

Consumer Preference Informs the Next Generation of LED Lighting Solutions

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CLTC is working to improve the adoption of LED light sources by developing optimized performance and product designs. Design criteria was determined through a series of targeted studies aimed at identifying the features and performance attributes most valued by today's consumers.

A cross-section of the general public were asked to conduct a number of tasks under varying lighting conditions. These studies evaluated the qualitative and quantitative experiences of the participants to identify consumer preferences for color related metrics. Three of the tasks are shown here:

- ❖ **Consumer perception of intentional color shift during dimming.** This study explores whether added lighting product complexity is appropriate by determining if consumers expect and want the light to behave similar to incandescent lamps (Figure 1).

- ❖ **Trade-offs between melanopic stimulus and visual performance.** Circadian rhythms (Figure 2) are predominantly driven by light intercepted by the intrinsically-photosensitive retinal ganglion cells (ipRGCs). ipRGCs respond to light based on the absorption of light by the photo-pigment called melanopsin.

The action spectrum of melanopsin compared to the photopic sensitivity curve in provided in Figure 3. Understanding the impact that light has on both visual performance and circadian rhythms is necessary to guide the design of fixtures for use in spaces occupied at night. Tools used to gather this information are provided in Figure 4 and Figure 5. Analysis of results is provided in Figure 6.

- ❖ **LED consumer market penetration.** Specific questions aimed at understanding how many LED lights are installed in the study participant's home. Select responses are provided in Figure 7 and Figure 8.

According to the self-reported market saturation survey performed in 2018 as part of this study, approximately 50 percent of the medium screw-base lamps used by consumers in the greater-Sacramento area are LED. Additionally, approximately 30 percent of tubular lamps and candelabra based lamps were reported as LED.



Figure 1. CCT of table lamps in 'intentional color shift' study.

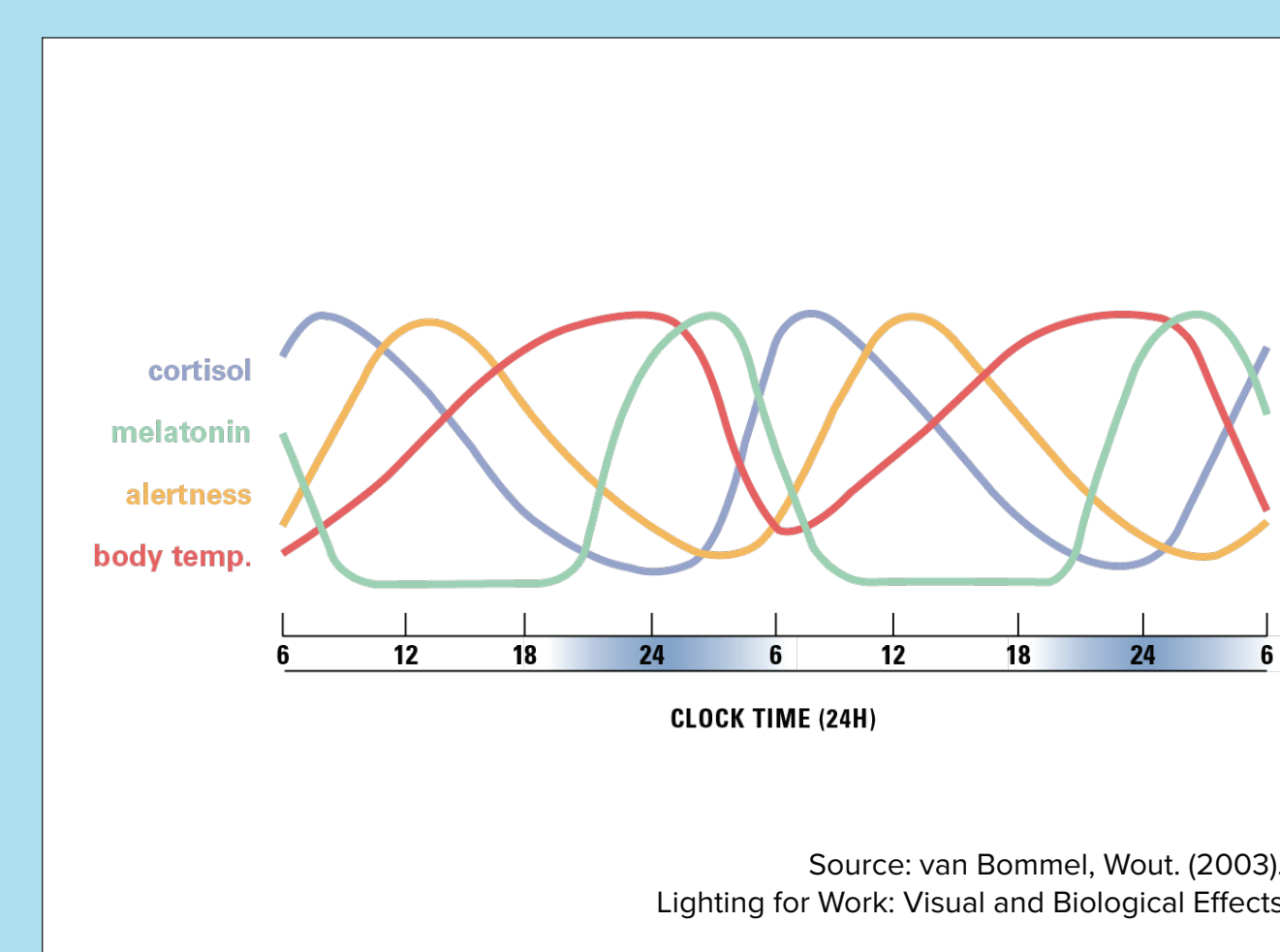


Figure 2. Circadian rhythms showing the variation of cortisol, melatonin, alertness and body temperature over two 24-hour periods

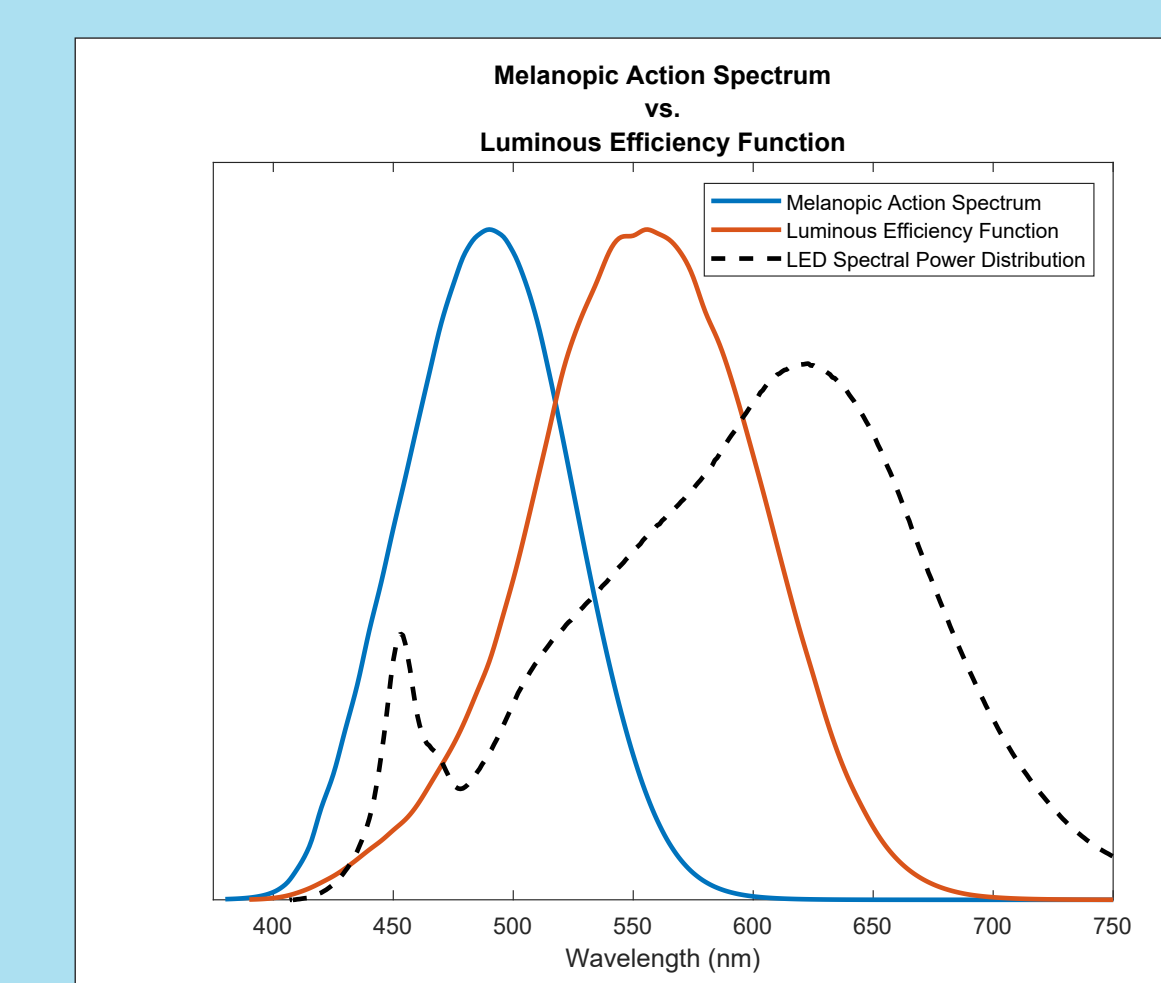


Figure 3. Melanopic vs. photopic action spectrum

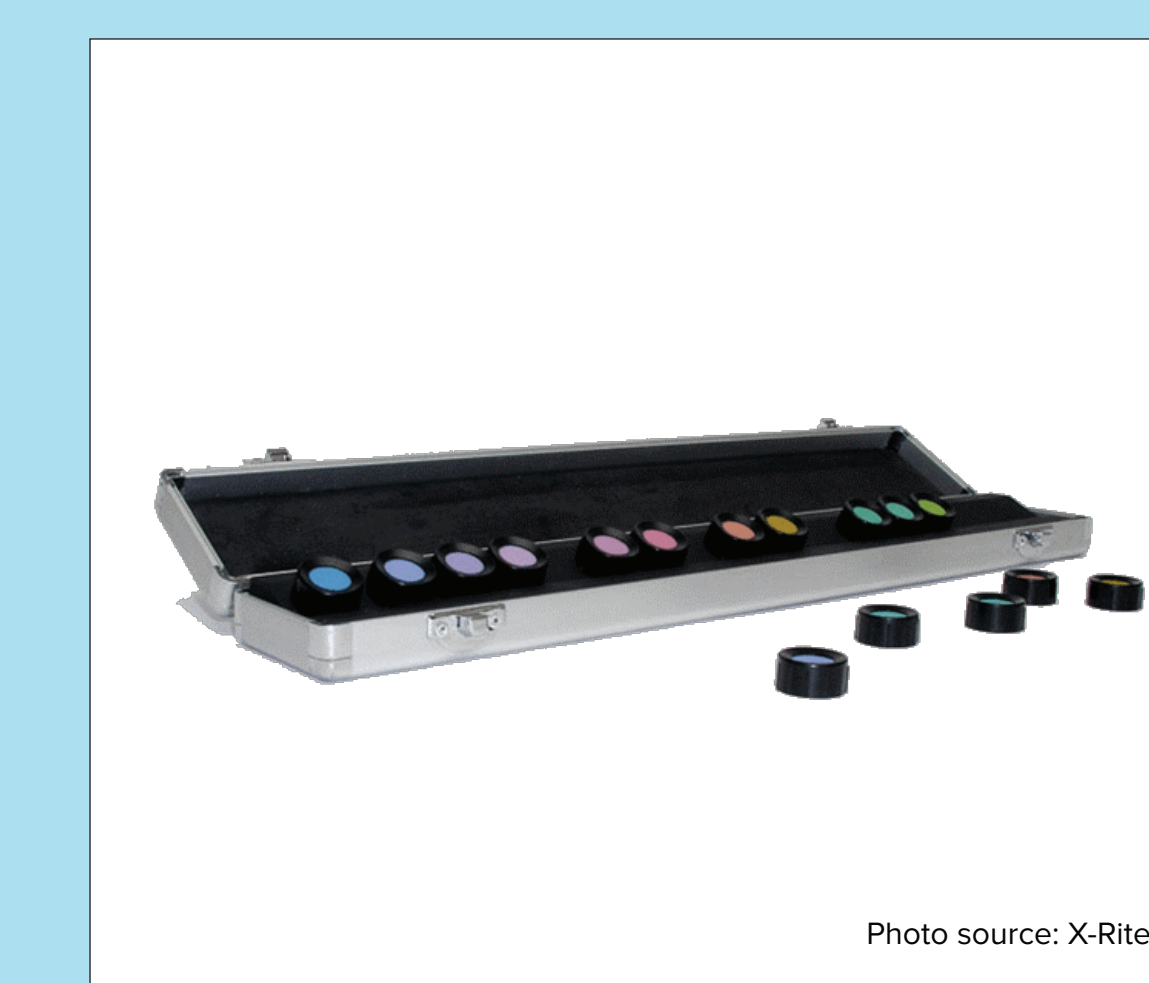


Figure 4. Farnsworth-Munsell D-15 Color Test

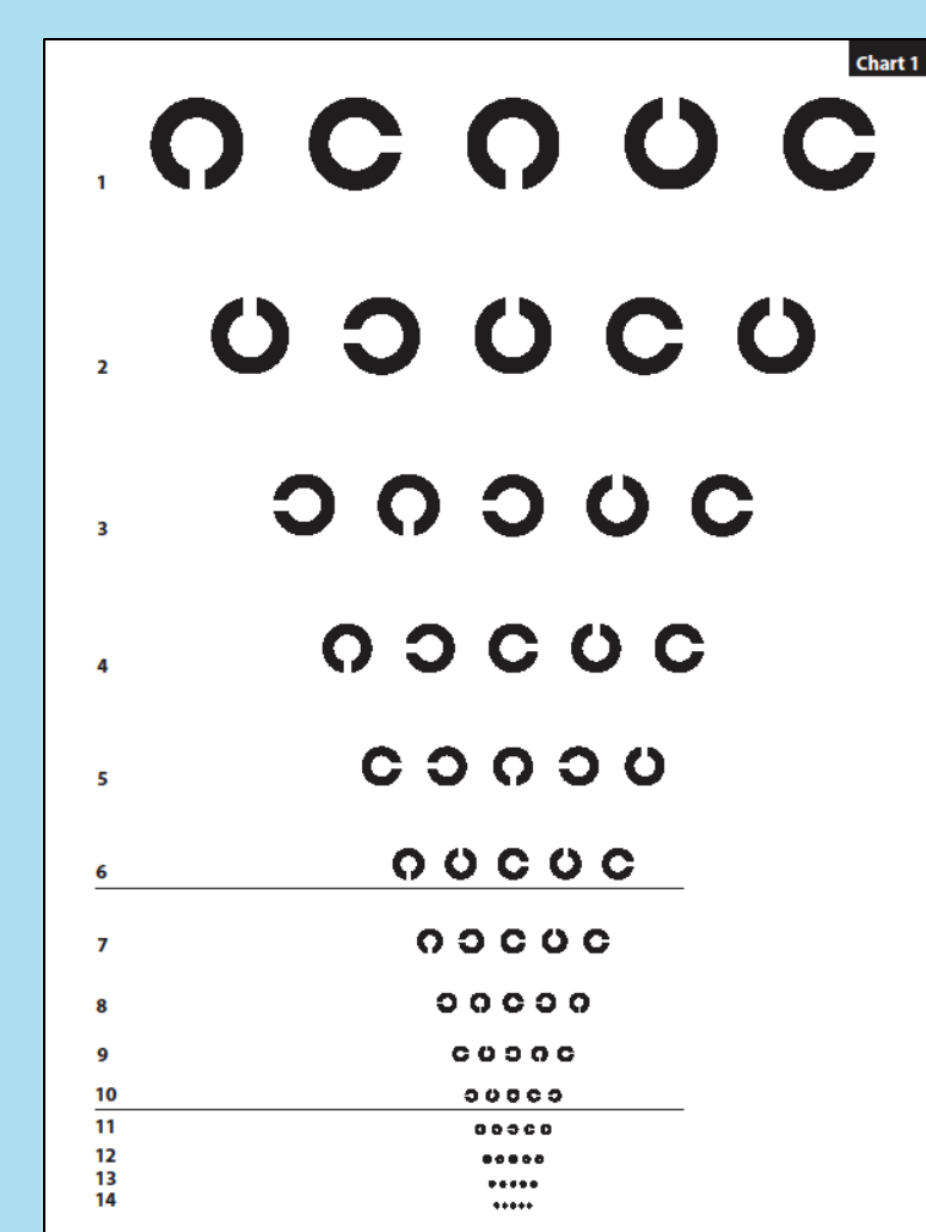


Figure 5. Example Landolt-C chart used to test participants' visual acuity in the 'Multi-Spectral Melanopic Lighting Study'

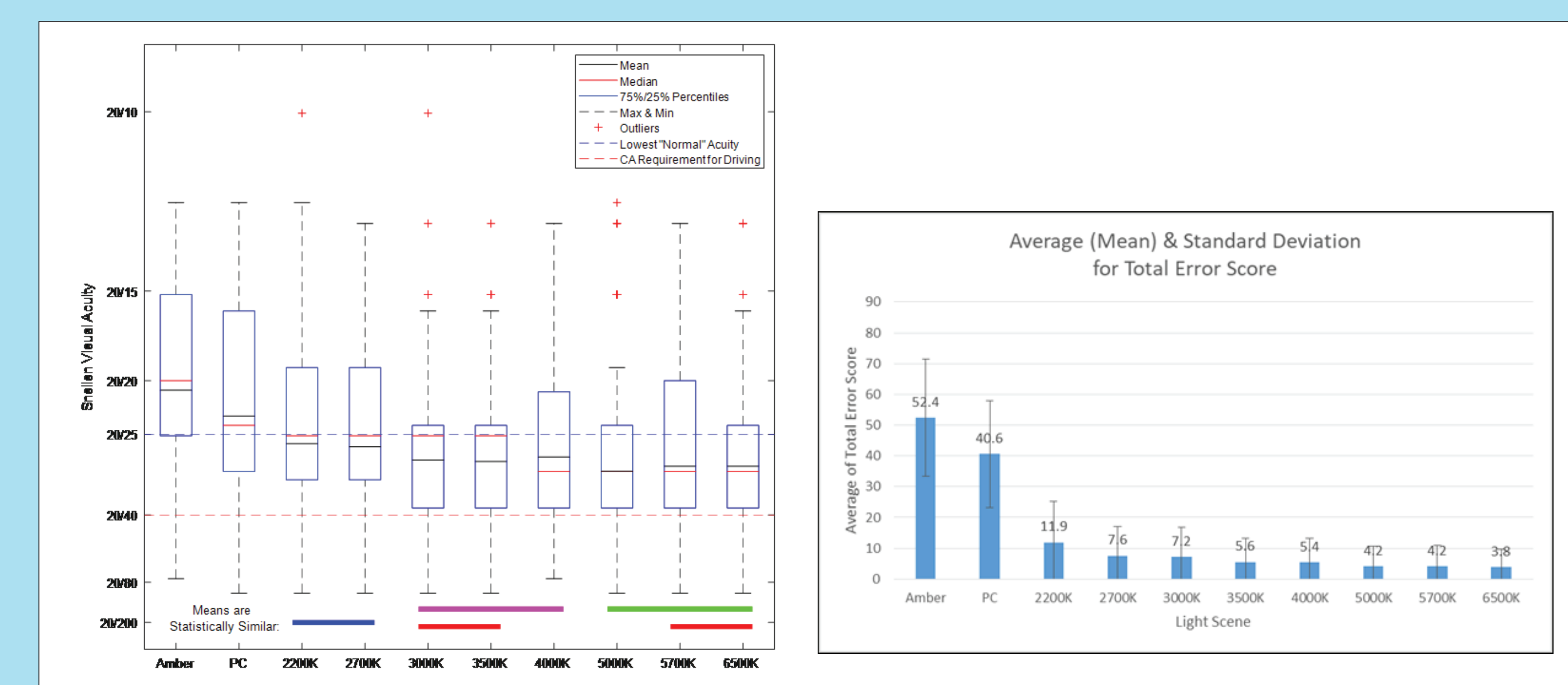


Figure 6. Visual acuity test results under the 10 CCT channels for Phase B. Blue boxes indicate 25 percent and 75 percent quartiles, red lines in blue boxes indicate median visual acuity and black lines in blue boxes indicate average visual acuity (left). Results from the 'Multi-Spectral Melanopic Lighting Study' (right).

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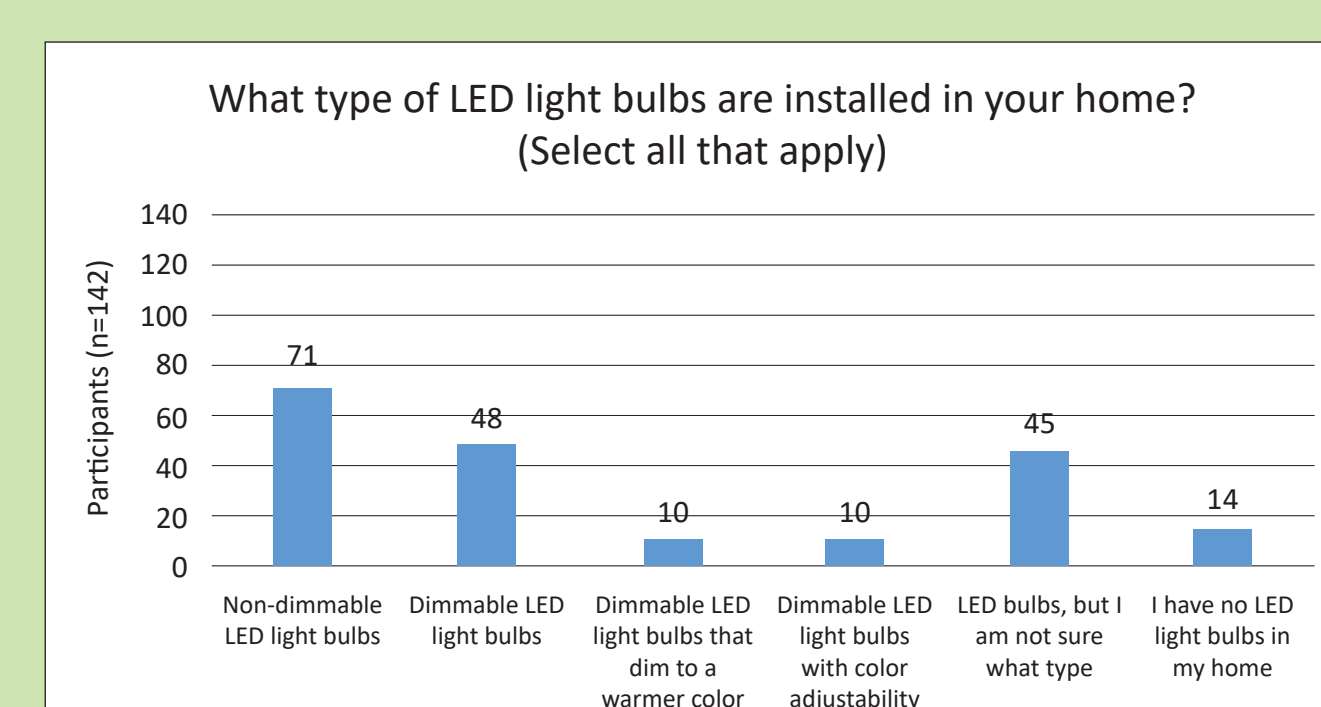


Figure 7. Number of participants who have installed LED lights in their homes

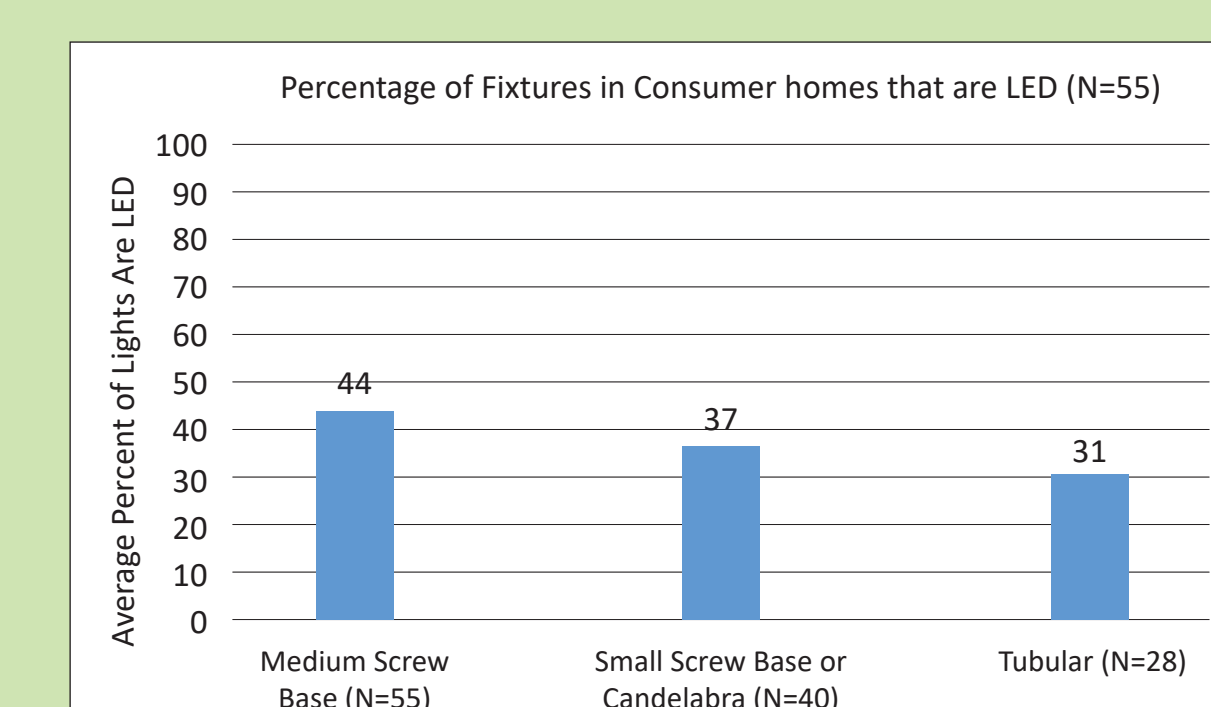


Figure 8. Percentage of Fixtures in Consumer Homes that are LED