Surface color matching under mesopic illumination

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Color appearance undergoes significant changes during mesopic vision. Such changes pose a problem for color perception when regions of a surface are differentially illuminated, as from shadowing. Color signals from each region may be processed differently (e.g., more or less rod involvement) depending upon the level of illumination. Thus, perceiving constant surface color may be impaired under low light levels. The present study used a visual search task to measure ability to match surface color across different levels of mesopic illumination. Dark-adapted observers viewed a two-chambered light box with each chamber containing an array of spectrally calibrated colored paper samples (Color-aid, NY). Light level in each chamber was independently controlled to produce different levels of illumination that were either the same or different. The observers' task was to view a color test sample (2^{o} x 2^{o}) under one level of illumination and locate its physical match from an array in the adjacent chamber. The physical match to the test sample was present in the adjacent chamber's array on 80% of the trials. Twenty test samples, chosen to represent a large region of color space, and 20 arrays of 25 color samples each were used. Matching performance depended on light level and uniformity of illumination across the two chambers. The general effect of decreasing light level between 20-2 Lux was sharply lower hit rates and higher false alarm rates regardless of sample color; below 2 Lux matching approached chance performance. A significantly larger decrement in matching performance was observed when light level differed across the chambers. Our finding that matching surface color is more impaired under non-uniform than uniform levels of illumination suggests that constant surface color perception mediated by mesopic vision is influenced by the spatial distribution of light level across a visual scene.