IS RECOVERY OF VISUAL SENSITIVITY TO LIGHT AFFECTED BY WEARING "BLUE-BLOCKING LENSES"?

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MOTIVATION AND AIM

- Blue-blocking lenses (BBLs) have been designed to beneficially reduce exposure to blue hazard light, their secondary and unintended effect on vision has not been fully characterized [1, 2].
- The selective reduction in visible wavelengths transmitted through commercially available blue-blocking lenses (BBLs) is known to influence the appearance and contrast detection of objects, particularly at low light levels which may impact the human retinal receptor response time to dynamic light changes during photo-stress events [3-6].
- This study aimed to quantify the effect of BBLs on the photo-stress recovery times (PSRT) for chromatic and achromatic stimuli under photopic and mesopic luminous conditions.

MATERIALS & METHODS

- Photo-stress recovery times for four types of plano BBLs (UV++Blue Control, Crizal Prevencia, Blue Guardian, and Blu-OLP) and untinted lens (control) were evaluated (Fig. 1).
- Twelve participants aged between 18 and 39 years participated in the study.
- The visual stimuli (achromatic and chromatic) were generated using MATLAB and displayed on a linearised CRT monitor screen and was viewed on a black background from a viewing distance of 130 cm (Fig. 2).
- Recovery times from photo-stress event were investigated using:
  - A- achromatic stimuli at luminance Weber contrast levels (0.1, 0.2, and 0.4).
  - B- four chromatic stimuli: red, green, yellow, and blue at a level contrast of 0.4.
- Statistical data analysis was conducted using IBM SPSS.

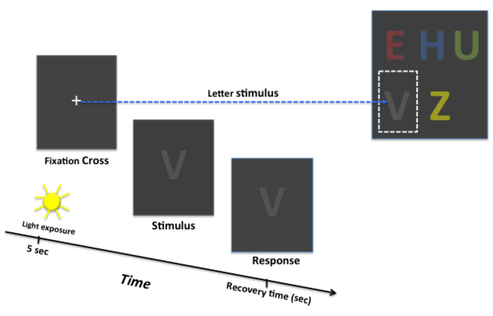
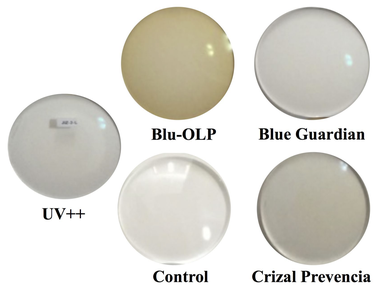


Fig 2. A schematic representation of a PSRT experimental trial showing achromatic and chromatic stimuli.

RESULTS



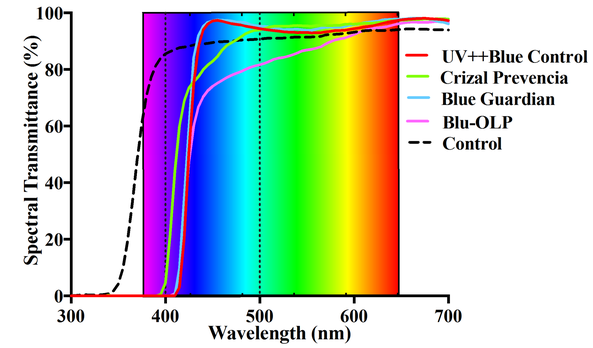


Fig 1. Spectral transmittance of four BBLs from four brands and one clear untinted lens were measured from 280 to 780 nm with 5 nm interval using a Cary 5000 UV-Vis-NIR spectrophotometer.

PHOTO STRESS RECOVERY TIME ON ACHROMATIC STIMULI

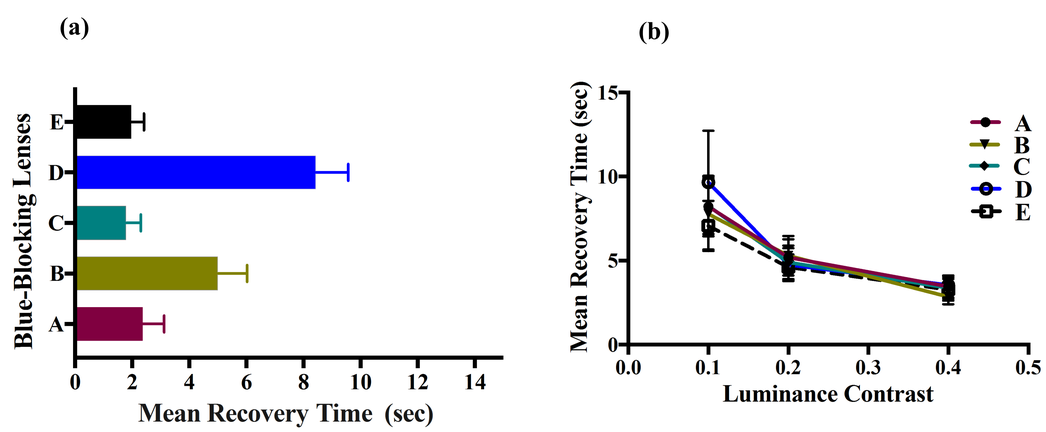


Fig 3. Mean difference in recovery times for 4 blue-blocking lenses (BBLs): A= UV++Blue Control, B= Crizal Prevencia, C=Blue Guardian, and D= Blu-OLP. All BBLs were tested at (a) low , and (b) high contrast achromatic stimuli . Error bars signify one standard error of the mean.

PHOTO STRESS RECOVERY TIME ON CHROMATIC STIMULI

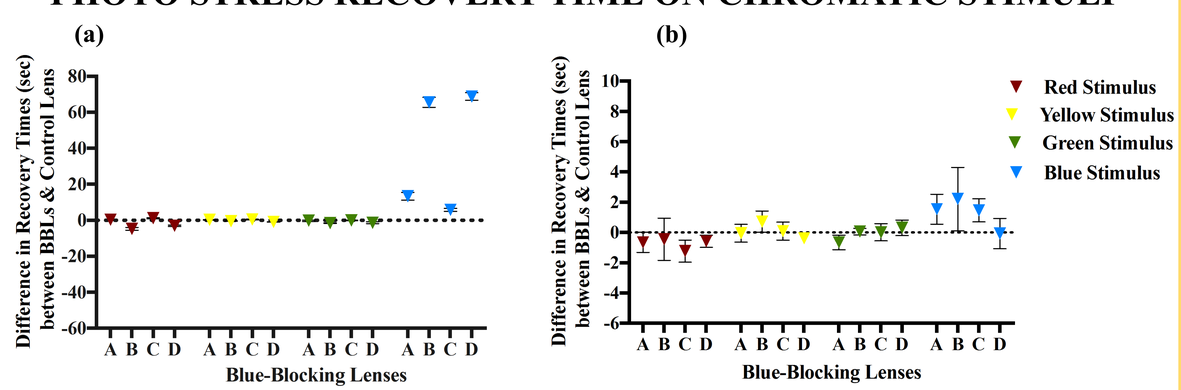


Fig 4. Mean difference in recovery times for 4 blue-blocking lenses (BBLs): A= UV++Blue Control, B= Crizal Prevencia, C=Blue Guardian, and D= Blu-OLP. All BBLs were tested at (a) low , and (b) high contrast coloured stimuli. Error bars signify one standard error of the mean.

DISCUSSION

- The transmittance profiles of the four BBLs show that they are effective in reducing short wavelengths, whilst allowing longer wavelengths through. Though our results show a degree of variability between lenses types with the Blu-OLP lens being the most effective in blocking more blue light.
- Under high stimulus conditions, while reducing luminance contrast increased PSRTs, BBLs had a modest influence on PSRTs (relative to a clear control lens) for chromatic stimuli only. (Fig 3 (b))
- Under low stimulus conditions, BBLs significantly affect PSRTs for both achromatic and chromatic stimuli, particularly for blue coloured targets, which had considerably longer PSRTs.
- The type of BBL was also shown to selectively affect PSRTs, with those with transmittance profiles that block the most blue light having longer PSRTs.

CONCLUSION

- Our study demonstrate that the use of BBLs may have unintended adverse consequences to visual function particularly under low light conditions and in situations in which the observer is directly exposed to bright light sources.
- For example, during night time driving, the driver might be briefly exposed to bright lights by glancing at the headlights of a passing car. This increases the time required for vision to be restored after bright light exposure, resulting in delayed object detection, and therefore stoppage and reaction times, which might pose a safety risk for a driver, which outweighs their benefits, which has yet to be proven.
- These unintended properties of BBLs are particularly significant given that newer generation BBLs are a design feature of spectacles intended for everyday wear and cannot be removed.

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