BY **MIKE WOOD**

Red, just red . . .

THE LAST TWO ISSUES I've written about the colors blue and green. It should come as no surprise therefore that this time the topic is red. Just red. Nothing else. It's inevitable. This is an article I've been planning for a while, and the RGB sequence just made it the perfect moment.

As is often the case, this column was triggered by recently released research, this time into the potentially beneficial effects of red light on aging eyes. In particular, how, if you are over the age of 40, your nighttime vision and color differentiation can be improved by exposure to deep red light. In its early days, the study, run at University College London's Institute of Ophthalmology (UCL), was a small one, just 24 people, but the results were clear enough to suggest that there is some real science here. If these results are confirmed by larger studies, then there is potential for simple home therapy that would give noticeable improvement to both our eyes' ability to distinguish colors and their sensitivity to light as we get older.

These results were published by the UCL team led by Dr. Glen Jeffery in a research report in *The Journal of Gerontology* in June 2020. The team report that the retina ages faster than other organs in the human body, due to its high metabolic rate, and that the pace of ageing is partially controlled by the loss of mitochondria in the retinal cells. The breakthrough was in realizing that these mitochondria absorb longer light wavelengths, and this energy absorption improves their health and activity. There

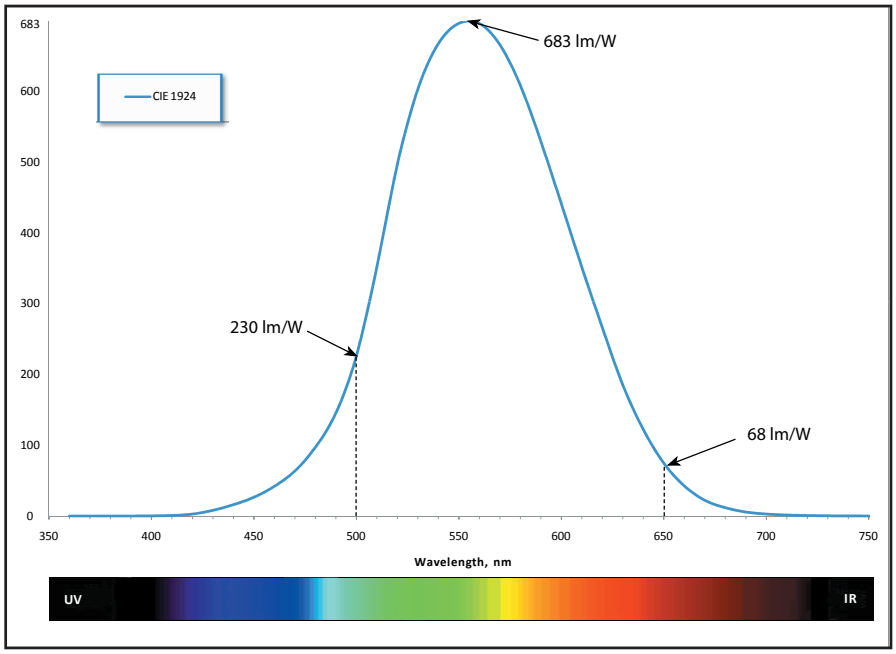

Figure 1 – Photopic curve

are also less dramatic beneficial effects from these long wavelengths on the retinal nervous system. The experiment was designed to test the hypothesis ". . . that relatively brief daily exposures to 670 nm for two weeks can significantly improve retinal function in those over approximately 40 years of age, particularly in the cones mediating the tritan visual axis, which we see as blue."

The researchers wanted to use as deep a red as was readily available with normal inexpensive technology, so went with 670 nm LEDs. This is a longer wavelength than is typically used in our industry, where most of the reds are around 640 to 650 nm. With lighting it's a tradeoff: we want deep reds but the deeper the red we use the less bright it appears to our eyes. **Figure 1** shows the photopic response curve for the human eye. You can see that at 650 nm our sensitivity is only 10% of our sensitivity to peak green. At 670 nm we are down to about 3%. Because of this perceived low output, such long wavelength red LEDs are not common in luminaires. However, for this experiment, the perceived brightness is irrelevant; it's the mitochondria we are stimulating with this light, not the light sensitive cells themselves, it doesn't matter if we can see it or not!

The UCL team go on to describe their

test device. They modified existing simple flashlights (Well, they call them torches, which is my native language, but I've translated here for the sake of my US readers.) and replaced the existing white LEDs with 670 nm red LEDs. According to their measurements, when held close to the eye, this assembly delivered approximately 40 mW/cm^2 of the 670 nm radiation at the cornea. In their tests, they asked their participants to use these lights to illuminate their dominant eye only for three minutes a day for two weeks. Interestingly, the participants could close their eyes if they wanted; the deep red passes straight through the eyelid without much attenuation!

> **"From an evolutionary perspective, we fundamentally have never lived past 40."**

After the two weeks, both eyes were measured again to see if there was any change to the eye that had received the deep red treatment. The good news is that there was! In subjects over 40 there was a 22% improvement in tritan thresholds (which is a measure for color contrast along the blue axis) and significant improvement in scotopic thresholds, which means that low light vision was noticeably improved. The participants hadn't noticed any subjective changes, but the results showed marked improvement. On the whole, the older the participant, the more the improvement. "The retina ages faster than any other organ in your body," Jeffery said. "From an evolutionary perspective, we fundamentally have never lived past 40." Most improvement was seen when the eyes were stimulated at times when the mitochondria are likely to be less loaded and have spare capacity. This was in the morning soon after the participant woke up.

As someone who falls heavily into the "over 40" (and some…) age group, this article was fascinating. If UCL can modify a flashlight to use 670 nm emitters, then so can I! So, in early July, just after the paper published, I started work. Two quick Amazon and Mouser orders later, and I had a box of small white light flashlights and a strip of 670 nm SMT LEDs. Now, of course, comes the irony of this whole endeavor. I have to desolder and replace these teeny-weeny SMT emitters on this teeny-weeny circuit board. If only I had good young eyesight this would be easy, wouldn't it? I have a hot air SMT soldering system but hadn't used it for some time. Nevertheless, I prevailed, and by stacking two pairs of spectacles and using a magnifier I was able to see well enough to successfully modify the flashlights. I worked out how far away the source would have to be from the cornea to get the recommended 40 mW/cm2 dose and 3D printed some extension tubes to hold a piece of Luminit diffuser to ensure even illumination, and to keep the eye at the right distance. **Figure 3** is the result, the Mike Wood clone of the UCL 670 nm

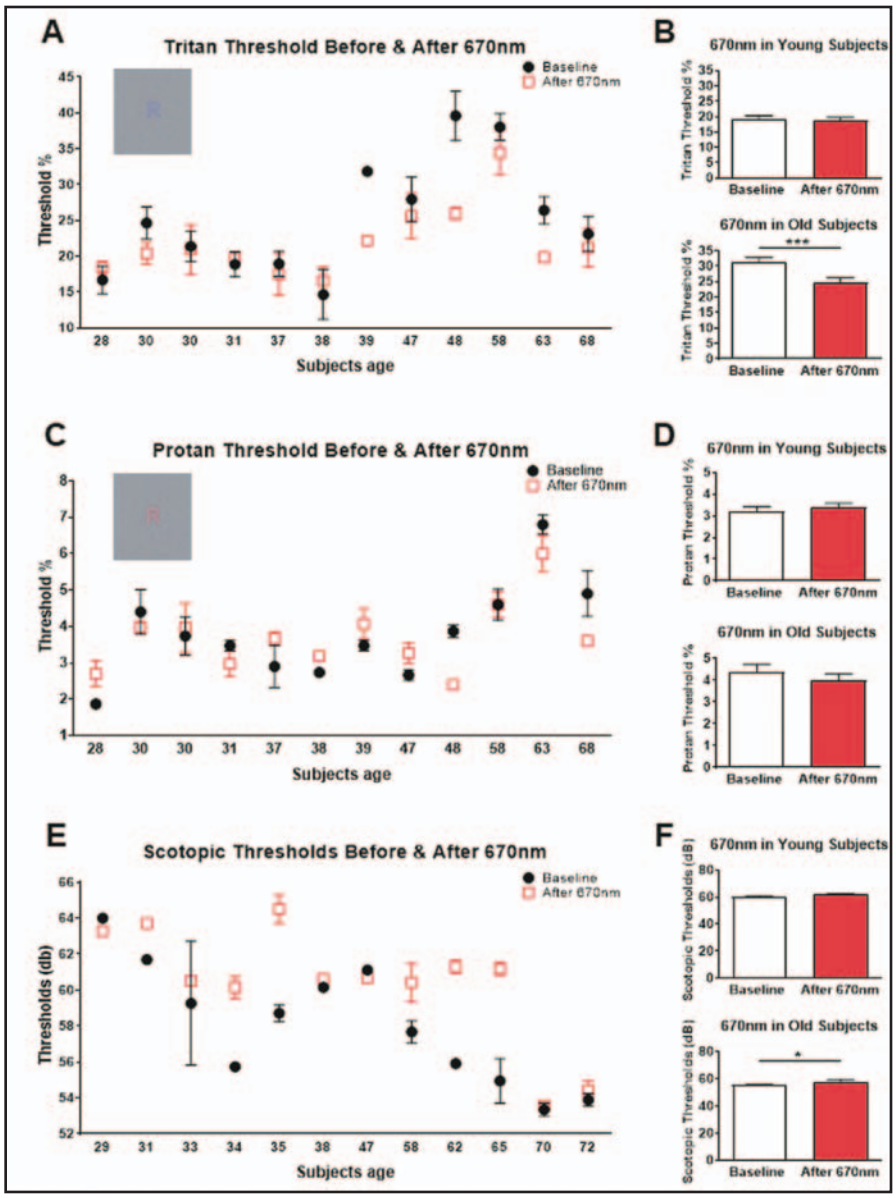

Figure 2 – Test results

Figure 3 – Modified flashlight 1

long-wavelength anti-aging mitochondrial-stimulating flashlight. (Note—You can't see the true red color here. No matter if you are reading this article in print or on a computer screen, these media are incapable of displaying the deep red color. To the eye it's much, much redder.)

> **"I have to desolder and replace these teeny-weeny SMT emitters on this teeny-weeny circuit board."**

Does it work? Well, it certainly emits deep red light, and I've treated my eyes with it for a little while. The immediate result, as might be expected, is that everything looks green for a minute or two immediately after the treatment. Not surprising as you completely overload the long wavelength cones in the eye! I didn't do a true scientific test where I only treated one eye leaving the other as a control. I got impatient and treated both eyes immediately so I've not got an easy way to check for any improvement. I'm not sure I'd notice a small difference over a period of time, but I like to think that it's doing something to help.

Disclaimer: If you decide to do something like this yourself, you are on your own! I trust UCL as a well-established responsible research establishment, but this needs a lot more research before it becomes widely accepted. Nevertheless, this paper received wide reporting back in June and July, and now 670 nm flashlights are available on Amazon. There's also a website at https://670nm.net/ which shows you a red screen! (This seems pretty useless to me as there's no way a video screen can output 670 nm, but it shows the level of interest.)

Will I ever know if my eyes have improved? Likely not. As I didn't leave one eye untreated I have no frame of reference. Changes are also so slow that you aren't aware of them. Would I try it again? Yes, of course. ■

Figure 4 – Modified flashlight 2

Mike Wood runs Mike Wood Consulting LLC, which provides consulting support to companies within the entertainment industry on product design, technology strategy, R&D, standards, and Intellectual Property. A 40-year veteran of the entertainment technology industry, Mike is a past President of ESTA and Co-Chair of the Technical Standards Council. Mike can be reached at mike@mikewoodconsulting.com.

Reference:

Optically Improved Mitochondrial Function Redeems Aged Human Visual Decline. *Journals of Gerontology: Biological Sciences 2020*, Vol. 75, No. 9, e49–e52