

Quantitative assessment of commercial filter 'aids' for red-green colour defectives

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We assess the effect of commercial filter 'aids', which are claimed to improve the colour discrimination of red-green colour defectives, using colour spacing of the Farnsworth-Munsell D15 test and of standard red, yellow and green traffic signals (EN 1836:2005) in protanomalous and deuteranomalous colour vision. The spectral transmittance of 42 'aids' (5 manufacturers) is measured. Chromaticities are computed by convolving these spectra with the cone fundamentals (De Marco, Pokorny and Smith, 1992, *Journal of the Optical Society of America A*, 9, 1465-76) and either the D15 spectral reflectance factors and spectral power distribution (SPD) of CIE Illuminant C or the SPDs of traffic signals. Chromaticities are presented in an analogue of a cone excitation diagram (MacLeod and Boynton, 1979, *Journal of the Optical Society of America*, 69, 1183-6). Standard deviations of chromaticities, parallel to the $L/(L+M)$ axis of that diagram, are used to compute 'enhancement' factors E (ratio of filtered to non-filtered standard deviations) related to the relative excitation of long (L) and medium (M) wavelength sensitive cones. Account is taken of the diagram's non-uniformity. Luminous transmittances are computed for all 'aids'. Plots of luminous transmittances against E factors depict both the safety and utility characteristics for each 'aid'. Values of E for traffic signals with most 'aids' are less than unity, rendering them useless and some 11 to 15 of those (for deuteranomals and protanomals respectively) are dangerous: failing the EN standard with less than 8% luminous transmittance. A few 'aids' have expansive E factors but these are small (1.09 to 1.16 for deuteranomals and protanomals respectively) for signal lights and somewhat larger for the D15 test (1.24 to 1.29). Analyses, replicated for 19 'aids' of one manufacturer using 657 Munsell colours within the D15 locus, yield E factors within 1% of those found for the D15 test itself.