Blue Light
Should we have standards for human protection?

Jim Sheedy, OD, PhD
“The groundswell of interest around blue light and its effects on our vision and overall health is fueling a boom in optical sales unlike any other in recent years”.

Andrew Karp, editor, Lenses and Technology
Principle

• **Tissue** absorbs EMR
  • Measures of tissue damage
  • Protection standards (exposure limits)
  • The total irradiance to the tissue

• **Vision** reacts to ratios
  • Contrast – Weber/Fechner Law
  • Color – Trichromatic Vision
  • Emmetropization
  • Neural coding


Anything post-receptor
Does blue light cause *Tissue damage (retina)*?

*Probably*


– but only at high exposure levels
Even allowing for pupil size changes, there is about 10X greater retinal illumination **Outdoors** on a cloudy day **than Indoors**

(For a given waveband (e.g. blue light) this statement is true if indoor distribution is same as daylight distribution)

(Retinal damage limits on general interior exposure should not be applied unless 1) damage is first shown to occur on a cloudy day, and 2) if the waveband exposure is greater with interior lighting than on a cloudy day)
What are the effects of **Blue Light** on **Vision**?

Ratios are important (not absolute amount)
- Contrast sensitivity is not affected (in practical terms) at the illumination levels of concern
- Color vision
  - Very forgiving because of color constancy
- Circadian rhythm – probably also based on ratios
- Emmetropization (myopia development) - probably also based on ratios (perhaps highly so!)
Progressive Myopia or Hyperopia Can Be Induced in Chicks and Reversed by Manipulation of the Chromaticity of Ambient Light

Figure 2. One-day-old chicks (n = 16) raised in red light became myopic at 14 days, more myopic at 21 days (n = 6), and still more myopic at 28 days (n = 6), while those (n = 19) raised in blue light became hyperopic at 14 days, more hyperopic at 21 days (n = 6), and still more hyperopic at 28 days (n = 6). The differences in mean (±SD) myopic and hyperopic refractive errors were significant at each time interval (*P ≤ 0.001). At 14 days induced myopia or induced hyperopia were each significantly different from emmetropia (zero refractive error) (*P < 0.001). Error bars: 1 SD.

Is blue light associated with emmetropization (myopia development)?

Possibly

What damage (myopia) has been caused by interior tungsten light?
Blue Light – current state of the art

Circadian rhythm, sleep issues
  • YES

Emmetropization – possibly

Asthenopia? – possibly via flicker sensitivity

Retinal damage – possibly, but not at indoor illumination levels
  • Amber sunglasses
  • Protection at computer? - No
What should we do….

...about

...Blue Light?
Where is the smoking gun?

• Human studies are lacking
  • Environmental studies also have UV exposure
  • No studies show damage using LED devices
    • Exposure level is much lower than outside

• Damage is shown in rat studies
  • Most studies on albino rats
  • Rats are nocturnal animals
  • Exposure levels are excessive

• Research does not support damage from typical interior lighting
What needs done

Place Blue light document on the web
  • Scholarly discussion that decreases concern

Don’t spend time or $ on negating blue light effects
  • Public opinion is already settled
  • Ophthalmic opinion is already settled

Extol and research the advantages of blue light
  • Enhanced personal energy
  • Circadian effects such as increased wakefulness and productivity

Refractive error development in children

Strive towards goal of mimicking outdoor spectral distribution.
Circadian effects

- Daily attention level
- Daytime attitudes
- Performance
  - Vision function measures
  - Task performance
  - User symptoms

* Effects of interior lighting on refractive error

Needed Research – the benefits of Blue Light
Use a **cloudy day** and daylight distribution as standards

- Blue light **tissue exposure** should not exceed this condition
  - Interior illumination is considerably less than on a cloudy day

- For general interior (day) lighting standards, the **ideal spectral distribution is daylight**
What should the relative distribution (spectral distribution) be?

Ideal would be daylight

- This is what the eye and vision have developed around
Blue Light

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