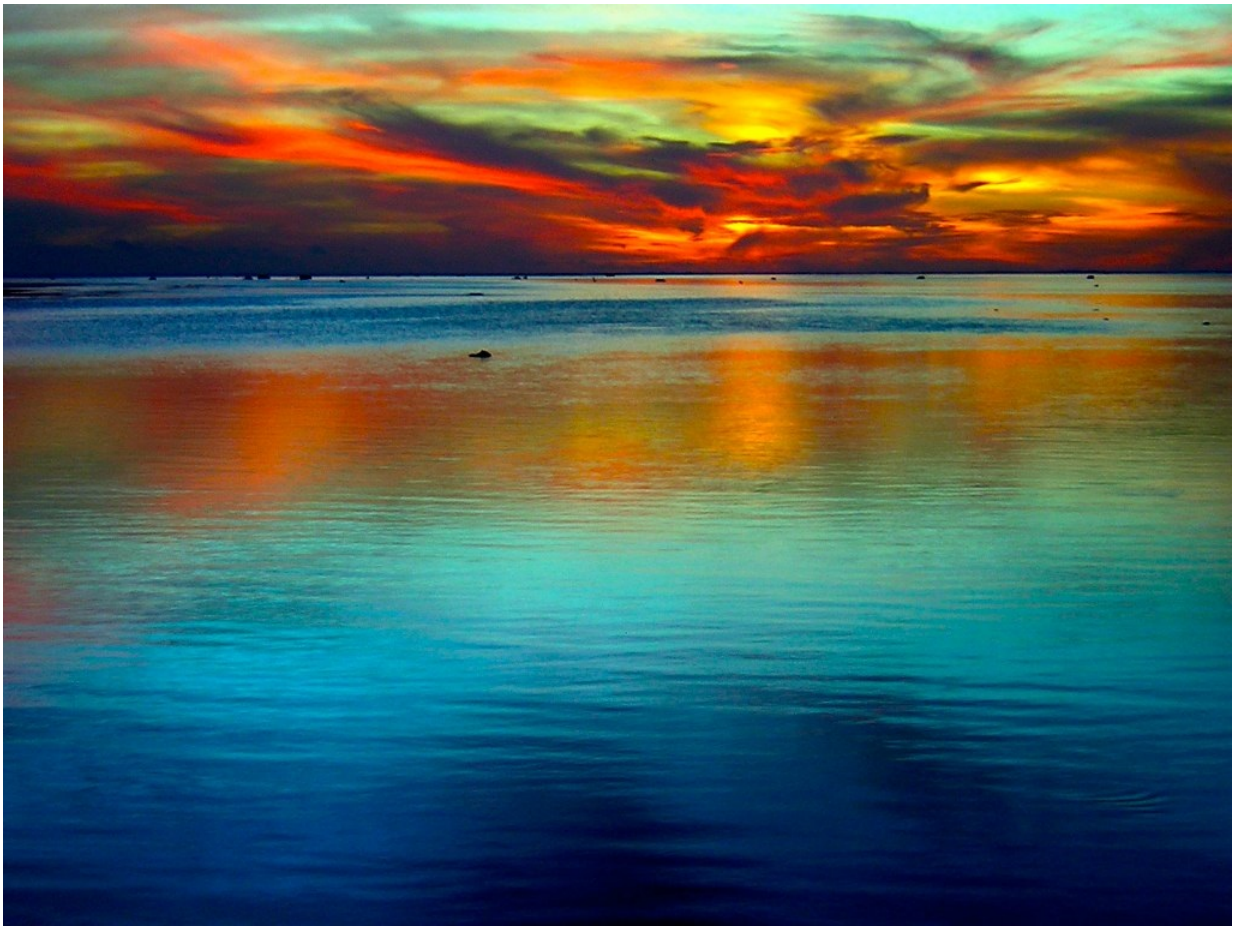

The color of light matters: blue light keeps mice awake longer, while green light puts them to sleep easily. Credit: Flickr user Pilottage. License CC 2.0.

Light affects sleep. A study in mice published in Open Access journal *PLOS Biology* shows that the actual color of light matters; blue light keeps mice awake longer while green light puts them to sleep easily. An accompanying Primer provides accessible context information and discusses open questions and potential implications for "designing the lighting of the future".

Light shining into our eyes not only mediates vision but also has critical non-image-forming functions such as the regulation of circadian rhythm, which affects sleep and other physiological processes. As humans, light generally keeps us awake, and dark makes us sleepy. For mice, which are mostly nocturnal, light is a sleep-inducer. Previous studies in mice and humans have shown that non-image-forming light perception occurs in specific photosensitive cells in the eye and involves a light sensor called melanopsin. Mice without melanopsin show a delay in their response to fall asleep when exposed to light, pointing to a critical role for melanopsin in sleep regulation.

Stuart Peirson and Russell Foster, both from Oxford University, UK, alongside colleagues from Oxford and elsewhere, investigated this further by studying sleep induction in mice exposed to colored light, i.e., light of different wave lengths. Based on the physical properties of melanopsin, which is most sensitive to blue light, the researchers predicted that blue light would be the most potent sleep inducer.

To their surprise, that was not the case. Green light, it turns out, puts mice to sleep quickly, whereas blue light actually seems to stimulate the mice, though they did fall asleep eventually. Mice lacking melanopsin were oblivious to light color, demonstrating that the protein is directing the differential response.

Both green and blue light elevated levels of the stress hormone corticosterone in the blood of exposed mice compared with mice kept in

the dark, the researchers found. Corticosterone levels in response to blue light, however, were higher than levels in mice exposed to green light. When the researchers gave the mice drugs that block the effects of corticosterone, they were able to mitigate the effects of blue light; drugged mice exposed to blue light went to sleep faster than control mice that had received placebos.

Citing previous results that exposure to blue light—a predominant component of light emitted by computer and smart-phone screens—promotes arousal and wakefulness in humans as well, the researchers suggest that "despite the differences between nocturnal and diurnal species, light may play a similar alerting role in mice as has been shown in humans". Overall, they say their work "shows the extent to which light affects our physiology and has important implications for the design and use of artificial light sources".

In the accompanying Primer, Patrice Bourgin, from the University of Strasbourg, France, and Jeffrey Hubbard from the University of Lausanne, Switzerland, say the study "reveals that the role of color [in controlling sleep and alertness] is far more important and complex than previously thought, and is a key parameter to take into account". The study's results, they say, "call for a greater understanding of melanopsin-based phototransduction and tell us that color wavelength is another aspect of environmental illumination that we should consider, in addition to photon density, duration of exposure and time of day, as we move forward in designing the lighting of the future, aiming to improve human health and well-being."

More information: Violetta Pilorz et al, Melanopsin Regulates Both Sleep-Promoting and Arousal-Promoting Responses to Light, *PLOS Biology* (2016). DOI: 10.1371/journal.pbio.1002482

Bourgin P, Hubbard J (2016) Alerting or Somnogenic Light: Pick Your

Color. *PLOS Biology* 14(8): e2000111. DOI: 10.1371/journal.pbio.2000111