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CONTRAST SENSITIVITY OF INDIVIDUAL COLOUR MECHANISMS OF HUMAN VISION

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SUMMARY

1. Contrast sensitivity functions of isolated colour mechanisms were measured at spatial frequencies from 0·2 to 32 c/deg.

The contrast sensitivity *vs.* spatial-frequency functions of the red (π_r) and green (π_g) mechanisms are similar, while the blue (π_b) mechanism has

In both of these studies, single colour mechanisms were isolated by

the spectral composition of which was selected so as to selectively depress

the sensitivity of the unwanted systems. This method has a serious drawback: because the spectral sensitivities of the R and G mechanisms overlap

to a great extent, chromatic adaptation is rather ineffective in separating them, since any adapting colour will depress not only the sensitivity of the unwanted mechanism, but also that of the mechanism that is being measured. Further, the sensitivity of a colour mechanism when no adapting field is present can be estimated only by indirect means.

This problem can be avoided by taking advantage of the fact that if

natural pupils. At spatial frequencies of 8 c/deg and above, observations were made

axial chromatic aberration of the human eye.

In order to obtain the desired spatial frequencies, viewing distances from 50 to

87 cm were used, except at the two highest spatial frequencies of 40 and 50 c/deg,

for which viewing distances of 105 and 120 cm were used. The diameter of the circular

used to calculate the compensation ratios for two lights of different spectral composi-

tion that will equally stimulate a given mechanism, and will thus be seen as identical

data. The only systematic differences between our results and Stiles' are

that the short wave-length branch of our G, and the long wave-length

branch of our B, mechanisms are somewhat more sensitive than the

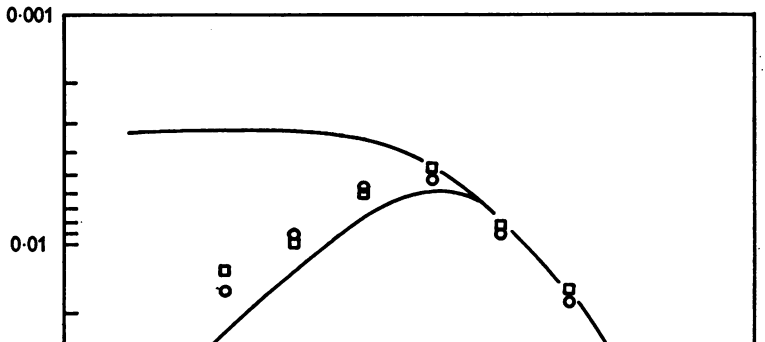
π mechanisms. Judging by its shape and position relative to the R and

Contrast sensitivity

Contrast sensitivity was measured with gratings in which only the

Fig. 2. and show the thresholds for normal contrast sensitivity, when both

compensated situation, when only one mechanism is modulated. The R and G mechanisms continue to have similar sensitivities after hue information is removed. However, there is now a distinct loss of sensitivity at low spatial frequencies, and the shape of the sensitivity functions for the isolated mechanisms now resembles the shape of the normal contrast sensitivity function.



DISCUSSION

The present data are summarized in Fig. 4, which also shows the results

of our *B* mechanism agrees reasonably well with Green's. The fact that we find higher sensitivities to low spatial frequencies may be due to individual differences among observers in the number of *B* receptors, or to

Kelly's B mechanism. This may have to do with the fact that Kelly measured the sensitivity of π_1, whereas we measured π_2. The combination of green phosphor and 45A filter that Kelly used to produce his blue stimulus yields a mean luminance of 124 td, which from Green's threshold

sensitivity is dominated by the π_1 mechanism, whereas in Green's study and ours the stimuli were within the luminance range in which π_2 is found.

result, when the R and G mechanisms are isolated by means of chromatic adaptation, the adapting light affects the sensitivity of the mechanism that is being measured as well as the sensitivity of the unwanted mechanism. Therefore, the absolute sensitivity of an isolated mechanism can only be estimated by extrapolating from the sensitivity that is measured at two or more adapting-field luminances to the hypothetical sensitivity when no adapting field is present. The difference between R and G sensitivities that was reported by Kelly could result from a basic difficulty in this extrapolation technique, which is that a small error in the measured sensitivi-

a colour mechanism in order to determine its absolute sensitivity. The

to $\pi_{5...}$ $\pi_{4...}$ and $\pi_{5..}$ that we felt justified in using Stiles' tabulated values.

Even if the spectral sensitivity was incorrect, the resulting error in the

has a normal G system, but no R system, these results suggest that our stimulus for the R system can only stimulate the G system in normal observers by 10%. The complementary experiment with the deuteranope

the G system resulted in 16% stimulation of the R system. This is substantially better than can be obtained with chromatic adaptation where, because of the overlap in spectral sensitivities of the R and G systems, the

REFERENCES

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