ERRATUM

How the CIE 1931 Color-Matching Functions Were Derived from Wright–Guild Data

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In the subject article,[1] there is an error in Eq. (A2) that propagates into Eq. (A8) and into the interpretation of Eq. (A19). This error concerns the CIE's rescaling of the original color-matching functions $\bar{r}(\lambda)$, $\bar{g}(\lambda)$, and $\bar{b}(\lambda)$. Although the scaling indeed equalized the visible-wavelength integrals of these three functions, it is not true that the integrals are equal to $\int V(\lambda)d\lambda$. Rather, the far-right-hand side of Eq. (A2) should be changed to $K \int V(\lambda)d\lambda$, and the right-hand sides of Eq. (A8) should all be K instead of 1. Here, K is given by

$$K = 1/(L_R + L_G + L_B) = 0.1770. \qquad (1)$$

The above value for K is obtained from the observation[2] that $\bar{r}(\lambda)$ was rescaled in such a way that $\bar{r}(\lambda_r) = V(\lambda_r)$, where $\lambda_r = 700$ nm and $V(\lambda)$ is the 1924 CIE luminance function. This rescaling ensures [see Eqs. (A15) and (A16)] that the coefficient b_{21} of $\bar{r}(\lambda)$ in the RGB expansion of $V(\lambda)$ is 1, and hence the luminance coefficients L_R, L_G, L_B defined in Eq. (A19) are identical (not just proportional) to the expansion coefficients b_{21}, b_{22}, b_{23}. Substituting the L's for the b's in Eq. (A15), integrating

over visible wavelength, and recalling the equality of the $\bar{r}$, $\bar{g}$, and $\bar{b}$ integrals (Eq. A2), one can then obtain the relation

$$\int \bar{r}(\lambda)d\lambda = K \int V(\lambda)d\lambda, \qquad (2)$$

where K is defined in Eq. (1) above.

In summary, the area under each of the $\bar{r}$, $\bar{g}$, $\bar{b}$ color-matching functions is only 0.1770 times the area under each of the $\bar{x}$, $\bar{y}$, $\bar{z}$ functions, contrary to Appendix A of Ref. 1. This scaling convention is what enables the luminance coefficients to be equal to (not just proportional to) the best-fit coefficients of $\bar{r}(\lambda)$, $\bar{g}(\lambda)$, and $\bar{b}(\lambda)$ to $V(\lambda)$. It is also implicit in Hunt's recent discussion.[3]

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1. H. S. Fairman, M. H. Brill, and H. Hemmendinger, How the CIE 1931 color-matching functions were derived from Wright–Guild data, *Color Res. Appl.* **22,** 11–23 (1997).
2. G. Wyszecki and W. S. Stiles, *Color Science,* Second Ed., Wiley, New York, 1982, pp.737, 751.
3. R. W. G. Hunt, The heights of the CIE colour-matching functions, *Color Res. Appl.* **22,**, 335 (1997).