Variation of chromatic discrimination thresholds with luminance and state of chromatic adaptation

B. J. Jennings & J. L. Barbur

Applied Vision Research Centre, The Henry Wellcome Laboratories for Vision Sciences, City University, London, UK.

Colour discrimination is affected by both luminance level and the spectral composition of the adapting background. In this investigation we measured colour detection thresholds under conditions that isolate the use of colour signals (Barbur, 2003: *Progress in Brain Research* 144:243-259). We examined specifically how the luminance level of the adapting background field (range: ~ 0.1 to 31 cd/m^2) and the state of chromatic adaptation of the eye affect both red/green and yellow/blue chromatic sensitivity. 20 subjects took part in the study, but only 4 subjects carried out the full set of measurements. The background chromaticities selected for the 12 states of chromatic adaptation employed were within the limits imposed by the CRT display. For each background luminance and state of chromatic adaptation we measured the subject's chromatic discrimination ellipse and computed the corresponding cone photoreceptor contrasts. The results show that the major and minor axes of the ellipse relate linearly to corresponding cone excitations, over most of the range.

A model was produced that predicts colour detection thresholds based on the spectral radiance of the adapting background and assumed spectral responsivities for cone photoreceptors in the eye. The major and minor axes of the ellipse can be predicted from knowledge of background cone excitations levels and measured experimental data. For each adapting background chromaticity the orientation of the major axis of the ellipse is computed by establishing the direction in colour space that yields close to zero L- and M-cone contrasts. The model predicts well the parameters of the measured ellipses with typical errors of less than 10% (over most of the range of light levels investigated). In conclusion, the simple colour discrimination model developed in this study can be used to predict colour discrimination thresholds from a knowledge of the spectral radiance of the adapting background field.

PhD funding: Engineering and Physical Sciences Research Council (UK).